Pest Management Plan for Zambia: Support for Economic Expansion and Diversification (SEED) Project

Prepare for
The World Bank

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Prepared by
Global Development Solutions, LLC
A mission to Zambia was undertaken by a consultant from Global Development Solutions, LLC between 13 – 21 May 2003 to prepare a pest management plan for the agriculture and agro-processing component of the forthcoming World Bank Support of Economic Expansion and Diversification (SEEDS) Project.

A review of current pest management practices presented in this document is not meant to be comprehensive, but places emphasis on issues relevant particularly to the horticultural sector where the initial pilot project will be targeted. With this said, however, many of the challenges faced by the export oriented horticultural sector also reflects problems faced more broadly by the Zambian agricultural sector. In this context, further work may be required to develop a more robust outlook on the formulation of a national integrated pest management strategy for Zambia.

Findings from the study suggests that large commercial farms and export oriented farmers have embraced integrated pest management (IPM) practices to a certain degree, particularly as import regulations in Europe have become increasingly stringent. At the same time, however, IPM practices among smallholder farms continue to be limited.

While legal and regulatory framework to encourage IPM methods in Zambia are generally in place and reflect international norms, the lack of capacity and capability to implement and monitor IPM activities have done little to accelerate the adoption of IPM practices in Zambia. In this context, some parts of the agro-processing industry have taken their own initiative to develop and apply codes of conduct that reflect international standards.

Government and NGOs provide technical support of wide ranging quality to farmers in Zambia. Much of these activities, however, continue to be ad hoc and lack outreach to rural farming communities. As a result, innovative IPM activities are generally taking place in isolated pockets at individual farms, particularly among export oriented farmers. Training and capacity building support is offered through a number of local institutions, but the most creditable support activity is managed through the Zambian Export Growers Association Training Trust. The Trust is sponsored by both the private sector and Government, and has had a positive impact, particularly on export oriented farmers. But the scope and capacity of the Trust to deliver training, particularly training-of-trainers continues to be limited.

In general, reliance on pesticides continues to be relatively high, particularly among smallholder farmers where very little knowledge and awareness of IPM practices is available. Similarly, as IPM practices in Zambia is currently void of the use of biological control agents, technical assistance will be critical to accelerate the integration of internationally accepted pest management standards.
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Basic agriculture and agro-processing account for more than 40% of Zambia's GDP and about 15% of its merchandise exports. These figures provide some insights into the importance of supporting the expansion of the sector, particularly in the light of declining foreign exchange inflow from the mining sector.

The farming community in Zambia can be defined in three categories: commercial and large scale farmers (1% - 3%); medium scale or emergent farmers (7% - 9%); and smallholder farmers (88% - 92%).

Small-scale farmers: numbering approximately 800,000 households. These farmers cultivate on average 1.45 hectares of land, generally using low-input, hand hoe technology and relying primarily upon family labor. A large proportion of food production is retained for household consumption. The major constraints faced by such farmers are their geographical isolation, seasonal labor constraints, lack of timely availability of inputs, weak market information and (in the south) vulnerability to drought.

Emergent farmers: numbering some 40,000 to 60,000. These farmers cultivate an area ranging from 5 to 20 hectares, typically with draught power and greater use of purchased inputs. Survey evidence has found relatively higher levels of education and a majority with either prior formal sector jobs or other training. These farmers use both family and hired labor. Production, including that of food crops, is predominantly for sale. The vast majority of such farmers operate along the line-of-rail cutting across the country in a north to south line. The leading constraints for such farmers are labor bottlenecks (especially for land preparation), access to finance, and weak market information. The incidence of animal diseases plus non-availability of affordable working capital has led many such farmers to scale back their operations.

Large-scale commercial farms/Corporate operations: Large scale commercial farmers numbering some 600 to 750. These generally cultivate between 50 and 150 hectares, have extensive mechanization and rely upon a combination of permanent and casual staff. The majority of these farms are family-owned. Production is for commercial sale (and the feeding of staff). These farms are located along the line of rail, primarily in Central, Lusaka, and Southern Provinces. Major constraints faced by these farmers include high indebtedness, limited access to and high cost of working capital, lack of capacity to store crops, and weak market information. There are no more than a dozen large corporate operations in Zambia. These involve the cultivation of several thousand hectares (or more) of crops and/or one thousand or more head of livestock. These are managed by hired professionals and most such operations involve vertical integration with agro-processing.

2 Only 16% of such households own cattle.
3 One farmer argues that emergent farmers have increasingly become 'submerged'.
Pest management approaches and practices

Current and anticipated pest problems relevant to the projects

A. Overview of the crops to be cultivated

The initial phase of the project will cover high value added horticultural products, organic lemon grass, maze for use as feed for hogs, which will in turn be slaughtered for the production of pork meat products such as sausages. Lastly, the project will also support dairy farmers, particularly with respect to increasing yield per cow, quality of milk and linking small dairy farmers to the chill chain of a major dairy processor.

With regards to introducing an effective integrated pest management (IPM) system, focus will be placed on the production of a number of high value added horticultural products, which include: leeks, fine beans, chilly, squash, baby carrots, baby corn, mange tout and sugar snap peas.

The total volume of export vegetables and flowers have been growing at a steady pace, where the industry has enjoyed an average growth of over 100%. With this said, however, the composition of exports is gradually shifting away from flowers to vegetables. As evident from the Table 1 below and its corresponding graph (Table 2), drought in 2002 had a substantial impact on the growth of exports.

<table>
<thead>
<tr>
<th>Year</th>
<th>Flowers (Tons)</th>
<th>% Change</th>
<th>Vegetables (Tons)</th>
<th>% Change</th>
<th>Total (Tons)</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>582.0</td>
<td></td>
<td>451.0</td>
<td></td>
<td>2416.0</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>1746.0</td>
<td>300%</td>
<td>2120.0</td>
<td>470%</td>
<td>3866.0</td>
<td>160%</td>
</tr>
<tr>
<td>1997</td>
<td>2261.0</td>
<td>129%</td>
<td>3181.0</td>
<td>150%</td>
<td>5442.0</td>
<td>141%</td>
</tr>
<tr>
<td>1998</td>
<td>3177.0</td>
<td>141%</td>
<td>4115.0</td>
<td>129%</td>
<td>7292.0</td>
<td>134%</td>
</tr>
<tr>
<td>1999</td>
<td>3423.7</td>
<td>108%</td>
<td>5004.5</td>
<td>122%</td>
<td>8428.2</td>
<td>116%</td>
</tr>
<tr>
<td>2000</td>
<td>3467.8</td>
<td>101%</td>
<td>4904.3</td>
<td>98%</td>
<td>8372.1</td>
<td>99%</td>
</tr>
<tr>
<td>2001</td>
<td>3764.0</td>
<td>109%</td>
<td>7884.4</td>
<td>161%</td>
<td>11648.4</td>
<td>139%</td>
</tr>
<tr>
<td>2002</td>
<td>3717.9</td>
<td>99%</td>
<td>8159.2</td>
<td>103%</td>
<td>11877.1</td>
<td>102%</td>
</tr>
<tr>
<td>2003</td>
<td>760.2</td>
<td>20%</td>
<td>2097.9</td>
<td>26%</td>
<td>2858.1</td>
<td>24%</td>
</tr>
</tbody>
</table>
B. Key pest, weed and diseases problems

Horticultural commodities, particularly crops grown for export market, is a driving force in the agricultural sector in Zambia. Based on interviews with the principal producer of high value added horticultural crops, the following pests, weeds and diseases were identified as problems areas where IPM is required (Table 3).

<table>
<thead>
<tr>
<th>Pest, Weeds and Diseases Associated with High Value Added Horticultural Crops Grown in Zambia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>Broad leaved weeds</td>
</tr>
<tr>
<td>Red spider mite</td>
</tr>
<tr>
<td>Caterpillars</td>
</tr>
<tr>
<td>Aphids</td>
</tr>
<tr>
<td>Thrips</td>
</tr>
<tr>
<td>Cutworm</td>
</tr>
<tr>
<td>Seed fly</td>
</tr>
<tr>
<td>Leaf miner</td>
</tr>
<tr>
<td>Mealy bugs</td>
</tr>
<tr>
<td>Sucking insect pests</td>
</tr>
<tr>
<td>Pumpkin fly</td>
</tr>
<tr>
<td>White fly</td>
</tr>
<tr>
<td>Leaf hopper</td>
</tr>
<tr>
<td>Carrot fly</td>
</tr>
</tbody>
</table>
Leeks
Fine Chilly Squash Baby Beans Carrots Corn Sugar Snap Peas

<table>
<thead>
<tr>
<th>Insect pest</th>
<th>Leeks</th>
<th>Fine beans</th>
<th>Chilly</th>
<th>Squash</th>
<th>Baby carrots</th>
<th>Baby corn</th>
<th>Mange tout/ Sugar snap peas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stalk borer</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Botrytis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Rust</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bacterial blight</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternaria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Downy mildew</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ascochyta</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angular leaf spot</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhizoctonia</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sclerotinia</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gummosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fungus diseases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyperus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>available to help improve</td>
</tr>
<tr>
<td>Grey leaf spot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Mycosphaerella</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Spodoptera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Heilothis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Source: Compiled with the assistance of York Farms.

Other export and domestic market oriented crops such as tomato, mango, maize, sorghum, potato, cassava, cotton, coffee and tea face a wide range of pests problems in Zambia (refer to the Annex 1 for a complete list of pests, commodities and control methods).

It is estimated that weeds, pest attacks and disease contribute to nearly 20% pre-harvest crop loss and as much as 80% post-harvest losses. Specifically, on-farm crop losses in Zambia due to insect pests are averaging 40% annually. Such figures are a testimonial to the relevance of supporting an IPM strategy in Zambia.

C. Current and proposed pest management practices

Current methods of pest management in Zambia can only be described as ad hoc and lacking a clear institutional framework to facilitate the needs of the agricultural sector. Until recently, commercial farmers, particularly those that grow crops for export markets, were developing their own pest management programmes that respond to standards prescribed by importers and buyers, principally in Europe. In this context, there are a number of individual company level activities focused on reducing reliance on pesticides, while at the same time, phasing in IPM practices. With this said, however, European buyers are increasingly recognizing and requiring EUREP GAP standards as a norm. Consequently, there is a gradual shift among Zambian exporters to move away from buyer-specific IPM standards towards compliance with EUREP GAP standards.

In fact, the urgency to adapt IPM practices, particularly those prescribed under EUREP GAP, are driving export oriented commercial farms to pick up the pace to reduce their reliance on pesticides (refer to www.eurep.org for a copy of the EUREP GAP checklist and methodologies).

According to commercial farmers, EUREP GAP full compliance is expected by 2005. In this context, in the absence of a national IPM strategy, export oriented farmers and their out growers are using EUREP GAP standards as a benchmark and target.
For export oriented commercial farmers, employing IPM practices is a must to survive in the export market. For small holder farmers, taking into consideration the high cost of agro-chemicals, introducing IPM practices continues to be one of the few options yield, as well as to reduce pre- and post-harvest losses. This in turn defines whether small holder farmers will continue to be bound by subsistence level farming or be able to create opportunities for income generation through the sale of excess harvest, or even an opportunity to link up with export oriented out grower programmes.

However limited it maybe, export oriented commercial farmers have resources to prepare themselves for the demands of EUREP GAP standards. As the same time, however, smallholder farmers have very limited resources, awareness, information and means to introduce IPM practices. Government research and training activities catering to the needs of smallholder farms are taking place in Zambia, but it continues to be ad hoc, limited in its scope to offer commercially viable solutions and lacks the reach to impact rural farming communities where pest and diseases problems are most acute.

D. Pest management practices to be used or promoted under the project

As export oriented farmers will need to comply with EUREP GAP by 2005, IPM practices to be promoted under the project, particularly for export oriented farmers who will reflect standards defined by EUREP GAP. A comprehensive pest management guideline expected by importers is presented in Annex 2 (Rational use of pesticides) and Annex 2.1 (Pesticide use), which covers the following issues:

Rational use of pesticides
- Non-pesticide prevention and control measures
- Justification for pesticide use
- Pesticide selection
- Pesticide application procedures
- Instructions to operators
- Confirmation of treatment
- Recording keeping
- Crop record sheets
- Control of vertebrate pests
- Dispensing and mixing of pesticides
- Pesticide disposal
- Pesticide storage
- Storage of personal protection equipment
- Storage and maintenance of pesticide application equipment

Rational use of fertilizers and manures
- General principals
- Nitrogen application to soil grown crops
- Phosphate, potassium and magnesium application to soil grown crops
- Farmyard and organic manure application
- Fertilizer application for hydroponically grown crops
- Fertilizer storage
- Application instruction and records

Pollution prevention
- Pollution audit
- Soil, water and air protection
- Chemical residuals in water
- Fuel and lubricant storage

Protection of human health
- Chemical residuals in food and water
- Chemical residuals in water
- Safety
- Storage of acid

While the guideline presented in Annex 2 provides a thorough coverage of pest management issues relevant for export oriented farmers, the coverage of farmers, particularly smallholder farmers, expected to follow such guidelines are minimal as a large majority of local farmers are not affiliated with an export oriented out grower programme. Consequently, a larger issue of how to expand internationally recognized pest management standards to a much broader community of farmers in Zambia continues to remain a challenge.

This suggests that while the guidelines to be utilized by out grower programmes may be
adequate for export oriented farmers, the project must take the next step to introduce a means of disseminating information and provide assistance to smallholder farmers to help them come into compliance with international standards and norms. In this respect, strengthening local support institutions and the development of delivery mechanism that effectively reach rural farming communities will be a critical feature of the project.

An important feature of moving toward EUREP GAP standards and the practical application of IPM, particularly among smallholder farmers is the understanding and commercially viable application of biological control agents. Currently, there is a complete void in the market for service associated with the use of biological control agents. In fact, there are several individuals with specialized knowledge in IPM and entomology offering training and advisory services at the individual corporate level. But due mostly to the lack of a support structure to help institutionalized and organization, the farming community is unable to take advantage of pockets of knowledge that exists in the market.

E. National agricultural research center, extension service and/or other institutions with potential for providing advice to farmers

A number of national agricultural research centers, extension services and other support organizations are currently operating in Zambia, offering a range of support services of varying quality to local farmers. Such organizations include the following (Table 4):

<table>
<thead>
<tr>
<th>Support Organizations</th>
<th>Support Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Zambia Export Growers Association (ZEGA)</strong></td>
<td>Currently has 2 on-farm trainers offering group training for 10-15 farmer groups, as well as offer on-campus diploma courses in areas including:</td>
</tr>
<tr>
<td></td>
<td><strong>Use of Pesticides</strong></td>
</tr>
<tr>
<td></td>
<td>Safe Use of Pesticides</td>
</tr>
<tr>
<td></td>
<td>Effective Spraying</td>
</tr>
<tr>
<td></td>
<td>Supervision of Spraying</td>
</tr>
<tr>
<td></td>
<td>Store Keeping</td>
</tr>
<tr>
<td></td>
<td>Transport of Pesticide</td>
</tr>
<tr>
<td></td>
<td>Instructors Certificate in Safe Use</td>
</tr>
<tr>
<td></td>
<td><strong>Crop Scouting</strong></td>
</tr>
<tr>
<td></td>
<td>Crop Scouting (Roses)</td>
</tr>
<tr>
<td></td>
<td>Advanced Crop Scouting (Roses)</td>
</tr>
<tr>
<td></td>
<td><strong>Man Management</strong></td>
</tr>
<tr>
<td></td>
<td>Introduction to Supervision (Team Leaders)</td>
</tr>
<tr>
<td></td>
<td>Supervision Skills</td>
</tr>
<tr>
<td></td>
<td>Getting the Best From Your Investment in Training</td>
</tr>
<tr>
<td></td>
<td><strong>Basic Food Hygiene</strong></td>
</tr>
<tr>
<td></td>
<td>Food Safety (Farm and Pack house Staff)</td>
</tr>
<tr>
<td></td>
<td>(Supervisors and Quality Controllers)</td>
</tr>
<tr>
<td></td>
<td>First Aid</td>
</tr>
<tr>
<td></td>
<td>Red Cross Basic Certificate</td>
</tr>
<tr>
<td></td>
<td>ZEGA charges approximately $100/day to deliver this service</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organic Producers and Processors Association of Zambia (OPPAZ)</th>
<th>Technical advice and training:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Methods of organic production of the diversified/specialized crops</td>
</tr>
<tr>
<td></td>
<td>• Production quality and hygiene requirements for products for the market</td>
</tr>
<tr>
<td></td>
<td>place (local, regional and international)</td>
</tr>
<tr>
<td></td>
<td>• Appropriate crops for production during the two year transitional period</td>
</tr>
</tbody>
</table>

Global Development Solutions, LLC
Methods and facilities for harvesting, drying, handling and storage
Specifications for capital items such as storage facility
Co-ordination of crop production in relation to OPPAZ identified market opportunities

Other services offered to farmers include:
- technical leaflets and information sheets and build-up market information
- Recruit and train extension workers
- Conduct research and trails on new potential crops and technologies
- Support and aid the link between the larger estate sector and small-scale farmers through out-growers and processors schemes
- Encourage and support the development of regional organic growers groups within Zambia, and foster partnerships with appropriate NGOs and organizations in order to extend the training in sustainable agriculture and organic market opportunities to the small shareholder sector
- Develop fair-trade opportunities
- Develop and support linkages and working partnerships with NGO’s and other relevant associations

### Golden Valley Agricultural Research Institute (GART)
Principal focus to promote conservation farming technologies with emphasis on conservation tillage systems. Main activities include publication of a yearbook, organization of field days, basic training courses and on-farm training activities.

### Mt. Makulu
Annex 3 provides a comprehensive list of research undertaken by Mt. Makulu.

### Zambia National Farmer’s Union
Principal objectives of the ZNFU is stated as:
- Distribution of technical/marketing information
- Liaison with the financial sector
- Liaise with and promote agricultural research
- Provide advice to farmers on production and marketing
- Lobby government
- Educate and train farmers
- Promote training to enhance labour skills in the agricultural sector
- Offer technical assistance through technical seminars, open days, and association meetings
- Outreach programmes to help promote empowerment of small-scale farmers

The principal strength of the Union is its network and ability to reach small scale farmers

Many training and research organizations are said to offer pest management advisory services, when in reality there are only a few individuals within each organization with adequate knowledge to provide practical advise to farmers. With this said, however, most advice originating from universities and government institutions tend to be much more theoretical, and provide basic information pest management, while lacking in commercial viability.

In fact, there are no augmentative release of biological control agents in Zambia beyond experimentation from European sources. Many of these trials have been unsuccessful due to limited knowledge and resources, and thus as a result, IPM is often viewed as impractical, expensive and ineffective. In this respect, there are a number of critical gaps between baseline IPM support services currently available to farmers in Zambia, and what can be expected at the international level. Critical gaps include the following:

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Farmers. In the area of conservation farming, focus is placed more on reducing damaging farming practices by smallholder farmers. For example, emphasis is placed on reducing farming practices that reduce deforestation and land degradation, destructive crop establishment practices, and inappropriate animal husbandry methods.

These harmful methods are being replaced with simple conservation farming techniques that help reduce stress on the land, while at the same time contribute to reducing pre and post-harvest losses resulting from pest and disease. Such practices include:

- Retention of crop residue to replace widespread practice of burning;
- Restricting tillage;
- Establish precise and permanent grid of planting basins, planting furrows or contoured ridges;
- Early and continuous weeding; and
- Rotation and inter-cropping with nitrogen fixing legumes.

Common practices among large commercial export-orientated farms include:

- Minimal tillage and mulching;
- Drip irrigation for conservation of moisture;
- Use of resistant varieties;
- Emphasis on seed coating to help minimize spraying during growing period;
- Crop rotation; and
- Introduction of beneficial havens to attract biological predators.

Organic farmers, particularly those involved in essential oil production face less problems with pest management issues as aromatic plants tend to have less pest problems than other crops. While organic farmers face problems with aphids, whitefly and several other pests, inter-planting, intensive mulching, and the introduction of barrier crops tends to minimize crop damage from pests. Fungicidal problems are often tackled through spraying either a combination of compost and water, or milk and water combination.

F. Relevant IPM technology, knowledge and experience applicable to the project

Currently, a range of conservation farming and integrated crop management methods are employed, particularly among larger commercial export farmers. At the same time, however, the proper use of these techniques continue to be minimal among smallholder farmers. In the area of conservation farming, focus is placed more on reducing damaging farming practices by smallholder farmers. For example, emphasis is placed on reducing farming practices that reduce deforestation and land degradation, destructive crop establishment practices, and inappropriate animal husbandry methods.

These harmful methods are being replaced with simple conservation farming techniques that help reduce stress on the land, while at the same time contribute to reducing pre and post-harvest losses resulting from pest and disease. Such practices include:

- Retention of crop residue to replace widespread practice of burning;
- Restricting tillage;
- Establish precise and permanent grid of planting basins, planting furrows or contoured ridges;
- Early and continuous weeding; and
- Rotation and inter-cropping with nitrogen fixing legumes.

Common practices among large commercial export-orientated farms include:

- Minimal tillage and mulching;
- Drip irrigation for conservation of moisture;
- Use of resistant varieties;
- Emphasis on seed coating to help minimize spraying during growing period;
- Crop rotation; and
- Introduction of beneficial havens to attract biological predators.

Organic farmers, particularly those involved in essential oil production face less problems with pest management issues as aromatic plants tend to have less pest problems than other crops. While organic farmers face problems with aphids, whitefly and several other pests, inter-planting, intensive mulching, and the introduction of barrier crops tends to minimize crop damage from pests. Fungicidal problems are often tackled through spraying either a combination of compost and water, or milk and water combination.
While the use of biological control agents is a prominent component of IPM, it is not presently used in Zambia. In addition, the use of IPM compatible chemicals is limited, particularly as samples are difficult to access from local chemical companies as the import of chemicals, even trial samples, are assessed a $1,000 levy by the Environmental Council of Zambia. With this said, however, according to local entomologists, it is possible to harvest and raise the following biological control agents relying solely on native species, but such opportunities are not currently being explored nor exploited in Zambia (Table 5).

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
<th>Target pests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trichoderma</td>
<td>Egg parasitoids</td>
<td>Lepidoptera pests</td>
</tr>
<tr>
<td>Geocodes</td>
<td>Predatory bugs</td>
<td>Mites, lepidoptera eggs, plant bugs, leafhoppers, lepidoptera larvae</td>
</tr>
<tr>
<td>Aphelininae sp</td>
<td>Parasitoids</td>
<td>Aphids, whitely, scale</td>
</tr>
<tr>
<td>Coccinellidae</td>
<td>Predatory beetles</td>
<td>General soft bodied insects</td>
</tr>
<tr>
<td>Anthocorinae</td>
<td>Predatory bugs</td>
<td>Aphids, mites, thrips, psyllids, insect eggs</td>
</tr>
<tr>
<td>Amblyseius</td>
<td>Predatory mites</td>
<td>Mites, thrips</td>
</tr>
<tr>
<td>Phytoseius</td>
<td>Predatory mites</td>
<td>Mites</td>
</tr>
<tr>
<td>Diglyphus</td>
<td>Larval parasitoids</td>
<td>Leafminers</td>
</tr>
<tr>
<td>Chrysopa</td>
<td>Predator</td>
<td>Aphids</td>
</tr>
<tr>
<td>Eudorylaimu, labronema, seiner</td>
<td>Nematodes predator</td>
<td>Nematodes</td>
</tr>
</tbody>
</table>

As a means of promoting IPM practices, substantial merit exists in conducting regular insect surveys to define and offer solutions to farmers based on the use of biological control agents and other IPM compatible products. This would require the establishment of a commercially viable insectary with demonstration sites offering workshops, trials and extension services, something which currently does not exist in Zambia.

In this context, there is a need to explore the possibility of forming an independent body that helps to institutionalize pockets of knowledge that currently exists in the market, and to consolidate such experience and know-how under a single entity. Such an organization would go a long way in helping to match the demands of international standards against the needs of local farmers, both for smallholders and commercial farmers, while at the same time improve the competitiveness of Zambian farmers. The goal for such organization would be twofold:
- Rationalize current pesticide use through up-to-date IPM practices, particularly in compliance with EUREP GAP, which help to improve competitiveness of Zambian farmers; and
- Reduce crop losses resulting from pests using a balanced regime of biological control agents and pesticides to help improve economically sustainable farming in Zambia.

During the proposed pilot phase of the project, consideration is required to develop a small-scale demonstration site that tests the commercial viability of establishing an insectary, and to provide test trials, on-farm demonstrations, training and advisory services to local farmers. Such a demonstration could be coordinated with the basic research capability of entities like Mt. Makulu, University of Zambia and to a limited degree GART, and training capabilities of existing organizations such as the ZEGA Training Trust. Results from such demonstration and research can in turn take advantage of and exploit the information and support networks currently supported by ZNFU to promote...
awareness raising and information dissemination, particularly for smallholder farmers.

G. Research, field trials, extension and practical application associated with IPM in Zambia

A number of basic research and small field trials have been conducted by government organizations and universities such as Mount Makulu and the University of Zambia. Such research covers potential IPM approaches employable in Zambia that incorporates host plant resistance, use of microbial agents, cultural control, and the use of natural enemies have produced favorable results in responding to a number of problems. Examples include the following.

- Potato tuber moths: came under control following a mass rearing and release of two natural enemies, Copidosoma Koehleri and Braconid Braconid Green, together with a combination with cultural methods (Mingochi et al, 1997).
- Blackrot: serious impact on cabbage and rape production, particularly during rainy season was brought under control using cultural methods and resistant varieties.
- Cassava mealybug: controlled using mass release of a natural enemy Epidinocarsis lopezi.
- Grain borer: threats brought under control using improved storage structure, biological control using a predaceous beetle, chemical admixes for stored grain and general storage hygiene.

Historically, Zambia has participated in research activities such as the Southern Africa Community/Asian Vegetable Research and Development Center’s Tomato Improvement Collaborative Research, which aims to incorporate host-plant resistance to important diseases such as bacterial wilt and tomato mosaic virus.

Field trials and research activities are conducted at the industry level where information is collected for specific crops, but then is not disseminated more widely to the agricultural community as a whole. Some examples are provided below.

Coffee: coffee growers have developed scouting practices which was meant to assist farmers make chemical spray decisions, but in practice very little link exists between the two activities. In addition, minor level of cultural practices have been introduced where sunhemp is planted between smaller trees to help suppress weed and is later cut back as mulch.

Cotton: Consultants from South Africa are known to make regular visits to train Zambian cotton growers in activities associated with IPM such as scouting, effective spraying, and pest identification. At the same time, however, little attention has been given to the use of biological control agents.

Organics: a wide range of organics are grown in Zambia and they are practicing one form of IPM, but consistently in the absence of biological control agents.

Vegetable and flower growers, particularly export oriented farmers, are aware of IPM and principally regulated by strict European and UK regulations which prescribe minimal use of pesticides and have increasing demand traceability. As a consequence several farmers are using monitoring techniques such as sticky pads and pheromone traps, but continue to face a lack of information and know-how in employing IPM practices.

Despite these efforts, the country continues to face formidable challenges. Evidence suggests that the rise in pesticide poisoning may be linked to the over use of pesticides by farmers in an effort to combat pesticide resistant diamondback moth and red spidermites. This also suggests that there is a substantial gap...
between research and commercial application of research findings.

As early as 1996, the government in conjunction with FAO was conducting research on integrated crop management, and more recently research has been conducted by the University of Zambia on integrated pest management. With this said, however, research and available data continues to lack depth where methodologies require further refinement, particularly in the context of offering a framework to translate results into commercially viable and sustainable activity for local farmers. In most all cases, such research fails to cost out IPM options and its commercial implications.

In addition, a number of trial tests have been conducted, but in all cases, no viable strategy and framework is offered as a means of rolling out a trial as a nationwide programme, where again, methodologies used for the trials do not lend themselves to commercial uptake as a part of a nationwide IPM programme.

Recently, the Ministry of Agriculture and Cooperatives with support by USAID compiled a publication entitled the Agricultural Field Insect Pests of Zambia and Their Management. A useful manual for the identification of insects, description of symptoms, and control methods, where both biological, cultural and chemical control methods are prescribed, particularly as the manual provides a photograph of insects to help farmers identify problems.

As with any other research, however, while the manual offers solutions using biological control agents, no information is provided on accessing biological control agents, as well as the availability of pesticides in Zambia. Furthermore, very little practical solutions are offered with respect to seeking a balance between the use of biological and cultural control agents with pesticides.

As there is no insectary in Zambia, the option to utilize biological control agents is virtually a non-issue particularly as importing or growing biological control agents, if not conducted in an organized commercial fashion, would not offer a financially viable option for farmers. In addition, the use of the term IPM in Zambia is principally void of any solution involving pests as biological control agents. Consequently, IPM is reduced to a limited number of cultural practices, managing the use of fertilizers, weeding, adjustments in cropping practices, and non-capital intensive improvements in storage and post-harvest handling.

H. Individuals, Groups and Programmes Working on relevant IPM Issues in Zambia

Zambia Export Growers Association (ZECA) Training Trust was formed as a Trust in 1999 with 9 trustees from the private sector (current chairman is Neil Slade from Agriflora). Its principal objective is to provide training, technical support and to conduct research in the field of agriculture, particularly in areas related to the support of agricultural exports.

The Government of Zambia provides free access to the land and office space, and the Association is located on the campus of the NRDC (Natural Resources Development College). It's current budget is approximately $400,000 (60%-70% from donor funds), where income is generated from:

- Grant
- Donor funds (Netherlands, Norway)
- Income from training
- Student fees

Global Development Solutions, LLC
Sales of crops from the farm operated as a part of the training programme Consulting service (audit for compliance for ZEGA members)

Currently, activities of the Association place emphasis on providing training to students, where training is offered through a subsidy by the Trust. Student fees are K750,000/yr where actual cost is about $4,000/yr.

At the same time, however, the Trust is expanding its research and consulting capability to help support the information needs of the agriculture and agribusiness community in Zambia.

ZEGA has taken leadership in formulating a code of practice manual which introduces good agricultural practice and environmental protection measures, protection of buyers and sellers of vegetables, support and code of conduct for flower growers, human resource management and welfare of employees and best practice for out grower development.

The Organic Producers and Processors Association of Zambia (OPPAZ) is the leading NGO in Zambia providing support and promoting organic farming, both with small scale farmers and commercial farmers. OPPAZ was founded in 1999 by a group of farmers and small local NGO's keen to promote and expand the opportunities of organic agricultural. The Association has received the full supported of the Zambian Government, the Zambian National Farmers Union, and the Ministry of Agriculture. The growth in the organic movement in Zambia over recent years and the lively interest from the farming fraternity has largely come about through the recent exposure to the organic marketplace, supported through a series of seminar and workshops, held by OPPAZ over the last two and half years, together with visits from specialist consultants, field days and demonstrations OPPAZ also organizes as ongoing activities.

The principal objective of the Association is to provide technical advisory service, together with the development of formal and informal working partnership with appropriate associations/NGO's, provide an accessible export route and viable opportunities for income generation in the rural farming sector of Zambia as a nationally functioning body operating to fulfill the following objectives.

- To support the development of income generating and diversification opportunities by enabling viable markets to develop for certified and non-certified organic produce within Zambia and externally, and to expand the already established export market for certified products.
- To encourage small-scale, rural based primary production and processing of agricultural products for the socio-economic benefits these activities can provide.
- To promote and actively develop with sustainable methods of agricultural production.

Mount Makulu/University of Zambia Mt. Makulu, which is under the Ministry of Agriculture, and the University of Zambia work on basic research associated with IPM. While both are responsive to requests for specific research from the agricultural sector, particularly issues relevant to smallholder farmers, the type of research and quality of the out continues to be more basic and lack commercial applicability. The type of research conducted by Mt. Makulu and the University of Zambia are an important awareness raising tool for the agricultural sector, and this type of demand-driven research should continue to be supported. But much closer coordination is required with organizations and individuals that have practical commercial experience to help translate the research into commercially viable option for Zambian Farmers.

Individual Experts
Currently, there is a British entomologist and tropical agriculture specialist living and working in Zambia developing IPM trial
plots, as well as a small private insectary to help promote IPM in Zambia. Both have been granted land from Borassus, an export oriented horticultural company operating outside Lusaka. Suzanne Neave and Dominic Bedward collectively have relevant experience in Kenya, Zimbabwe, Swaziland, and Ghana, offering advisory services to both ZEGA and private companies in Zambia to help establish a more robust IPM programme for the country. According to government organizations, NGOs, and private companies, currently, Neave and Bedward are the only two individuals in Zambia with a comprehensive understanding of IPM methods and their commercially application.

What is clearly evident in Zambia is that activities related to IPM are taking place in an ad hoc fashion based on pockets of information and the knowledge of a few experts. In such an environment, information and know-how is neither institutionalize nor standardized. A close look at organizations and individuals with some form of IPM experience suggests that this project should work with existing organizations and individuals to take advantage of the comparative advantage offered by each player and to help identify synergies and consolidate support activities to the farming sector. For example, basic research on topics like establishing small-scale farm-level insectary, and the identification of new natural predatory insects can be directed towards Mt Makulu and the University of Zambia. Such research, however, should be demand driven where problems and issues are identified through direct interaction with farmers and experts who work directly with the private sector.

As research stations have shown substantial weakness in the application and commercialization of research findings, the use of individual consultants, particularly those with relevant and commercial experience in introducing and managing biological control agents within a larger IPM framework is seen as essential for the farming community. Their interaction with farmers and the outcome from the integration of IPM methods can also be a source of information for directing basic research by Mt. Makulu and the University of Zambia.

As there is a substantial shortage of qualified practitioners of IPM in Zambia, training-of-trainers to help mobilize a larger number of practitioners with practical knowledge will be essential for the development of the farming sector. Consequently, organizations like the ZEGA Training Trust would be a useful medium to support training-of-trainer activities. Several entomology and tropical agriculture specialist already working in Zambia can be tapped to deliver training-of-trainer support to the Training Trust. This can also be supplemented by possibly accessing foreign experts, even retirees in a number of relevant fields to help strengthening and build up a cadre of IPM practitioners.

Findings from both basic research, on-farm commercial application, and information on support services can then be disseminated through organizations such as the ZNFU, and in part through Mt. Makulu’s network of stations around the country. Both organizations have outreach networks, particularly those that reach rural farmers.

Currently, all of these activities are taking place on an ad hoc basis, and a great need exists to help centralize these activities and to help introduce standardization in such areas as scouting practices. In addition, while some parts of the activities described above should remain a public service, such as awareness raising and creating opportunities for accessing information, a crucial element will be to move towards commercialization of services, particularly with respect to the introduction of an insectary and consulting service. While it is clearly obvious that cost to individual small holders will be prohibitive, programmes must be structured through organizations like the Training Trust to help deliver services to a cluster of farmers, as well as to adapt technologies such as small-scale insectary to village level agriculture.
Regarding phytosanitary issues, a phyto-guide was issued in 1998 based on experience and lessons learnt from the national larger greater borer (LGB) containment and control programme in Zambia. The guide is considered the implementation document for The Plant Pests and Disease Act (Laws, Volume VII, Cap. 345). The guide covers the following issues:

- Quarantine principals
- Phytosanitary legislation and regulations
- International grain trade
- Quarantine treatment for exclusion of LGB
- On-farm pest management and storage
- Extension and awareness campaign
- Monitoring LGB & *Tereutis nigrescens*
- Standardized methods for inspection and grading shelled maize

While the guideline is robust with information, the fact remains that the guideline is theoretically sound, but not adequately practical for commercial application. While the guideline was prepared in 1998, as of last year, recommendations provided in the guideline have yet to be implemented.

a. review the pest management/crop protection research programs of any institutions carrying out agricultural research in Zambia

b. assess the extent to which they incorporate an IPM approach including alternatives to chemical pesticides and rationalization of pesticide use.

c. propose how the project could support these institutions

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III

Pesticide use and management: Review of present, proposed and/or envisaged pesticide use

While a range of non-chemical options continue to be used among farmers in Zambia, organic solutions have shown some limitations in its capacity to deal with recurrent problems. In this respect, without further promotion of IPM practices, a wide range of herbicides, fungicides, and insecticides are expected to be used by local farmers. At the same time, however, usage rate among out growers is expected to be closely monitored, particularly when chemical agents are used as a part of an out grower programme to produce export crops where processors must comply with international standards.

Substantial amount of research and field trials are required to identify and introduce rational use of pesticides and 'soft' chemicals in conjunction with IPM practices. With this said, however, accessing pesticide samples from local chemical companies (these companies are mostly sales agent of chemical producers) continues to create a bottleneck for the development of IPM methods. Specifically, chemical companies are assessed an import levy of $1,000 by the Environmental Council when chemicals are imported into the country. Consequently, chemical companies are reluctant to provide samples to local organizations and companies to be tested in conjunction with IPM options developed for various crops (for example in Kenya, field samples are not taxed). In fact, most chemical companies are not open to discussing the range of chemicals which they offer.

In addition, for most chemical companies, large producers of cotton, tobacco, maize and coffee are their principal clients in Zambia. And as a result, interest in providing services to the budding horticulture and floriculture industry is of limited interest to chemical companies. Until such time when the Ministry of Agriculture reconsiders the current levy on imported chemicals, administrative barriers may continue to dampen the development and promotion of IPM practices in Zambia.

Currently, herbicides, fungicides and pesticides utilized by local farmers are registered under one of nine internationally recognized registrations. These registrations include the following:

- Kenyan registration under Pest Control Products Board
- South African registration
- United Kingdom registration
- Zimbabwe registration
- Chilean registration
- French registration
- Spanish registration
- Italian registration
- USA registration

Annex 4 (Pesticides used in the horticultural sector) provides a comprehensive list of herbicides, fungicides and pesticides currently used and expected to be used by farmers in the horticultural sector for the study phase. In addition, a list of prohibited pesticides are provided in Annex 5 - Banned and restricted pesticides.

Generally, among smallholder farmers decision making on pesticide use is driven by education and socio economic factors. At the same time, the dissemination of critical
information concerning usage level, application, handling, and storage continues to be weak. As a consequence, non-observance of pre-harvest intervals have resulted in cases of human poisoning from consumption of pesticide contaminated vegetables. Such cases are seemingly on the rise. Furthermore, even though the Government and NGOs continue to be strong proponents of IPM, indiscriminate routine pesticide use is often seen as a problem in the agricultural sector.

While in general random use of pesticides continues to be a problem particularly among smallholder farmers, farmers attached to out grower programmes are kept to a stringent regimen and close monitoring of pesticide use. In most cases, out growers must comply with pre-existing pesticide treatment programmes which are closely monitored. Some out grower programmes have spraying teams that go out to participating farms to spray rather than relying on decisions making processes of local farmers.

In this context, extensive awareness and a training gap continues to exist, particularly among smallholder farmers where there is a gross absence of knowledge about proper scouting methods. Some of the basic problems revolve around the scouting methods used, particularly among smallholder farmers, which emphasizes spraying regimes based on the identification of harmful pests, rather than a broader perspective of identifying and incorporate the use of beneficial pests. Consequently, wholesale spraying regimes have tended to eliminate all pest, including beneficial pests.

A. Types of pesticides available

There are a wide range of chemicals available through chemical trading agents operating in Zambia. While it is possible to acquire a list of available chemicals in the market (refer to Annex 6 - Registered chemicals in Zambia), local trading agents are very closed about the types and cost of chemicals available through an agent. According to local farmers, particularly large farmers that received investment incentives from the Government for tax free import of inputs, it is cheaper to import chemicals directly from South Africa than to purchase from local agents. Consequently, local agents are generally very reluctant to discuss the availability and price list of chemicals in stock.

There is virtually no publicly available information on the effectiveness of pesticides. Whatever data that is available is collected at the company level and is generally not available to the public. While this is the sort of field research which would suit the capability of organizations like the Mt. Makulu and the University of Zambia, no such research has been conducted.

Given the high cost of chemicals in Zambia, substantial volume of illegal trading of chemicals is found, including the trading of banned substances. Generally, commercial farmers, particularly export oriented companies, tend to follow guidelines established by ZEGA (refer to Annex 5 - banned chemicals), which reflects standards prescribed by the WHO, 79/117/EEC, POPs (Persistent Organic Pollutants), UN and EC. The following is a summary of ZEGA standards:

- Avoid use of pesticides containing active ingredients that are considered to be extremely or highly hazardous (WHO classification class 1a and 1b).
- Avoid use of active ingredients whose use is forbidden by the EU Directive 79/117 which lists active ingredients of pesticides for which marketing and application is forbidden in the EU.
- Avoid use of Persistent Organic Pollutants, POPs, as classified by the UN Economic Commission for Europe (UNECE). These are to be banned in the near future.
- Not use any of the active ingredients that are on the list developed in 1994 by the Department for Policy Coordination and Sustainable Development from the UN.
While export oriented farmers have relied on ZEGA Codes of Conduct as a benchmark for the use of chemicals, most, if not all are quickly moving towards compliance with EUREP GAP. With this said, however, there is a substantial gap between the knowledge and practices of export oriented farmers and smallholder farmers.

To address the issue of ecological and health hazards of pesticide use, the Environmental Council of Zambia (ECZ) and a programme funded by UNITAR on hazardous chemical communication programme has taken a major first step in raising awareness and information dissemination particularly among smallholder farmers.

Originally designed by the University of Capetown, ECZ is collaborating with private sector representatives to conduct a survey of farmers to identify the level of awareness regarding hazards associated with the use and handling of pesticides. A survey conducted around the Lusaka area (with 70 km of Lusaka) is recently completed and is now being used to formulate an action plan, which is expected to be issued by the end of July 2003.

Preliminary survey results suggests that there is a gross misunderstanding of the dangers posed by improper handling of pesticides. In many cases, farmers are often unaware of how to read and interpret hazardous labels, and also to understand the meaning of pictograms. Common practice among farmers, for example, is to reuse containers to store different types of chemicals. Consequently, the warning labels have little to do with the substance stored in the container. Similarly, there are numerous cases of poisoning resulting from chemicals stored in containers originally used for consumable products like bottles originally containing mineral water and juice containers. The problem of poisoning is often compounded by the fact that there is virtually no awareness among farmers regarding proper storage measures. As a result, chemicals are often stored inside the house where it is readily accessible to children.

To avoid mishandling and poisoning, export oriented farmers have a well established spraying regime, and some have spraying teams that spray on behalf of their out growers. In addition, for some crops, seed coating is used to help reduce the number of spraying, and for other crops preventative spraying is conducted by processors on behalf of their out growers.

For smallholder farms, when pesticides are available and pests are a problem, random spraying is a common response. This is a result of the lack of awareness regarding the health and safety consequences of pesticide use. In this context, an attempt to reduce infestation as well as to generate more revenue from the harvest, some farmers have been found to spray their plants shortly before harvest in hopes of reducing infestation.

Similarly, smallholder farmers currently have no means of evaluating the economic costs and benefits of pesticide application, particularly in the context of improving yield rates and profitability. This type of economic benefit analysis is only conducted among large commercial farms and export oriented farms.

The principal objective of the proposed project will be to assist farmers in reducing their reliance on pesticides, particularly with consideration for the fact that exports will be required to comply with EUREP GAP by 2005. Furthermore, the grant portion of the fund is expected to place emphasis on technical assistance rather than on the purchase of inputs. While participating companies may wish to purchase inputs for their out growers from their portion of the contribution, the matching portion from the project facility is likely to discourage the use of funds for inputs.

In addition, the project is expected to emphasize the use of integrated crop management, and integrated pest management, where cultural and biological options are expected to be maximized in balance with minimal amount of pesticide use. While the objective will be to reduce reliance on pesticide use, the ability of
smallholders farmers to respond effectively to this effort will continue to be limited in the absence of technical support activities to promote IPM, and an intensive awareness and information dissemination campaign which is linked to expansion of market opportunities.

During the pilot phase, participating farmers are expected to move forward at an increasing pace towards compliance with EUREP GAP. As evident from the EUREP GAP requirements, participating farmers will not only be consistent with the requirements of OP 4.09, but may even exceed its requirements. With this said, however, principal problems associated with compliance with OP 4.09 is likely to arise during the national roll out phase when a larger number of farmers, particularly smallholder farmers, must be directed towards reduced reliance on pesticide and greater incorporation IPM methods.

Currently, there are a number of hazards associated with local conditions. First, while SCZ has helped to create a legal framework for IPM in Zambia, the acute lack of capacity to enforce its own guidelines and regulations continues to leave ample room for import and use of illegal pesticides. This problem is further compounded by the fact that there is a gross lack of awareness about the health consequences associated with misuse of pesticides.

While labeling requirements are clearly stated in both ECZ’s Pesticides and Toxic Substance General Handling Guidelines and Government’s Pesticide and Toxic Substance Regulations, 1994, when pesticides are repackaged into smaller packages for resale to smallholder farmers, labeling requirements are either ignored, or the quality of the printing on the label is so poor or undersized that it is virtually impossible for farmers to decipher even pictogram warnings. In this context, strengthening ECZ’s capacity to enforce its own guidelines and regulations will define the future success of IPM initiatives in Zambia.

As mentioned earlier, there is an absence of an insectary in Zambia. Consequently, an entire gamut of options available through biological control agents is currently not open to farmers in Zambia. In this context, the introduction of a commercially viable insectary is likely to have a substantial impact on integrating IPM methods in Zambia.

In addition to introducing biological control strategies, other preferential use of non-chemical alternatives that need to be considered for inclusion in developing a more robust IPM strategy in Zambia includes developing monitoring techniques such as scouting, use of traps (sticky pheromone), cultural practices such as intercropping, cover crops, crop rotation and break crops. Furthermore, research and development resources need to be focused on formulating botanical teas or alternatives to conventional chemicals such as detergents, molasses, starch and biocarbonate of soda.

B. Conditions of pesticide use and the capability and competence of end-users to handle products within acceptable risk margins

ZEGA has taken leadership in defining conditions of pesticide collection, transport, handling, storage and disposal. As a part of its code of practice, ZEGA provides a detailed guideline in its ZEGA Code of Practice Guide. ZEGA members which include all agro-processors that export from Zambia have embraced the Code as the guiding operational principal.

Types of pesticide application equipment in general use

The Industrial and Labour Relations Act (Act No. 27 of 1993) defines the type of equipment and protective clothing to be utilized by farmers. In general, the application equipment and protective clothing available include the following standard items (Table 6):
Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

<table>
<thead>
<tr>
<th>Equipment and Protective Clothing Generally Available to Farmers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gloves</strong></td>
</tr>
<tr>
<td>- Gloves should be impermeable to chemicals (e.g. nitrile rubber).</td>
</tr>
<tr>
<td>- Flexibility and grip when wet are important.</td>
</tr>
<tr>
<td>- Gloves should be purchased in the right hand size and should be long enough to overlap the overall sleeves.</td>
</tr>
<tr>
<td>- Leather or warehouse gloves or lined rubber/plastic gloves are NOT suitable.</td>
</tr>
<tr>
<td><strong>Gum boots</strong></td>
</tr>
<tr>
<td>- Gum boots should be rubber and calf length.</td>
</tr>
<tr>
<td>- Steel toe-caps are advisable for persons handling heavy boxes and drums.</td>
</tr>
<tr>
<td>- Leather boots are NOT suitable.</td>
</tr>
<tr>
<td><strong>Cotton overalls</strong></td>
</tr>
<tr>
<td>- Overalls should be made of good quality cotton, which will keep the operator dry and withstand frequent washing.</td>
</tr>
<tr>
<td>- Legs should be long enough to overlap the boots.</td>
</tr>
<tr>
<td><strong>Spray suits</strong></td>
</tr>
<tr>
<td>- One piece spray suits are best for greenhouse application, but in outdoor situations a two piece suit and hat is more comfortable.</td>
</tr>
<tr>
<td>- Consider weight, size and flexibility.</td>
</tr>
<tr>
<td>- Materials should be impermeable to pesticides.</td>
</tr>
<tr>
<td><strong>Respirators</strong></td>
</tr>
<tr>
<td>- Full cover face masks are best for greenhouse use. Otherwise mouth and nose protection is satisfactory and can be augmented with goggles if necessary.</td>
</tr>
<tr>
<td>- Respirators should be fitted with cartridges that filter out ORGANIC VAPOURS.</td>
</tr>
<tr>
<td>- The expiry date should be checked and the cartridge should also be replaced:</td>
</tr>
<tr>
<td>- if the operator complains of taste or smell</td>
</tr>
<tr>
<td>- if the operator notes difficulty in breathing</td>
</tr>
<tr>
<td>- after 1-200 hours use in heavily contaminated atmospheres</td>
</tr>
<tr>
<td>- The fitting of the face piece should be checked: mask inflates slightly if you cover the exit valve and breath out.</td>
</tr>
<tr>
<td><strong>Dust masks</strong></td>
</tr>
<tr>
<td>- These masks ONLY give protection from SOLID dust particles, NOT from toxic liquid and gas vapours, so should not be used when toxic products are sprayed.</td>
</tr>
<tr>
<td><strong>Face shields</strong></td>
</tr>
<tr>
<td>- These shields protect the face ONLY from LIQUID SPLASHES, NOT fumes or vapours.</td>
</tr>
<tr>
<td>- Face shields should cover the whole face and be made of light weight clear flexible acetate or PVC.</td>
</tr>
<tr>
<td><strong>Goggles</strong></td>
</tr>
<tr>
<td>- Clear plastic goggles are a useful addition to a mouth and nose respirator.</td>
</tr>
<tr>
<td>- Take care that your goggles and respirator are compatible.</td>
</tr>
<tr>
<td><strong>Head covering (hat)</strong></td>
</tr>
<tr>
<td>- Light weight cotton for sun protection</td>
</tr>
<tr>
<td>- Water proof for spraying overhead</td>
</tr>
</tbody>
</table>

Source: ZEGA Code of Conduct

Given the general category of equipment to be used by farmers, ZEGA has taken the initiative to prescribe the most appropriate types of equipment and clothing to be used based on most common operating conditions faced by farmers.
<table>
<thead>
<tr>
<th>Operating Condition</th>
<th>Hazard Category</th>
<th>Equipment/Clothing Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dealing with leaks and spills, or Measuring and mixing including tank filling</td>
<td>Poisonous / Corrosive</td>
<td>- Spray suit or cotton overalls and apron plus:</td>
</tr>
<tr>
<td>All personnel involved</td>
<td>Hazardous / Others</td>
<td>- gloves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- gum boots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- respirator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- eye protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spray suit or cotton overalls and long apron plus:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- gloves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- gum boots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- face shield</td>
</tr>
<tr>
<td>Greenhouse operator and team supervisor</td>
<td></td>
<td>Spray suit plus:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- gloves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- gum boots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- respirator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- eye protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spray suit or cotton overall and long apron plus:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- gloves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- gum boots</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- respirator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- eye protection</td>
</tr>
<tr>
<td>Knapsack Operator (Field)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spray man (Field)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervisor (Field)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tractor driver (Field)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handling unopened containers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storekeeper and store workers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: ZEGA Code of Conduct

While farmers currently do not adhere to any particularly prescribed use of application equipment and protective clothing, export oriented farmers must recognize and employ methods required under EUREP GAP. Here again, unless support to smallholder farmers is intensified, it is likely that Zambia will experience a growing gap in safety standards between smallholder farmers and export oriented commercial farmers.

The general state of knowledge among farmers and among agricultural workers with respect to understanding chemical hazards is at best minimal. This problem is a well known and recognized fact. As a result, the ECZ in collaboration with the private sector initiated a hazardous communication programme to identify where and how awareness raising, training, and information dissemination can best be tackled. The programme recently
completed a survey of farmers in the Lusaka region and is expected to issue an action plan by September 2003. The survey results point to the gross lack of understanding about labels, how to interpret warnings and pictograms, appropriate handling procedures, proper clothing and equipment used, and basic preventative measures.

Taking into account the poor state of awareness among farmers regarding the impact of hazardous chemicals, the ZEGA Training Trust has developed and is now offering courses on hazardous materials and proper handling techniques. As the Trust can only accommodate a limited number of students, the outreach impact continues to be minimal when compared against the magnitude of the overall problem. Training offered by the Trust include the following:

- Safe Use of Pesticides;
- Effective Spraying;
- Supervision of Spraying;
- Store Keeping;
- Transport of Pesticide; and
- Instructors Certificate in Safe Use.

Such courses are offered as a part of a diploma course or as a part of on-farm training programme. In both instances, however, it is targeted towards supervisors, and the number of people trained continues to be limited, and thus the outreach and multiplier effect from these training courses continues to be marginal when considered in context of the impact on a larger farming community.

In this context, while farmers associated with out grower schemes will continue to receive information and training about the use of hazardous material, the broader farming community is expected to lag behind in the absence of efforts to expanded training and awareness activities.

Taking into account the substantial shortcoming in the level of awareness among farmers on proper pesticide and equipment use, strengthening and expanding existing training and awareness raising activities will be paramount for the successful introduction of IPM practices among small holder farmers.

In general, the legal and regulatory framework required for IPM is provided for under the Environmental Protection Act. Basic guidelines for implementation of regulations is offered by ECZ, corresponding training is made available through the ZEGA Training trust, and basic research is conducted by a number of government organizations. With this said, however, the lack of enforcement capability, low level of awareness and outreach, the absence of a monitoring system, the high cost of compliance, particularly for smallholder farmers, and the limited reach and coverage of existing training activities warrants a number of technical assistance interventions.

In this context, expanding training activities to cover:

- Non-student on/off farm IPM training;
- Non-student on/off farm scouting training;
- Non-horticultural IPM and scout training;
- Training of extension workers with comprehensive knowledge of IPM methods;
- Research and field testing the commercial viability of a cooperative smallholder farm insectary using locally available resource; and
- Pilots research to develop commercially viable insectaries to help introduce biological control strategies among large commercial and export oriented farmers.
IV

Policy, regulatory framework and institutional capacity and policies on plant protection

A. Government’s policies relevant to agricultural pest management and pesticides

In 1985, the Government of Zambia adopted the National Conservation Strategy (NSC) as a principal policy document for conservation and management of natural resources. This strategy was instrumental in developing the Environmental Protection and Pollution Control Act (Act No. 12), which was adopted in June 1990. In parallel, the Act also established the Environmental Council of Zambia (ECZ) as a principal policy document for statutory body, to implement the Act (refer to Annex 7 for a copy of the Environmental Protection Act). The Act provides the following provisions (Table 8).

| Issues Addressed Under the Environmental Protection and Pollution Control Act |
|-----------------------------|------------------|
| Issues                      | Sections         |
| Registration                | Part II/Registration Form PTS 1 |
| Labeling                    | Part III/Pictogram (Fifth schedule) |
| Handling                    | Part IV |
| Storage/Disposal            | Part V/Sixth Schedule/Regulation 11 |
| Transport                   | Third and fourth schedule |
| Protective clothing         | Eight schedule |

Similarly, the ECZ has issued the Pesticide and Toxic Substances General Handling Guidelines (refer to Annex 8 for the ECZ guidelines), which addresses general implementation issues associated with the Act. The guideline covers the following areas:

- Importation;
- Distribution;
- Storage;
- Pest control/fumigation;
- Storage and disposal;
- Protective clothing and equipment; and
- Transportation.

The Act and ECZ Guideline, supported by the Plant Pests and Disease Act (Chapter 233 of the Law of Zambia) are the three principal government documents that bind the behaviour of the agricultural sector, particularly as it relates to pesticides and the use of toxic substances. In addition, the ZEGA Code of Conduct offers a framework for self-regulating activities related to pesticide

*The Act covers issues relevant to eradication and prevention of the spread of pests: control of the importation of growing media, injurious organisms, invertebrates and plants; and special provisions relating to cured tobacco.
use and handling, specifically targeted toward export oriented farmers.

While national legislation is not much different from international standards and norms, the Government is grossly lacking in the implementation, enforcement and monitoring of its regulations. These issues are the domain of the ECZ, which admittedly continues to be understaffed, under-funded and lack the capacity to implement its own agenda. As a result, the issue of realizing the implementation, enforcement and monitoring of its regulations. These issues are the domain of the ECZ, which admittedly continues to be understaffed, under-funded and lack the capacity to implement its own agenda. As a result, the issue of realizing the integration of IPM practices in Zambia have little to do with prevailing policies, and more to do with the ability of the government to implement and monitor existing laws and regulations.

With this said, however, one area that requires further investigation is whether the implementation of policies by ECZ is consistent with IPM approaches. For example, the ECZ assesses a levy ranging from $400 - $1,000 for importing a pesticide. This levy is not a function of volume of importation. Consequently, even samples brought into the country are assessed the levy. And as a result, the levy places a heavy burden on testing and introducing new, less lethal 'soft' pesticides being prescribed by EUREP GAP and other international organizations.

Similarly, increasing reliance on biological control agents will require the introduction of new pesticides where a better balance between the use of biological control agents and pesticides to achieve IPM objectives. But the levy is already creating a bottleneck for companies and individuals who need to access pesticide samples, but are discouraged from exploring IPM options by the excessive levy. In this context, rather than promoting certain types of IPM compatible products, current legislation towards import of agro-chemicals does the exact opposite and discourages farmers from testing IPM compatible products.

Currently, there are no known direct or indirect subsidies for pesticide use with the exception that foreign investors enjoy tax free provisions for importing selected inputs, including fertilizers and chemicals.

In the cotton sector, for example, chemical companies have been known to distribute a complete packet containing an entire cocktail of seeds and agro-chemicals to grow one hectare of cotton. These are principally promotional events and occur on an irregular basis, and as a result it would be safe to say that there is very little, if any market distortion taking place from donated pesticides or other similar activities.

B. Assessment of the country’s regulatory framework for control of the distribution and use of pesticides

Part II of the Environmental Protection and Pollution Control Act specifically addresses issue related to:

- application for registration of pesticide;
- certificate of registration;
- import of experimental pesticide and toxic substances; and
- transportation of pesticides and toxic substances.

These provisions are accompanied by application forms that include:

- Application for registration of pesticide or toxic substances
- Certificate of Registration
- Use Only for Experimentation
- Authority to Import Experimental Pesticides or Toxic Substances
- Notice of Import of Experimental Pesticides or Toxic Substance
- Notice of Possession of Expired Pesticides or Toxic Substances
- Transporting Pesticides or Toxic Substances

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Generally, restrictions on sales and distribution of hazardous pesticides is regulated against a negative list of banned pesticides. Toxicological ratings used in Zambia, particularly among exporters, rely strictly on WHO standards (refer to Annex 9 for a list of products used in Zambia and their toxicology rating).

At the same time, however, only mechanism in place that restrict the distribution of hazardous pesticides falls under the labeling and transport standards. Specifically, labeling is dictated by pesticide toxicity levels which are identifiable according to symbols, color codes and international recognized pictograms. Examples from the Act are provided below (Tables 9 and 10).

<table>
<thead>
<tr>
<th>Signs Used to Represent Toxicity</th>
<th>Symbol</th>
<th>Lettering</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable liquids</td>
<td>Black</td>
<td>Black</td>
<td>Red</td>
</tr>
<tr>
<td>Flammable gases</td>
<td>Black</td>
<td>Black</td>
<td>Red</td>
</tr>
<tr>
<td>Flammable solid</td>
<td>Black</td>
<td>Black</td>
<td>Red</td>
</tr>
<tr>
<td>Corrosive substances</td>
<td>Black</td>
<td>White</td>
<td>White upper half black lower half</td>
</tr>
<tr>
<td>Corrosive substances</td>
<td>Black</td>
<td>Black</td>
<td>White upper half black lower half</td>
</tr>
<tr>
<td>Toxic gases</td>
<td>Black</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Organic peroxides</td>
<td>Black</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>Oxidizing substances</td>
<td>Black</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>Substances emitting</td>
<td>Black</td>
<td>Black</td>
<td>Blue flammable gases when in contact with water</td>
</tr>
<tr>
<td>Spontaneously</td>
<td>Black</td>
<td>Black</td>
<td>White upper half combustible red lower half white</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Labeling Pesticide Toxicity Levels</th>
<th>Color code</th>
<th>Warning</th>
<th>Additional</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Acute oral LD50</td>
<td>Red</td>
<td>Very dangerous poison</td>
<td>skull and cross bones</td>
</tr>
<tr>
<td>(ii) Acute dermal LD50</td>
<td>Red</td>
<td>Very dangerous poison</td>
<td>skull and cross bones up to 50 mg/kg</td>
</tr>
<tr>
<td>(iii) Acute inhalation LC50 50200mg/m³/4h</td>
<td>Red</td>
<td>Dangerous poison skull and cross bones up to 200mg/kg: skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(iv) Acute oral LD50 51-500mg/kg</td>
<td>Purple</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(v) Acute dermal LD50 201-2,000mg/kg</td>
<td>Purple</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(vi) Acute inhalation LD50 201-2000mg/m³/4h</td>
<td>purple</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(vii) Acute oral LD50 501-5,000mg/kg</td>
<td>Amber</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(viii) Acute dermal LD50 2,001mg/kg</td>
<td>Amber</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(ix) Acute inhalation LC50 2,001-20,000mg/m³/4h</td>
<td>Amber</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
</tbody>
</table>

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(x) Acute oral LD50 greater than 20,000mg/kg
(xi) Acute dermal LD50 greater than 20,000mg/kg
(xii) Acute inhalation LC50 greater than 20,000mg/m³
(xiii) Acute inhalation LC50 greater than 20,000mg/m³

Pesticides are expected to be classified according to color symbol and warning it carries:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Very dangerous poison</td>
</tr>
<tr>
<td>Purple</td>
<td>Dangerous poison</td>
</tr>
<tr>
<td>Amber</td>
<td>Poison</td>
</tr>
<tr>
<td>Green</td>
<td>Harmful</td>
</tr>
</tbody>
</table>

C. Institutional capacity for effective control of the distribution and use of pesticides

The implementation of the Act is the sole domain of the ECZ. The ECZ is made up of a council and a secretariat called the directorate. The Council is made up of 14 individuals representing stakeholders from various ministries, the private sector and NGOs and reports to the Ministry of Environment and Natural Resources. The Permanent Secretary of the Ministry of Environment and Natural Resources is a member of the Council.

The ECZ is divided into four division comprising the following:

- Pollution Control Division;
- Planning and Management Division;
- Legal and Administration Division; and
- The Ndola Office.

Each of the divisions are subdivided into various operating units. Within the Pollution Control Division, the Pesticide and Toxic Unit is responsible for the implementation of the Act.

By all accounts, the ECZ and more specifically, the Pesticide and Toxic Unit lack the capacity and the know-how to implement the Act. This problem revolves around the lack of manpower as well as training to enforce and monitor provisions of the Act. In this context, technical assistance is required to build up the capacity of the Unit to help the implementation of the Act improve compliance and integration of IPM methods.

Agricultural chemicals utilized in the country are principally imported and sold by agents. Formal and informal subagents distribute small quantities to farmers. To help reduce incidences of pesticide poisoning and to improve pesticide handling, the ECZ is working to legally bind chemical companies to provide training to their distributors and agents. Currently, no such training is required nor offered by chemical companies. While regulations to engage chemical companies to provide training to distributors and agents is a positive step forward, without additional resources and training, ECZ will continue to lack capacity to enforce and monitor such a regulation.
Implementing an Integrated Pest Management Plan: Strengthening National Capacities

A wide range of institutions, organizations, corporate and individual efforts to introduce IPM in Zambia is already beginning to take root. At the same time, however, the effort continues to be ad hoc, and only limited coordination is taking place among various stakeholders in the farming community, and smallholder farms are generally excluded from most efforts to introduce IPM in Zambia.

With this said, however, existing national capacity show signs of having some basic elements to expand research, training, awareness, information dissemination, enforcement and commercial viable alternatives to pesticide use. In this context, strengthening and promoting IPM methods in Zambia should focus on taking advantage of existing institutions and infrastructure, while at the same time expanding outreach and multiplier effect to cover the needs of rural farmers.

It is envisaged that the following institutions, organizations and individuals take part in the capacity building process and to strengthen the existing IPM capacity of the country (Table 11).

<table>
<thead>
<tr>
<th>Organizations and Individuals</th>
<th>Function</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Council of Zambia</td>
<td>Legal and regulatory framework</td>
<td>Implement and monitor provisions under the Environmental Protection and Pollution Control Act</td>
</tr>
<tr>
<td>Mt. Makulu, University of Zambia, GART, others</td>
<td>Basic field research, Testing and analytical services, Village level IPM solutions</td>
<td>Build up capability to respond to research requests from industry, Improve the quality of testing and analytical services offered to the private sector, Develop viable community-based insectary and biological response for rural farmers</td>
</tr>
<tr>
<td>ZEGA Training Trust, OPPAZ</td>
<td>Training-of-trainers, IPM training material</td>
<td>Expand training-of-trainer activities, Expand scope of training material to cover IPM and new scouting methods</td>
</tr>
<tr>
<td>Suzanne Neave*</td>
<td>Pilot Insectary, Commercially viable biological strategies</td>
<td>Develop a pilot insectary and demonstration site, Link the demonstration site with hands-</td>
</tr>
</tbody>
</table>

*Ms. Neaves is an entomologist trained in the U.K. and now living in Zambia with proven commercial success in integrating biological control agents as an IPM strategy in a number of African countries.
### Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

<table>
<thead>
<tr>
<th><strong>for IPM</strong></th>
<th><strong>on training programmes offered through the Training Trust</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>* Design demonstration activities around problems faced by local farmers</td>
<td>• Design demonstration activities around problems faced by local farmers</td>
</tr>
<tr>
<td>* In collaboration with the private sector, identify areas requiring basic research, and direct request for support through local universities and government research stations</td>
<td>• In collaboration with the private sector, identify areas requiring basic research, and direct request for support through local universities and government research stations</td>
</tr>
</tbody>
</table>

### ZNFU
- Information dissemination
- Awareness raising

### Mt. Makulu
- Organize field days, newsletters and awareness campaign

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As evident from the findings presented in the report, substantial gap exist between World Bank's Safeguard Policy on Pest Management OP 4.09 and IPM practices currently employed in Zambia. IPM activities already in place are ad hoc and require standardization. In addition, further application oriented research is required so that cost effective IPM options can be made available to smallholder farmers, particularly rural farmers currently not affiliated with large commercial farms and export oriented companies.

The proposed IPM activities are designed to build on existing institutions and take advantage of unique strengths and specialization available through government institutions, NGOs, companies and individuals currently engaged in IPM activities. In this context, support activities envisaged to strengthen the IPM capacity in Zambia will focus on the following issues:

1. **Institution capacity building**
   - a. Strengthen the capability of the Environmental Council of Zambia to implement and monitor provisions under the Environmental Protection and Pollution Control Act.
   - b. Expand the capability of the ZEGA Training Trust to increase the range of training-of-trainer activities as well as to increase the number of trainers and qualified graduates.

2. Expanding commercially viable IPM methods for employing non-chemical strategies

3. Increasing awareness raising and information dissemination activities regarding IPM targeted towards smallholder farmers, particularly in rural areas.

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second year when the programme enters the national rollout phase.

b. Expand the capability of the ZEGA Training Trust: current range of training-of-trainer activities, and the volume of trainers graduating through the system continues to be minimal. In this context, training activities as well as the number of qualified trainers must be increased. The following issues require further attention (refer to Annex 10 for a checklist of training activities required to meet EUREP GAP requirements).

- Develop and deliver curriculum that highlight use and benefits of biological control agents
- Introduce new training material on scouting methods which moves away from the current practice of emphasizing pests as detrimental to farming, and focus on greater distinction between detrimental and beneficial pests.
- Expand training in IPM and scouting techniques to cover non-horticultural crops.
- Expand training-of-trainer activities to strengthen training for extension workers.

c. Improve basic research capability of research institutions and government organizations, conducting research on IPM

- Improve the quality of testing and analytical services offered to the private sector.
- Formulate a partnership between local and foreign testing institutions to help strengthen research capability and credibility.
- Certify testing institutions for international accreditation.
- In coordination with the private sector and the pilot insectary, formulate a basic IPM field research agenda.
- Conduct field research and trials to formulate sustainable solutions to introduce village level insectary

2. Developing Commercial Viable Non-Chemical IPM Options

- Develop a demonstration insectary to simulate biological solutions to help reduce pesticide use. The initial demonstration phase will take 2 years or two growing seasons to collect necessary data on breeding requirements, market demand, as well as effectiveness of biological control agents to formulate a strategy for developing a commercially viable insectary. The demonstration plot would include:
  - 0.5 ha area with three 300 m² poly tunnel for insect breeding, with dam, building and nursery, office and storage
  - breed three key species of insects for an initial supply to cover 6 ha release per week
- Use the demonstration site for workshops, trials, extension feedback, and training:
  - Employ and train 5 - 6 local supervisors on set up and operation of an insectary. These supervisors are eventually expected to
become trainers/operators of a commercial insectary
- Conduct on-site training, workshops and trials
- Work closely with the private sector and research institutions to formulate a strategy to transform the demonstration site into commercially viable insectary providing natural enemy resources, as well as advisory and training services.
  - Work closely with 2 export oriented horticultural farms to demonstrate and collect relevant data during the first year of operation and to formulate a strategy to expand the programme into a commercially viable activity by year two
- In collaboration with the private sector and research institutions, formulate a pest management strategy which exploits and enhance the capacity of natural enemies to contain pest population.
  - During the course of developing and operating a demonstration plot, work closely with local research institutions and the private sector to identify and formulate 4 – 5 field research topics

3. Increasing Awareness and Information Dissemination
- Coordinate with ECZ and its action plan on hazardous chemical communication to help strengthen smallholder farmer awareness regarding health and safety issues associated with pesticide use.
- Expand and supplement existing awareness and information dissemination activities through ZNFU and government research stations to disseminate information from test trial and results of basic field research.
- Introduce pro-active community awareness programmes by taking road shows to rural areas to conduct mini-workshops and introduce community-based IPM solutions.

A. Sustainability

A major objective of the proposed IPM plan is to ensure commercial sustainability and the integration of affordable IPM methods into local farming practices, particularly smallholder farmers in Zambia. In this context, the delivery of services, whether training, testing, analysis, or the development of an insectary will be executed on a commercial basis. As the proposed programme is expected to strengthen as well as develop new out grower schemes, particularly in export oriented agriculture and agro-processing, medium and large commercial operations are expected to play a seminal role in the programme's success. In this context, medium and large commercial operations as intermediaries between export markets and smallholder farmers will be required to carry a bulk of the costs associated with integrating IPM methods into the farming practices of its out growers.

At the same time, however, sustainable village level options and solutions will need to be incorporated into the programme through field tests and trials so that farmers not directly involved in out grower schemes begin to observe and practice prescribed IPM methods. For example, training offered by the ZEGA Training Trust continues to subsidize students by raising funds through commercial activities implemented by the Trust such as sells of horticultural products and flowers to commercial processors, membership fees, consulting and advisory services. Thus, it will be critical to ensure that the proposed IPM activities help to stimulate demand for ZEGA services so that the Training Trust can continue to offer subsidized training to students and in turn increase the population of adequately trained IPM practitioners in Zambia.
It should be noted that the development of a demonstration insectary will be operated for at least 2 years to help ensure that adequate data collection and development of markets for biological control agents are in place before full commercialization is realized. During the demonstration phase, the insectary is expected to generate revenue through commercial sells of biological control agents, training, and advisory services as a means of supplementing the initial technical assistance funding required to set up a pilot programme.

B. Monitoring and Evaluation

Regular monitoring and evaluation will be required not only to ensure successful implementation of the proposed IPM activities, but should there be a need for mid-term corrections, ample opportunities are available to make adjustments in the IPM strategy. The principal focus of the IPM monitoring and evaluation will revolve around the coordination of activities undertaken by key stakeholders, improvements in local capacity to deliver and support IPM methods, the level of increased awareness and integration of IPM practices by both smallholder farmers and farmers affiliated with out grower schemes. And finally, to monitor the impact that IPM activities have on improving the livelihood of farmers, both in the context of financial as well as improvement in quality of life as a result of the reduction in exposure to chemicals.

In this context, activities which will require regular monitoring and evaluation during the course of the programme implementation include the following:

- Enforcement capability of ECZ and its impact on compliance, particularly as it relates to the use of hazardous chemicals;
- Number of new training modules produced and delivered to trainers and students in the area of IPM;
- Number of farmers who received training and adopted IPM practices;
- Impact on farmer yield rates as a result of adopting IPM practices;
- Customer satisfaction survey of private sector clients who use analysis and research services offered by local institutions;
- Number of research and analysis test executed by local institutions based on demand from the private sector;
- Successful adoption and commercial application of research and test results;
- Customer satisfaction survey of local farmers who utilize the services of the proposed insectary to access biological control agents, and advisory services;
- An evaluation of the supply-demand balance between insect breeding capability and market demand for biological control agents;
- Evaluate the commercial viability of expanding an insectary to service both Zambian and regional market demand;
- Monitor the impact of farmer awareness campaigns, particularly in rural areas, by benchmarking the integration of IPM methods in the day-to-day operation by farmers before and after the awareness campaign; and
- Monitor the impact of introducing community-based IPM solutions.

C. Monitoring and Supervision Plan

During the first 1.5 months of the project inception period, an IPM specialist will design a relevant evaluation and monitoring mechanisms as describe in the IPM plan. Following the approval of an evaluation and monitoring mechanism, services of local experts will be utilized to conduct the evaluation and monitoring every 4 months during the first year of the project. The data collected from this exercise will be analyzed by the IPM specialist to consider whether interventions are required to ensure that the programme is meeting its IPM targets and objectives. The IPM specialist is expected to advise the overall programme coordinator.
regarding the outcome of the evaluation and monitoring activity, and whenever necessary recommend interventions to ensure that IPM targets and objectives are met. In some instances, criteria used for the evaluation and monitoring may required adjusting to reflect conditions faced during the implementation phase.

From the second year onward, the evaluation and monitoring activities will be conducted twice per year with regular reporting to the overall programme coordinator.

D. Cost Estimates

The proposed budget is for a period of two years (Table 12). Prior to the end of the second year, an evaluation will be required to determine whether funding allocated for the proposed IPM support activities have met targets and objectives defined in the evaluation document. In addition, to accommodate new issues that might arise, particularly following the compliance requirement for EUREP GAP in 2005, another budget will need to be formulated to address prevailing IPM issues at that time.

**Estimated Budget for the First 2 Years of Programme Implementation**

<table>
<thead>
<tr>
<th>Field of Activity</th>
<th>Estimated Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Institution Capacity Building</strong></td>
<td></td>
</tr>
<tr>
<td>a. Design of a capacity building programme for ECZ*</td>
<td>$5,000</td>
</tr>
<tr>
<td>b. Expand capability of the ZEGA Training Trust</td>
<td>$100,000</td>
</tr>
<tr>
<td>c. Improve basic research capability</td>
<td>$100,000</td>
</tr>
<tr>
<td><strong>2. Develop non-chemical IPM Options</strong></td>
<td></td>
</tr>
<tr>
<td>a. Technical assistance to design and operate a pilot insectary, and to provide training and advisory services</td>
<td>$108,000</td>
</tr>
<tr>
<td>b. Develop and operationalize a pilot insectary</td>
<td>$126,000</td>
</tr>
<tr>
<td><strong>3. Awareness and information dissemination</strong></td>
<td>$75,000</td>
</tr>
<tr>
<td><strong>4. Monitoring and evaluation</strong></td>
<td>$50,000</td>
</tr>
<tr>
<td><strong>TOTAL Estimated Cost</strong></td>
<td><strong>$564,000</strong></td>
</tr>
</tbody>
</table>

* additional funds will be required to implement the design
# Annex 1

## Complete List of Pest List and Management Techniques

<table>
<thead>
<tr>
<th>Pest</th>
<th>Crop</th>
<th>Control</th>
<th>Biological</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>African army worm</td>
<td>maize, sorghum, rice, finger millet, millet, wheat, sugarcane</td>
<td>Bacillus thuringiensis</td>
<td>Endosulphan (1 litre/ha), Carbaryl (310g/ha), Cypermethrin (150 ml/ha)</td>
<td></td>
</tr>
<tr>
<td>Sweet potato moth</td>
<td>sweet potato</td>
<td>Handpicking, telenomus australicum</td>
<td>Kialux (2ml/litre of water), cyrx (1.5 ml/litre of water)</td>
<td></td>
</tr>
<tr>
<td>Cut worm</td>
<td>Maize, vegetable crops, rice, soybean, coffee, sorghum, potatoes</td>
<td>Plough</td>
<td>Dipterex, thiodan, carbaryl, chlorpyrifos, trichlorphon</td>
<td></td>
</tr>
<tr>
<td>Bollworm</td>
<td>Sorghum, cotton, beans, maize, pearl millet, tomato, pigeon pea</td>
<td>Handpicking, crop rotation</td>
<td>Endosulphan EC (2 litre/ha), deltamethrin EC (250 ml/ha), methomyl SP (200g/ha), tralomethrin EC (200ml/ha)</td>
<td></td>
</tr>
<tr>
<td>Maize-stalk borer</td>
<td>Maize, sorghum</td>
<td>Napier grass, sudan grass, molasses grass, silver leaf, crop rotation with legumes</td>
<td>Carosulfan (50ml/100 m row), endosulfan (650 ml/ha), carbaryl, phoskill (2 ml/litre of water), deltamethrin EC (2.5 ml/100m row)</td>
<td></td>
</tr>
<tr>
<td>African pink stem-borer</td>
<td>Maize, sorghum, rice, sugarcane</td>
<td>Weeding, crop hygiene</td>
<td>Endosulphan, carbaryl, phoskill</td>
<td></td>
</tr>
<tr>
<td>Spotted stem-borer</td>
<td>Maize, sorghum, rice pearl millet</td>
<td>Remove graminaceous weeds, cotesia flavipes</td>
<td>Deltamethrin EC (2.5 ml/100m row), phoskill (2ml/litre of water), endosulphan, carbaryl</td>
<td></td>
</tr>
<tr>
<td>Cotton spiny bollworm</td>
<td>Cotton</td>
<td>Plough</td>
<td>Carbaryl, triazophos, cyrx, kialux, fenkill, doom, cypermethrin</td>
<td></td>
</tr>
<tr>
<td>Coffee stinging caterpillar</td>
<td>Coffee, tea</td>
<td>Plough, “closed season”</td>
<td>Folidol, dipterex, malathion, thiodan</td>
<td></td>
</tr>
<tr>
<td>Pink bollworm</td>
<td>Cotton</td>
<td>Plough</td>
<td>Triazophos, carbaryl, trichlorphon</td>
<td></td>
</tr>
<tr>
<td>Sunflower lopper caterpillar</td>
<td>Sunflower</td>
<td>Handpicking</td>
<td>Fastac</td>
<td></td>
</tr>
<tr>
<td>Cotton red bollworm</td>
<td>Cotton</td>
<td>Plough</td>
<td>Carbaryl, cypermethrin, endosulphan</td>
<td></td>
</tr>
<tr>
<td>Coffee tailed caterpillar</td>
<td>Coffee</td>
<td>Regular survey</td>
<td>Endosulphan</td>
<td></td>
</tr>
<tr>
<td>Diamond back moth</td>
<td>Cabbage, rape, Chinese cabbage, cauliflower</td>
<td>Wasps, intercropping, bacillus thuringiensis, neem extracts</td>
<td>Chlorpyrifos EC (10 ml/100 litre of water), phoskill (10 ml/100 litre of water), deltamethrin EC (20 ml/100 litre of water), dichlorvos EC (100 ml/100 litre of water)</td>
<td></td>
</tr>
</tbody>
</table>

Fruit-piercing: Citrus, mango, Contact insecticide
<table>
<thead>
<tr>
<th>Pest</th>
<th>Plant Affected</th>
<th>Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coffee berry moth</strong></td>
<td><strong>Coffee</strong></td>
<td>Fenitrothion, fenthion</td>
</tr>
<tr>
<td>Orange dog</td>
<td>Citrus</td>
<td>Hand picking, predatory parasites, Foliar spray of fenitrothion, azodrin 40% EC (100ml/100 litre of water)</td>
</tr>
<tr>
<td>False codling moth</td>
<td>Mango, cotton, citrus</td>
<td>Hygiene and sanitation, Cyrux (1.5 ml/litre of water), kinalux, azophos - methyl WP, carbaryl, deltamethrin, methidathion, fenilidol dust</td>
</tr>
<tr>
<td>Coffee hawk moth</td>
<td>Coffee</td>
<td>Hand picking, Fenilidol dust</td>
</tr>
<tr>
<td>Pot moth</td>
<td>Cowpea, beans</td>
<td>Inter-cropping with sorghum and maize, Endosulfan, fastac</td>
</tr>
<tr>
<td>Groundnuts caterpillars</td>
<td>Groundnuts, soybeans, pigeon peas</td>
<td>Inter-cropping with millet, sorghum, Phoskill</td>
</tr>
<tr>
<td>Citrus leaf miner</td>
<td>Citrus</td>
<td>Collect fallen leaves, bacillus thuringiensis, buprofezin, pyriproxyfen, Monocrotophos</td>
</tr>
<tr>
<td>Coffee leaf miner</td>
<td>Coffee</td>
<td>Mites, thrips, Foliar spray of fenitrothion (0.1% ai, 140ml/100 trees), fenitrothion, cypermethrin (10-20g/ha)</td>
</tr>
<tr>
<td>Fat john</td>
<td>Maize</td>
<td>Rotation farming, Carbosuran, phoskill</td>
</tr>
<tr>
<td>Tomato moth</td>
<td>Tomato</td>
<td>Rotation farming, Dichlorvos, carbaryl, cypermethrin, malathion, cyrux</td>
</tr>
<tr>
<td>Black maize beetle</td>
<td>Maize, rice, wheat</td>
<td>Permethrin, chlopyrifos (1ml/ha), carbofuran</td>
</tr>
<tr>
<td>Blister beetle</td>
<td>Beans, cotton, okra, sweet potato</td>
<td>Hand picking, blue container with detergent, Carbaryl, fenithion</td>
</tr>
<tr>
<td>Epilachna beetle</td>
<td>Cotton, tomato, maize, sorghum, soy beans, rice, wheat</td>
<td>Plough, Carbaryl, malathion, phoskill, thioctil, chlorban</td>
</tr>
<tr>
<td>Cabbage flea beetle</td>
<td>Cabbage</td>
<td>Keep down weeds, Phoskil</td>
</tr>
<tr>
<td>White coffee borer</td>
<td>Coffee</td>
<td>Uproot and burn affected bushes, Paint trunk with insecticide, carbofuran</td>
</tr>
<tr>
<td>Dusty brown coffee beetle</td>
<td>Coffee</td>
<td>Endosulphan dust, malathion</td>
</tr>
<tr>
<td>Mango weevil</td>
<td>Mango</td>
<td>Collect fallen fruit</td>
</tr>
<tr>
<td>Shiny cereal weevil</td>
<td>Maize, barley, wheat, coffee, tea</td>
<td>Crop rotation, early planting, Application of fertilizer in marginal soil</td>
</tr>
<tr>
<td>Sweet potato weevil</td>
<td>Sweet potato, maize, coffee, cowpea, sesam</td>
<td>Burn infested crop, early planting, crop rotation, mulching, sanitation, carbofuran, cypermethrin, permethrin</td>
</tr>
<tr>
<td>Mango black borer</td>
<td>Mango</td>
<td>Hygiene, scrap off infested stem parts, Chloropyrifos 48EC, cypermethrin 25%EC</td>
</tr>
<tr>
<td>Brown leaf beetle</td>
<td>Sesame, soy beans, cow pea, groundnuts, beans, coffee, cocoa, cotton</td>
<td>Crop rotation with legumes, burning, early planting, intercropping, Foliar spray of cypermethrin (10-20g/ha), thioctil, carbaryl, permethrin</td>
</tr>
<tr>
<td>Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Weeding</strong></td>
<td><strong>Maize tassel beetle</strong></td>
<td><strong>Groundnut hopper</strong></td>
</tr>
<tr>
<td></td>
<td>Maize, cassava</td>
<td>Groundnut, beans, sunflower, citrus, okra, cashew</td>
</tr>
<tr>
<td><strong>Lygus</strong></td>
<td>Sunflower</td>
<td>Hand picking</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fastac</td>
</tr>
<tr>
<td><strong>White fly</strong></td>
<td>Cotton, tomato, cassava, sweet potato, cabbage</td>
<td>Hygiene, weed control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phoskill (2ml/litre of water), chlorpyrifos (15-20ml/5 litre of water), cypermethrin EC (1ml/1 litre of water), deltamethrin (10ml/1 litre of water)</td>
</tr>
<tr>
<td><strong>Green stinkbug</strong></td>
<td>Cotton, vegetable crops, tomato, citrus, sweet potato</td>
<td>Early planting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbaryl</td>
</tr>
<tr>
<td><strong>Bagrada bugs</strong></td>
<td>Cabbage, rape, cleome</td>
<td>Regular irrigation, burn cruciferous weeds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carbaryl (1kg a.i./ha), karate, fastac (1ml/litre of water)</td>
</tr>
<tr>
<td><strong>Coreid bug</strong></td>
<td>Cowpea</td>
<td>Diazonon, fenitrothion, cypermethrin</td>
</tr>
<tr>
<td><strong>Coffee antestia bug</strong></td>
<td>Coffee</td>
<td>Pruning, Foliol dust, deltamethrin (315-440ml/ha), thioikill, endosulfan, fenitrothion</td>
</tr>
<tr>
<td><strong>Blue bug</strong></td>
<td>Cassava, cotton, sorghum, castor oil</td>
<td>Hand picking, remove trash from threshing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fenkill, cypermethrin</td>
</tr>
<tr>
<td><strong>Mealy bug</strong></td>
<td>Coffee</td>
<td>Strip unwanted sucker growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Band stump of tree with parathion-diazinon, thioikill</td>
</tr>
<tr>
<td><strong>Citrus mealy bug</strong></td>
<td>Citrus</td>
<td>Fungal diseases</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phoskill, thioikill, methidalthion, diofenolan, petroleum oils</td>
</tr>
<tr>
<td><strong>Tomato aphids</strong></td>
<td>Tomato, potato</td>
<td>Early planting, avoid moisture stress, neem extract</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fastac, karate (1ml/litre of water), carbaryl, carbamates, phrethroids, mineral oils</td>
</tr>
<tr>
<td><strong>Aphids</strong></td>
<td>Beans, soy beans</td>
<td>Cultural control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimethoate (75ml/100 litre of water), mercaptiothion (250g/100 litre of water), gamma – BHC EC (300ml/100 litre of water)</td>
</tr>
<tr>
<td><strong>Aphids (fitch)</strong></td>
<td>Maize, sorghum, rice, wheat</td>
<td>Burn crop residue, early planting, hover fly, lady bird beetle</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Organophosphates, demeton-S-methyl (500ml/ha), mercaptiothion (10 – 15kg/ha)</td>
</tr>
<tr>
<td><strong>Aphids (kaltenbach)</strong></td>
<td>Cucumber</td>
<td>Burn debri, crop rotation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimethoate EC (75 ml/100 litre of water), fenthion (100ml/100 litre of water), mercaptiothion WP (250g/100 litre of water)</td>
</tr>
<tr>
<td><strong>Aphids (glover)</strong></td>
<td>Cotton, citrus, pumpkins, watermelon, cucumber</td>
<td>Early sowing, early weeding</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demeton-S-methyl (500ml/ha), mercaptiothion (10-15kg/ha), dimethoate (800ml/ha), piricarb WG</td>
</tr>
<tr>
<td><strong>Aphids (koch)</strong></td>
<td>Groundnuts</td>
<td>Close spacing, cultural control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Demeton-S-methyl (500ml/ha) piricarb WG 250g/ha applied in 400ml of water</td>
</tr>
<tr>
<td><strong>Cassava mealy bug</strong></td>
<td>Cassava, sweet potato</td>
<td>Apoanagyrus lopesi, treat cutting with hot water (52°C for 10 min.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dimethoate (0.1%), mercaptiothion EC (10 litre/ha), chlorpyrifos (2 litre/ha)</td>
</tr>
<tr>
<td><strong>Aphids (brassica)</strong></td>
<td>Cabbage, Chinese cabbage, rape</td>
<td>Burn infested plants, crop rotation, mulching</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pyrethroids, organophosphates</td>
</tr>
<tr>
<td><strong>Aphids (coffee plant)</strong></td>
<td>Coffee, citrus</td>
<td>Dimethoate (80ml/100 litre of water), demeton-S-methyl (40ml/100 litre of water), chlorpyrifos EC (5ml/5 litre)</td>
</tr>
</tbody>
</table>

Global Development Solutions, I.L.C. 38
<p>| Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS) |
|---|---|---|---|
| Jassids | Cotton, groundnuts | Resistant cotton variety, early planting | Endosulphan, phoskill, thiochlor, chlorban, cabaryl |
| Cotton strainer | Cotton | Early planting, prevent fruiting | Phoskill (2 ml/litre of water), cypermethrin EC (1 ml/litre of water), nucor, chlorban, thiochlor, cabaryl |
| Chinese fluted red soft scale | Citrus, mango, mandarin | Methidathion with white oil |
| Citrus brown soft scale | Citrus | Methidathion (50 ml/100 litre of water), phoskill (2 ml/litre of water), diofenolan |
| Mango transplant scale | Mango | Prune infested leave | Diofenolan, methidathion, malathion |
| Citrus red scale | Citrus, roses, mango, guava, avocado, banana, okra, cotton, tea | Burn infested plant, aphyis, coperiella bifasciata | Dimethoate (100 ml/100 litre of water), phoskill (2 ml/litre of water), thiokill (1-1.5 ml/litre of water), methidathion, diofenolan, petroleum oils |
| Coffee white waxy scale | Coffee | Cut and leave on ground for parasites | Oleoparathion band applied to tree trunk, methidathion (150 ml/100 ml of water), carbaryl, dimethoate, malathion, methidathion |
| Cottony cushion scale | Citrus, roses | Rodolia cardinalis | Pyrethrin, buprofezin, methidathion, omethoate combined with 0.5% mineral oil |
| Bean stem maggot | Beans | Staggered planting | Endosulfan (50% 100 g/10 kg seed), endosulphan (100 g/100 ml of water - mix with 10 kg of seed) |
| Mango fruit fly | Mango | Protein bait spray (protein hydrolysate), sex attractants, burn infested fruits | Fenthion EC, dimethoate EC |
| Sorghum stem fly | Sorghum, pearl millet, wheat, maize | Adjust sowing date, high seeding rate, fly resistant cultivars | Carbofuran |
| Bean fly | Beans, cowpeas | Avoid overlapping crops, destroy crop residue, ridge crops, treat seeds with gaucho, crop rotation | Kinalux, fenthion |
| Citrus woolly white fly | Citrus | Hygiene, pick off infested leaves | Dimethoate (7.5 ml/10 litre of water) |
| Tomato leaf miner | Tomato | Burn seed and waste material | Abemectin, pyrethrum, permethrin (300 ml – 1,200 ml/ha), bifenthrin EC (300 ml/ha) |
| Bean seed fly | Beans, maize | Spray seed dressing with gamma-BHC DS (250 g/100 kg of seed), endosulphan, malathion, carbofuran, dimethoate |
| Onion thrips | Tomato, cotton, onion, potato | Early sowing, control weeds, plough, isolate new and old crop, matching | Fasta 1 ml/liter of water, imadocriopid, dimethoate |
| Groundnut | Groundnuts, beans | Early planting | Cypermethrine, triazophos |</p>
<table>
<thead>
<tr>
<th>Insect</th>
<th>Host</th>
<th>Damage</th>
<th>Control Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thrips</td>
<td>Peas</td>
<td>Cut infected branches</td>
<td>Fenitrothion</td>
</tr>
<tr>
<td>Coffee thrips</td>
<td>Coffee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thrips (giard)</td>
<td>Mango, avocado</td>
<td></td>
<td>Dimethoate, malathion, fenithrothion, methyl parathion</td>
</tr>
<tr>
<td>Grasshopper</td>
<td>Citrus, sunflower</td>
<td></td>
<td>Insecticide, poisonous bait</td>
</tr>
<tr>
<td>Amourrd cricket</td>
<td>Sorghum, maize, millet, wheat, soy bean, sun flowers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Termites</td>
<td>Maize, groundnuts, cassava</td>
<td></td>
<td>Permethrin, confidor, coopex TC</td>
</tr>
<tr>
<td>Harvest termite</td>
<td>Cotton</td>
<td>Crop rotation, weeding, organic fertilizers</td>
<td>Permethrin, confidor, coopex TC, permethrin</td>
</tr>
<tr>
<td>Citrus termite</td>
<td>Citrus</td>
<td>Weeding, organic fertilizers</td>
<td>Foliar spray of confidor, carbosulfan (10g/tree), coopex TC, permethrin</td>
</tr>
<tr>
<td>Carter termite</td>
<td>Fruit trees</td>
<td>Burnt brick and ash</td>
<td>Old engine oil and diesel flooding of trees</td>
</tr>
<tr>
<td>Cotton spider</td>
<td>Cotton, tomato</td>
<td>Weeding</td>
<td>Dicofol</td>
</tr>
<tr>
<td>Citrus gray</td>
<td>Citrus</td>
<td></td>
<td>Kelthane 50% EC (80-100ml/100 litre of water), chlorobenzilate (80-160ml/100 litre of water)</td>
</tr>
<tr>
<td>Citrus spider</td>
<td>Citrus</td>
<td>Crop irrigation</td>
<td>Foliar spray of acaricides petroleum oil, dicofol WP(200g/100 litre of water), amitraz EC(200ml/100 litre of water), tetradoxon EC (200ml/100 litre of water)</td>
</tr>
<tr>
<td>Red spider</td>
<td>Tomato, potato, eggplant, beans</td>
<td>Early planting, barrier crops like maize, matted grass</td>
<td>Dicofol, propargile, abamectin</td>
</tr>
<tr>
<td>Cassava green</td>
<td>Cassava</td>
<td>Early planting, resistant variety, typhlodromalus arigo de leon, sulphur</td>
<td>Tar, petroleum oils, dicofol, endosulfan, binapacryl</td>
</tr>
<tr>
<td>Citrus flat</td>
<td>Citrus</td>
<td>Kelthane 50%EC (100ml/100 litre of water)</td>
<td></td>
</tr>
<tr>
<td>Tomato rust</td>
<td>Tomato</td>
<td></td>
<td>Monocrotophos, dicofol, sulprofos</td>
</tr>
<tr>
<td>Citrus rust</td>
<td>Citrus</td>
<td>Fungus</td>
<td>Kelthane 50%EC (80 – 100ml/100 litre of water), zineb 75%WP (75g/100 litre of water)</td>
</tr>
</tbody>
</table>

Global Development Solutions, LLC
Rational use of pesticides

A written Policy Statement will state the intention to use pesticides rationally and will explain how the policy will be implemented.

Non-pesticide prevention and control measures
Produce supplied must be grown with the minimal number of pesticide sprays, and with the minimal amount of active ingredient needed to achieve an economic yield of the required retail quality standard. This means firstly making full use of non-pesticide measures for the control of pests, diseases and weeds, including the selection of resistant/tolerant varieties wherever possible, the use of beneficial insects and other organisms and the adoption of sound and sustainable rotations and sound cultural and hygiene practices. Applying Good Agricultural Practice where preceding crops are not being grown for exports will help to protect natural enemies and beneficial insects and reduce the need for pesticide intervention. Where rented land is to be used, it is important, wherever possible, to select fields which do not have inherent pest, disease or weed problems and forward planning and field inspection well beforehand will help to achieve this.

Justification for pesticide use
This must be based on crop monitoring.
Pesticides are permitted if non-chemical measures are inadequate for ensuring produce meets retail quality standards.

Pests, diseases and weeds must be closely and competently monitored to ensure pesticide treatment is applied to maximum effect with minimal dose. The use of satellite mapping and surveillance systems is encouraged where this will significantly help to achieve more rational decisions about the need for pesticide intervention.

Pesticide application should be in response to need only, based on risk assessment, including the use of treatment thresholds, guidelines and regular crop supervision.

Where appropriate, pest and disease prediction and warning systems which are practical and technically sound, should be used.

Need for use should be judged on information obtained from historical information, prediction and warning systems, crop monitoring and technically sound guidelines and thresholds.

Pesticide Selection
Pesticides allowed have been selected and included in a Crop Management Specifications, as being the most suitable for the purpose. They are environmentally safe when used responsibly and cause least harm to beneficial organisms.

Any pesticide which may significantly harm beneficial organisms or have a significant effect with regard to pollution, safety or wildlife if accidentally misused or mishandled, is only permitted for produce providing:

1) it is approved and suitable for the purpose.
2) it is the only practical way of ensuring the produce meets the required retail quality standards or it is significantly less hazardous to the Operator than alternatives.

Pesticide selection must be made following strategic advice by someone having BASIS qualifications registration, for the appropriate crop sector.

Pesticide selection must be from a designated Crop Management Specification, accepted as meeting international export requirements for the crop concerned. This specifies for each pest, disease or type of weed, the active ingredient and relevant products. It will provide appropriate information on the maximum application rate or dose, the maximum number of treatments allowed, the field of use and where appropriate, the latest time of use.

The Crop Management Specification is reviewed at least annually. However, if exceptional circumstances arise, it can be reviewed and if necessary modified to meet them.

Pesticides not listed in the Crop Management Specification may be allowed in exceptional circumstances. When this happens, justification must be fully documented and must fully meet international export requirements. Buyers must be notified and justification for use included.

Where cropping is under protection, disinfection of the cropping structure between cropping is permitted providing the products used are legally permitted for that purpose.

Where products which are hazardous to human operators or to the environment, are the only ones suitable for the purpose, producers should energetically seek and evaluate much less hazardous alternatives. A central objective should be to progressively eliminate the more hazardous pesticides whilst maintaining the highest retail quality standards.

Adjuvants can be incorporated providing their use enhances pesticidal activity and enables reduced rates of pesticide to be effective. Adjuvants selected must be legally permitted for the use required and their use must be in accordance with the conditions of use for the pesticide with which they are incorporated.

Pesticide selection, including that for use during propagation, must comply with the following conditions:

- Organisms and wildlife by using specifically
  - Targeted treatments whenever possible.
  - Minimise or eliminate the risk of contaminating surface and ground water.
  - Minimise the risk to operators and the public.
  - Eliminate or minimize
  - Minimize damage to beneficials

Timing and maximum application rate of chemicals must comply with the Crop Management Specification for the crop concerned. Lower rates are permitted and encouraged providing these will give the level of control needed without significantly increasing the risk of a resistance problem.
Pesticide application procedures
Operators must follow the guidelines contained in the MAFF Code of Practice for the Safe Use of Pesticides on Farms and Holdings, the 'Green' code.

Treatment is only to be made by operators (including contractors) who have the appropriate NPTC Certificates of Competence or their equivalents elsewhere. Exemption on age grounds is not permitted.

The method of application chosen should limit the environmental impact of pesticide usage. For instance, wherever possible approved seed treatments, module drenches directed or spot applications and guarded sprayers should be used in preference to overall field treatments. The rate used should be the minimum needed to provide adequate control. The application techniques must be appropriate for ensuring effective treatment at optimal rates and with minimal risk of drift.

Established weeds on non-crop areas (e.g. around glasshouses) and on seed beds where necessary, may be controlled by the use of contact or trans-located herbicides (toxic and residual herbicides must be avoided) treatments or cultivations.

Pesticides should not be applied to field margins and wildlife corridors.
A local environmental risk assessment (LERAPS) must be carried out before applying pesticides.
This assessment must be documented, and buffer zones for all pesticides should be complied with.

Instructions to Operators
Those responsible for issuing instructions to apply pesticide should be able to demonstrate their competence to do so.

Written instructions must be issued unless the person determining the need for pesticide use also undertakes its application.

Written instructions issued for applying pesticide must stipulate crop location, area to treat, rate of application, products, tank mixes, volume of water and the purpose for application. Any special precautions should be noted and the instructions must be signed, dated and a copy kept.

Confirmation of Treatment
The Manager must receive written confirmation of treatments applied by the operator. These documents should be signed and the date, time, applicator, weather conditions, as well as the details in the instructions above, should be recorded.

Record Keeping
Detailed records of pesticide application to each area treated must be kept by growers. These will include specifying for each crop area the harvest intervals and first permissible harvest date, the product used, its method rate and date of application and the reason for use. There must be a reliable and verifiable system for ensuring compliance with harvest intervals and for ensuring that produce supplied is either free from pesticide residues or does not exceed the maximum residue level (MRL) allowed. Harvest intervals must be recorded on the record sheets, and the first permissible harvest date calculated. These dates must be conveyed to the harvesting manager, and where appropriate a physical marking system used in the crop, or a large farm board, indicating when crops can be harvested.

If more than one crop, or more than one variety with different maturity dates is cropped in the same area, harvest dates should reflect each crop/variety.
Crop Record Sheets

Information from the instruction sheets should be summarised by crop. Records must include crop, harvest dates, application dates, location, product, harvest interval rate, volume, target, equipment operator and weather conditions.

Control of Vertebrate Pests (birds, rats, mice, rabbits etc) in the field

Regular monitoring of vertebrate pests, using authorised traps eg. fencing, scarers where appropriate, is essential to avoid the routine need for prophylactic treatment with chemicals.

At the first sign of vertebrate pests action must be taken to disrupt feeding patterns to allow non-chemical methods of control to be deployed. For example, visual/audible scarers for birds, cage trapping for rabbits, and fencing for badgers, deer and rabbits.

Only where non-chemical methods have proved inadequate should chemical treatments be considered. Such treatments should be restricted to the gassing of rabbits and the use of rodenticides for the control of rats and mice.

The chemicals used for the control of rabbits, rats and mice are very dangerous to other forms of wildlife, the public and employees. Their use must be restricted to qualified operators only.

Application must only be made in ways which avoid all risk to non-target species including pets and humans as defined in label recommendations.

Dispensing and mixing of pesticides

Facilities for dispensing of pesticide and preparation of spray liquid must have adequate health and safety provision and be located and designed to minimise pollution risk.

Equipment for measuring out pesticides must be suitable for the quantity to be measured.

Calibration of weighing equipment, to the appropriate accuracy, must be carried out and documented.

Equipment for measuring out pesticides should be cleaned after use. Heavy deposits of concentrated pesticide on measuring equipment is not permitted.

Direct transfer systems must be used where the label states a requirement.

Pesticide Disposal

Waste concentrated pesticides must be disposed of in compliance with current legislative requirements and comply with requirements specified in the MAFF Code of Practice for the Safe Use of Pesticides on Farms and Holdings. ‘Green’ code. Concentrate should be disposed of by:

a) returning to the supplier/manufacturer, or

b) engaging a suitably licensed specialist waste disposal contractor.

No other means of disposal shall be permitted

Disposal of dilute pesticide surplus should not normally arise. Where it is necessary, eg. post harvest solutions the dilute pesticide should be disposed of in accordance with the Groundwater Directive 1999. This permits:

a) By application to an area and in a manner which complies with the requirements stipulated in the Groundwater Directive 1999.

b) As for washings (see below).

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Disposal of tank and equipment washings

All equipment has to be rinsed and this will create contaminated water which must be disposed of in a manner which complies with the Groundwater Directive 1999. This permits:

a) Stored in a labeled container to be collected by a suitably licensed waste disposal contractor.

b) Disposed of by use of a suitably designed surface disposal system which complies with the Groundwater Directive 1999.

c) Sprayed onto an identified area of uncropped land which complies with the Groundwater Directive 1999.

d) Using an approved liquid waste treatment plant.

e) Sprayed onto the treated crop provided this will not result in breaking the label recommendation eg the maximum permitted dose for the product being exceeded, or the maximum number of treatments.

f) Sprayed on to an area of untreated crop, often the cropped headlands.

Empty pesticide containers must not be re-used (unless specified for the purpose) and must either be at least triple rinsed prior to disposal or be rinsed using a purpose designed system. Exceptions are those having contained:-

* cyanide gassing powders
* aluminium phosphide
* magnesium phosphide
* zinc phosphide

Containers need to be:-

a) crushed or punctured.

b) stored in a secure compound pending disposal by a suitably licensed waste contractor.

c) burnt in a manner which meets local authority requirements and complies with the Codes of Good Agricultural Practice for the Protection of Air.

d) cleaned and crushed and disposed of at a waste disposal site registered for that purpose.

Contaminated clothing, soil, sand, pest traps or packaging should be disposed of in a similar manner as follows.

Pesticide storage

Pesticides must be stored in a manner which meets appropriate Health and Safety Executive requirements. The storage unit must:-
a) be sound secure, provide protection from frost; have adequate ventilation and be able to retain all spillages to a volume of 110% of the total quantity of product likely to be stored (in some cases this will be 185% if you are in an 'environmentally sensitive area').

b) be designed to enable comfortable access and provide sturdy, non-absorbent shelving suitable for the purpose

c) have within 10 metres an easily accessible water source to deal with accidental splash or spillage of pesticide on persons

d) have a sign outside indicating that pesticides are present.

e) have a means of containing a small accidental spillage.

f) have suitable lighting to enable the operator to read the labels.

g) have access restricted to those staff who are competent in handling pesticides.

h) only contain pesticides, the storage of non-pesticide items is not encouraged.

i) have only approved pesticides stored within it.

j) have powders stored above liquids, only when there is not a health and safety risk to the employee retrieving heavy bags from higher shelves.

A detailed list of the contents of the store should be kept at a separate site for information in the event of a fire or of theft.

Stocks of pesticide should be rotated to ensure that stocked pesticides are used up before re-ordering. Where pesticides are transported around the farm to individual mixing stations, the concentrates must be transported in an appropriate vehicle/trailer. This should be marked with an appropriate warning sign and secure.

Temporary storage of pesticides at individual mixing stations must be marked with an appropriate warning sign, be bunded and secure. All concentrates must be returned to the pesticide store at the end of each day.

Storage of Personal Protective Equipment
Personal Protective clothing must be stored separately from concentrated pesticides. Two separate cupboards should be used, one for storing used personal protective clothing. This cupboard needs to be well ventilated. The second cupboard, separate from the first, should be used for the spray operators clothing, and new unused personal protective clothing.
Storage and maintenance of Pesticide Application Equipment
Storage should be in a well ventilated secure unit. The equipment must not be close to non-pesticide items, and must not be stored alongside concentrate pesticides.
Application equipment needs to be kept well maintained and accurately calibrated. There must therefore be a maintenance and calibration schedule and designated responsibility for its implementation.

Rational use of fertilisers and manures
A written policy statement will state a commitment to achieve rational use of fertilisers and manures and will indicate how this will be achieved.

General Principles
Use of fertilisers and manures must be in accordance with the MAFF, and Code of Good Agricultural Practice (hereafter referred to as COGAP).

Fertiliser application to field grown crops should aim to maintain soil fertility at recommended levels and ensure minimal environmental effects consistent with the production of high quality produce.

Fertiliser and manure application must be based on sound principles. Soil analysis should be used to provide a meaningful indication of soil nutrient status, particularly for pH, phosphate, potassium and magnesium and the application method must be appropriate for that need.
Recommendations for fertiliser applications should be made only by those with an appropriate qualification to do so, e.g. FACTS Registration and for soil grown crops they should be based upon recent soil analyses and cropping history.

Nutrients being provided in liquid form to hydroponically grown crops or in fertigation must be regularly and accurately monitored.

The use of human sewage, treated or untreated is not permitted within 3 years of the cropping cycle.

There must not be applications to conservation areas, wildlife corridors or watercourses and the application method must be appropriate for that need.

Nitrogen application to soil grown crops
Rate and timing must aim to match optimal need whilst minimising the risk of leaching. Farm yard manure must not contribute more than 250 kg/ha of total nitrogen in any twelve month period (COGAP). Application of fertilisers must not be made to conservation areas, wildlife corridors or watercourses and the application method must be appropriate for that need. The application method must be such that efficient and accurate spreading is achieved and application equipment should be maintained and calibrated according to the manufacturers recommendations. Where crops are grown intensively or regular applications of organic manures are applied, the use of soil mineral nitrogen testing may be worthwhile. Nitrogen application should take account of crop need bearing in mind the release of nitrogen from the soil, crop residues and applications of organic manure.

Special environmental considerations
Where crops requiring high levels of nitrogen are grown on light soils, particular care is required to match the amount and timing to crop needs and thus minimise leaching risk.

Phosphate, Potassium and Magnesium application to soil grown crops
Application of these nutrients should be based on the analysis of properly taken soil samples. Rotational application is acceptable but must be made to the most appropriate crops in the rotational
cycle in order to maintain soil fertility and ensure each crop has the necessary fertiliser for optimal crop production and quality.

The application method and the condition of the equipment must be such that efficient and accurate spreading is achieved.

There must not be applications to conservation areas, wildlife corridors or watercourses and the application method must be appropriate for that need.

Farmyard and Organic Manure application
The use of farmyard and organic manures should be encouraged to improve soil fertility, workability and structure. Full account should be taken of the nutrients contained in these materials.
Timing for application of pig/bovine slurries and poultry manure must comply with statutory requirements.

The rate and timing of the application of farmyard and organic manures, must aim to minimise risk of water pollution and comply with the COGAPs.

Farmyard and organic manures must be used in a way that is environmentally acceptable and not hazardous to human or animal health and be applied at an application rate and timing that minimises risk of leaching, does not cause odour problems or contain unacceptable contamination with heavy metals.

Fertiliser application (hydroponically grown crops)
Ideally, nutrient solution supplied to the crop should be recirculated and where practical and economic to do so, growers are expected to adopt this production method. If, for sound and justifiable reasons, recirculation is not a realistic option, run-off from the system must be minimised by close monitoring and manipulation of solution composition. Whichever system is used, growers must ensure that the nutrient status of the growing solution is frequently checked and adjusted to ensure optimal fertiliser use.

Equipment for applying fertilisers must be kept well maintained and there must be regular and recorded calibration checks.

Fertiliser storage
The storage building (or storage vessel in the case of liquids) must be suitably signed, sound and secure and located to minimise risk of pollution in the event of an accident. Fertilisers should not be stored with nursery stock material or fresh produce. Storage of solid fertiliser is only permitted outside as a temporary measure. In no case should solid fertilisers be stored within 10 metres of a watercourse or field drain. Solid fertilisers should be stored under cover, in a dry location with provision for dealing with spillages. The Fire Service and the Health and Safety Executive must be notified where quantities of dangerous chemicals (in any combination) exceed 25 tonnes (fertilisers containing greater than 27% N as ammonium nitrate are classified as 'oxidisers' and thus are classified as dangerous chemicals). The storage of liquid fertilisers is only permissible if the areas are able to retain all spillages to a volume of 110% of the storage vessels.

Fertilisers classified as 'oxidisers' must be transported in accordance with the appropriate Regulations.

Application instructions and records
Those responsible for issuing instructions to apply fertiliser or manure, should be able to demonstrate their competence to do so and those advising on use must be FACTS registered. Written
Instructions must be issued if the information is not being directly passed to the person undertaking the application.

Detailed records of type, amounts and timings of manure and fertiliser applications must be kept.

Pollution prevention
A written Pollution Prevention Policy will indicate and identify how the business is endeavouring to prevent damage to the environment.

Pollution audit
The company must identify potential pollutants and pollution risks and the measures needed to minimise risk of environmental damage. This will form the basis of a control action plan.

Soil, Water and Air must be protected by adherence to the relevant Government produced Codes of Good Agricultural Practice. This means:

- implementing sound husbandry practices including crop rotation, cultivation and the careful use of crop manures and fertilisers.

Demonstrating that pesticides and fertilisers are not contaminating ground or surface waters or water supply abstraction points beyond permissible levels; for waterways this may need to include information about the diversity of aquatic life as measured by the presence or otherwise of key indicator species. If levels are found which exceed those permitted, the reasons must be investigated and appropriate rectifying action taken.

Eliminating pollution and discharges of poisonous, noxious or otherwise polluting matter, liquid or solid waste into groundwater, coastal and inland waters. This is achieved by identifying the amount and type of waste, devising measures for minimising and containing it, identifying suitable areas for its disposal and designing an effective disposal system which meets legal requirements.

Minimising the contamination of air by odours and gases likely to increase the greenhouse effect or damage the earth's atmosphere.

Preventing contamination of air by dark smoke.

Preventing light emission and noise levels likely to adversely affect the night sky and the welfare of those living or working in the vicinity.

Responsible management of the soil including rational use of organic and inorganic fertilisers and pesticides.

Compliance with regulatory requirements in officially nitrate vulnerable zones.

Compliance with regulations and instructions about the storage, handling and use of fertilisers, pesticides and other chemicals.

Chemical Residues in Water
Procedures for minimising risk of water pollution are an important part of producing crops for export markets. This involves recording the location of waterways and abstraction points in the vicinity and any groundwater sources.

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Producers and Suppliers must demonstrate that production and processing is not causing a pollution problem, either to surface or groundwater. Where a problem is identified, action must be taken to identify the cause and to rectify the matter.

Where pesticides and fertilisers are used and run-off is possible, monitoring should be undertaken to check and ensure that water quality standards are met.

Washing water from processing and packing plants should be sampled to check for pesticide and other chemical or microbiological contamination. Where waste water is discharged onto land or into waterways, all relevant legal requirements must be met.

Samples should be taken at the time of highest risk.

Analysis required will be checked during auditing.

Fuel and Lubricant Storage
There are specific legal requirements covering fuel storage. Storage tanks must be in sound condition and installations provided with a means for containing the fuel in the event of failure. Containment should also include the tank inlet and outlet points but must not include a drainage facility.

Arrangements for filling and discharging should minimise the risk of accidental or malicious spillage.

Pesticide Storage
Pesticide Disposal Fertiliser storage
Storage and use of acid

Protection of Human Health
A written Policy statement will acknowledge the responsibility of management for the health and safety of employees and stipulate how the Policy will be implemented in a manner which protects the health and safety of consumers, the public and its employees and others working on the premises.

Chemical Residues in Food and Water
Monitoring of chemical residues in food and water is required to ensure compliance with the Crop Management Specifications and the Code of Practice.

All chemicals used in the production and processing of food and other business activities must be handled and recorded as for pesticide and fertiliser.

Pesticide Residues in Food
All produce supplied to export markets must meet international due diligence requirements. A risk assessment must be carried out to establish a rational system for undertaking residues analysis of produce. Residue analysis must be undertaken by an accredited laboratory, accredited for the pesticide which are to be tested where accredited test exist.

All pesticide residues should be below the Codex levels.
Chemical Residues in Water
Where pesticides and fertilisers are used in localities where water is being abstracted for drinking purposes, analysis should be undertaken to check that water quality standards are being maintained. Samples should be taken at times of highest risk and analysis data may be examined during auditing.

Minimising risk of water pollution as required by international standards is required for exports.

Safety
Producers and suppliers must comply with safety legislation including compliance with the Health and Safety at Work Act, Control of Substances Hazardous to Health (COSHH) Regulations and the need to undertake Risk Assessments or other similar legal provisions available in the country. COSHH assessments for substances hazardous to human health must be reviewed at 12 month intervals, or if procedures change.

Producers and suppliers must operate a written system which verifies that appropriate safety instruction and information has been provided to and is understood by staff. Adequate arrangements must be made for dealing with those who are illiterate or for whom English is not their native language.

Storage of Personal Protective Equipment
Storage of Pesticide Application Equipment
Storage of Acid
Ideally this should be in a purpose-built stainless steel tank with non-manual filling and dispensing facilities. The tank must be adequately supported and securely protected from accidental vehicle impact. Where storage is in drums, the vessels must be kept within a secure, bunded, very well ventilated and preferably roofed compound. Rainwater can sometimes accumulate within the bund and periodically will need to be pumped away. Before this is done, checks should be made to ensure that the liquid is not leaked acid.

As well as a COSHH assessment there should be a comprehensive written safe operating procedure for the handling and use of acids.

Storage use and disposal of hazardous materials and substances must be in a responsible manner meeting regulatory requirements.

There must be a comprehensive health screening system for staff handling and using chemicals and substances where this requirement is stipulated.

There must be sufficient staff with competence in First Aid formally acknowledged by a reputable organisation.

There must be adequate fire prevention and control procedures and these must be formally acknowledged by the Fire Service where this is a statutory requirement.

Every effort should be made to avoid employees being exposed and subjected to harmful noise levels.

Where this is unavoidable, adequate protection equipment must be provided and written instructions issued that it must be used.

Equipment, installations and vehicles (including field harvesting and packing rigs and equipment for accessing glasshouse roofs) must have an adequate level and frequency of scheduled maintenance and there must be written safe operating procedures for their use.
Electrical equipment must be installed and maintained to legally required safety standards and the work undertaken only by those competent to do so.

Operators of equipment and drivers of vehicles must have a recognised standard of competence. There should be a formalised system for safe operation in situations where there is a mix of vehicular and pedestrian traffic.

Use of sewage sludge must comply with the buyer's current policy, issued to all suppliers.

Risk assessment will identify what measures are needed to ensure that produce cannot become contaminated with substances or organisms that could be damaging to health. These measures must be implemented and monitored.
Annex 2.1

Pesticide Use

1. Use of Pesticides

Pesticides present a risk to farm staff, the environment and the consumer. Therefore it is important that:

- Internationally accepted standards and practices are observed whenever pesticides are handled or applied;
- Facilities and equipment on the farm facilitate the safe and effective use of the pesticide products;
- Pesticides are used responsibly and disposal kept to a minimum.

2. Collection, Transportation and Storage of Pesticides

Pesticides are at their most dangerous when in their concentrated form. Therefore it is essential that care be taken whenever concentrated product is being moved or handled.

2.1 Collection and Transportation of Pesticides to the Farm

Safe working practice must be observed at all times:

- All pesticides containers should be inspected prior to loading. Products which are damaged and leaking or which are inadequately labelled should not be accepted or transported;
- Labelling should be provided by the manufacturer and should include, as a minimum, the product name, active ingredient, concentration, production date or code, hazard warnings and recommendations for use;
- Pesticides must not be carried inside the passenger / driver compartment of vehicles. They should be placed in the boot of the car, in an outside container, or, preferably, in a trailer;
- Containers must be secured to prevent damage or theft in transit;
- Small pesticide packs (1 kg or 1 litre) if bought or collected personally by a farm worker, should be packed in a plastic bag and carried separately. They must not be carried together with food;
- Those directly responsible for collection and transport (drivers etc.) must know what their loads contain and what action must be taken in the event of an emergency. Vehicles should carry, in the cab, emergency advice notices and details of the contents of the load. Vehicles should also carry a bucket of sand, brush and shovel to clean up spills.

If there is a spillage the emergency procedure given below should be followed.

2.2 Spillage Emergency Procedure

In the event of an accident such as a crash, fire or spillage, the driver should:

a. Switch off the engine, and not light cigarettes;

b. Contain any spillage by surrounding and covering it with sand or earth to avoid contact risk and effect of fumes;
Inform the emergency services and the project manager of the accident and the nature of the damage to products;
Stay with the vehicle, but upwind of any spilled chemical, and keep people away;
The spillage must be absorbed in earth or sand and then be disposed of in a safe place. Lime, lye (a dilute alkali material), detergent or soap powder in a concentrated water solution are good for decontaminating hard surfaces. However, the wash water must not be allowed to run off into sewers or surface drains, waterways, ponds or lakes, but should be absorbed in sand or earth. Spilled dry powder should be covered with dry sand or earth before it is shovelled or swept into containers;
If there is any possibility that food, animal feed, clothing or general consumer goods have been contaminated, these must be destroyed;

2.3 Storage
The measures described in this section deal with the main requirements, which have to be satisfied if larger quantities are to be stored. Nevertheless, the basic principles should be followed when smaller quantities are stored. These measures concern:
Security;
Maintenance of pesticide stock in good condition;
Position and construction of the store;
Placement of products in the store;
Stock rotation;
Stock inspection and stock records;
Re-packaging;
Emergency procedures;

2.4 Security
a. Pesticides must always be stored under lock and key in a secure place, out of the reach of unauthorized people, children and animals.
b. Only authorized personnel are to be allowed access to the store and a list of these persons/key holders should be available.
c. Storekeepers should be competent in handling pesticide containers and dealing with spillage etc.
d. Where large quantities of pesticides are stored, the pesticide store should be a separate building or section of a building, which can be securely locked.
e. Where small quantities of pesticides are involved, the store may be a locked cupboard or box placed out of reach of children or animals, but it must not be situated in food storage areas, or near fires, stoves or lamps, and should not be kept in occupied rooms.

2.5 Maintaining Stocks in Good Condition.
Specific instructions regarding storage conditions may be provided on the product labels and, if in doubt, refer to the supplier. To ensure that stocks of pesticides are kept in good, useable condition. Due attention must be given to the following four points:
Positioning and construction of pesticide store to minimise deterioration due to climatic conditions;
Placing and stacking of containers to avoid damage and to facilitate inspection;
Use of stocks - "first in, first out"; and
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Regular inspection. Absorbent non-combustible material to clean up spills must be readily available within the store.

2.6 Positioning and Construction of Pesticide Store
Pesticide stores should be located, preferably on high ground, at least 100m from any water source or catchment area and they must be rainproof. Floors should be impermeable to liquids and free from cracks, to allow easy cleaning, and should be designed to contain leakage by means of a surrounding 15 cm sill. If there are drains, they MUST be connected to a separate catchment pit and NOT directly to waterways. Stores should be adequately ventilated to prevent excessively high temperatures and humidity, which can cause deterioration of pesticides. Ventilation may be by extractor fan or natural airflow and where the latter is employed some ground level ventilation must be provided to prevent the build-up of heavy vapours.

Rats can destroy bags and boxes, so stores should be made rat-proof e.g. by covering all wall vents with sound wire netting.

2.7 Placing and Stacking Inside the Store
Spoilage in store is reduced and stock taking made easier if stocks of pesticides are methodically arranged and clearly marked so that they can be easily identified and inspected.

Containers must be stored upright and the height of stacks should be restricted to avoid damage by crushing. Manufacturers recommendations on stack height should be followed where this is stipulated.

Packages should not be stored directly on the floor, but preferably on pallets or racks and away from walls, to allow ventilation.

Care must be taken to avoid cross-contamination of products, which leads to increased wastage:

- always store powders above liquids; and
- herbicides and plant growth regulators should be in a separate store or separated from insecticides and fungicides to prevent possible contamination.

Shelves should not be above shoulder height and it is desirable that heavy containers are stored on pallets at floor level to facilitate leak detection and spill management.

2.8 Records
Accurate, up to date stock records must be maintained at all times and should be used to ensure that products are present when needed but not ordered in excess of requirements.

Records must be stored outside the stores so that they are readily available in the event of an accident and the storekeeper is not required to spend long periods of time in the store.

2.9 "First In, First Out" Use of Stocks
As a general rule the oldest stock of any product must be used up first, so as to avoid deterioration. The orderly arrangement of stocks in a store according to manufacturing or purchase dates and the maintenance of a permanent inventory book will help to make this a routine practice. However, if a particular container or batch is leaking or deteriorating, it is sensible and economical to use the entire contents at the earliest opportunity regardless of its date of arrival in store, provided it is still in a fit state to be used.

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Efficacy of a product will eventually be affected by age so it is good practice to use products in the year in which they were purchased. However where this is not possible use in subsequent years is usually possible provided that there are no signs of deterioration. The following characteristics should be taken as cause for doubt and for seeking expert opinion before use:

- Marked change of colour or consistency;
- Separation of liquid into distinct layers, which cannot be re-mixed by shaking;
- Formation of crystals, which will not dissolve with shaking or rolling;
- Apparent contamination by another pesticide;
- Uncharacteristic smell;

If it is decided that packs of pesticide must be disposed of, then the procedures given for disposal of pesticide concentrate must be followed. In large stores there must be a system of authorization, which enables unusable stock to be written off.

2.10 Regular Inspection of Stocks
All stocks must be regularly inspected for signs of deterioration or leakage, and stock inspections recorded. Points to watch out for include:

- Strong odour - often indicative of leaking or product decomposition;
- Metal drums - rusting and leaking seams or dents;
- Plastic drums and bottles - deformation and leakage;
- Cartons and boxes, paper or plastic sacks - dampness and discoloration, holes and signs of leakage;
- Glass bottles - cracks or breakage; and
- Missing lids or labels.

Wherever deterioration or leakage is seen or suspected, all affected packs must be removed and isolated. Neighboring packs must be carefully inspected and removed for cleaning if they are contaminated.

2.11 Re-Packaging
No re-packing on the farm should be done, except in emergency, because of the dangers associated with unsuitable packaging materials and inadequate labeling. However, in cases of emergency, leaking containers should be placed in oversized containers or in heavy-duty polythene bags. Where large quantities of product are stored or handled, it is advisable to keep a few decontaminated containers for this purpose. The safety precautions recommended by the manufacturer for the handling of the product must be observed during re-packing. The containers must be securely closed and properly labeled, ideally with the original product label, but failing that, with an accurate copy. The product should be used up or disposed of as soon as possible.

2.12 Emergency Procedures and Equipment
An emergency procedure, in case of fire, accidental spillage and/or leakage and in cases of contamination of personnel must be defined, documented and made known to key staff. Such procedure must include the following:
- decontamination of personnel
action in the event of fire

cleaning up spillage and leaks and disposal of waste material

disposal of contaminated aqueous waste e.g. from the fire fighting equipment or
from de-contamination of store.

a record must be made of all spillage along with remedial action.

The following equipment will be needed in the event of an emergency and should be readily
available at all times:

water under high pressure if possible.

buckets of absorbent non-combustible material to clean up spills

buckets of sand or earth should be available for the purpose of extinguishing small
fires.

suitable fire extinguishers e.g. dry chemical powder (DCP), CO₂, foam and water as
appropriate, must be available and regularly checked.

full-face respirators, protective overalls, gloves and boots, for at least two persons,
must be permanently available near to but outside the store.

2.12 Issuing Pesticides from the Stores and Transport Around the Farm

Issue From the Farm Store

a. Pesticides should only be issued by the Storekeeper to Spray-men on receipt of, and in
accordance with, written instructions from the farm manager.

b. Instructions should specify the product name, the amount to be issued, where the
product is to be used and the rate of application.

c. To minimize the risk of confusion it is wise to restrict individual issues to quantities to
be used in one work period only.

d. Where possible, pesticides should be issued in their original containers but where this is
not possible, suitable clean containers should be used and these containers should be
clearly labeled with the product name and the appropriate hazard warning sign.

e. All issues should be recorded and signed for.

2.13 Transport of Pesticides Around the Farm

a. Pesticides should be adequately secured to equipment or carried by personnel wearing
protective clothing.

b. At no time should pesticides be left unattended.

2.2 Application Practices

2.2.1 Management Responsibilities

The decision to spray should be taken by a competent member of the management team and
all instructions should be issued in writing.

2.2.2 Operation Controls

The work should be organized to minimize exposure to both concentrates and diluted spray
liquids.

All spray equipment must be calibrated on a regular basis and records kept of this
operation. Regular calibration of spray equipment is the simplest and most
immediate method to highlight nozzle wear and other imperfections in the spray
system. Correct calibration is essential to ensure that chemicals are applied at
recommended rates and to prevent uneven application or overdosing of crops. Accurate calculation or requirements ensures that appropriate quantities of spray solution are made up for any given area. This reduces the need to dispose of waste and is more economical.

All equipment to be used for spraying is to be well maintained and serviced to avoid the need for repairs during actual spraying operations. Any defective equipment must be repaired or replaced. Service records must be kept for all equipment.

All workers within the vicinity of an area to be sprayed should leave the area. When spraying in greenhouses, warning signs are required stating time and date of application and indicating when entry is safe without protective clothing.

In the case of static/fixed spraying systems, where the pumping unit is remote from spray line risers, these should be marked clearly as not suitable for drinking and labelled poison.

Where irrigation tanks are used for mixing, these should be fitted with non-return valves to prevent contamination of water supplies.

There should be a clear line of control, and responsibility for the following activities should be documented and made known to the people concerned:

- monitoring of safe working practices;
- inspection and replacement of protective equipment;
- inspection, calibration and maintenance of spray equipment;
- store keeping and stock control;
- scouting;
- selection of pesticides and programme control; and
- waste disposal.

### 2.2.3 Spraying Practice

a. Sites for mixing the spray and filling the sprayer must be carefully chosen to avoid the risk of spillage draining into ditches, drains or watercourses.

b. Spray tanks must be positioned, so that operators are not required to lift chemical containers above chest height to fill them.

c. Spray tanks should be half filled with clean water and, with the agitator running, the chemicals added in the correct order (addition of chemicals to the tank in the wrong order or omission of suitable buffers can result in products being inactivated).

d. When spraying outside, the wind direction should be taken into account to avoid spray drift onto the operator, other workers, adjacent crops and land, areas of habitation and watercourses.

e. Personal hygiene is of utmost importance when using pesticides. Operators must be made to understand that they should not eat, drink or smoke during spraying and should avoid touching the face or other bare skin with soiled hands or gloves.

f. Within a greenhouse, workers should be advised of the minimum re-entry time.

g. Areas that have been treated with methyl bromide should be clearly marked with warning signs and no re-entry permitted into the treated area for four days.
h. All operators should receive instructions regarding the set-up of the sprayer and the correct placement of sprays. Operators must be adequately supervised to ensure that instructions are followed accurately.
i. Pesticides should be placed accurately and coverage monitored during application.

2.2.4 After Spraying
a. At the end of the day’s spraying, the tank should be rinsed out with several changes of water and detergent. Several changes of a few liters of water will give a better result than one wash with a larger volume and minimize the disposal problem. Other special washing/rinsing instructions, as detailed on the label, should be observed. All rinsates, no matter how dilute, should be considered pollutants and disposed of carefully. The sprayer exterior, tractor or any other contaminated equipment should also be washed in an area where the run off will not contaminate streams and waterways.
b. Personal protective equipment must be cleaned at the end of each day.
c. All waterproof equipment provided must be rinsed off, including the inside of the gloves.
d. Cloth overalls must be taken off and stored hygienically on the farm premises. The company must undertake to wash the overalls after every 20 hours of spraying or sooner if necessary.
e. Facilities for storing personal clothing and protective clothing must be supplied and should be separate from the chemical store.
f. After each application of pesticides, spray operators must wash thoroughly. Showers, soap and towels must be made available to spray operators.
g. Spray staff should change into normal clothes before leaving the farm.

3.0 WASTE MANAGEMENT

Waste management is essential to avoid unnecessary pollution, preserve natural resources and the natural beauty of the surroundings. Each project should have a policy stating how the different categories of waste should be handled. This policy should be communicated to all relevant staff and implemented reliably. ‘Due diligence’ requires that consideration should be given to the following:

- Composting of organic material for use later for soil amelioration;
- Burning or burying, at designated sites, of materials that cannot be recycled or composted;
- Re-cycling plastic waste by supplying it to a re-cycling plant;
- When this is not possible, plastic waste may be buried, so long as it is not in an environmentally sensitive area;
- Use of packaging material that can be re-cycled in the receiving country;
- Disposal of contaminated water, sprayer washings etc. in a soak away which is sited at a safe distance from bore holes and open water courses;
- Disposal sites should be shown on a map of the enterprise and records should be kept of the nature and amount of hazardous waste that is buried;
- Control of vermin and mosquitoes; and
- Minimising waste by careful handling of materials, good stock control and accurate calculation of requirements.

Note: The policy concerning waste management should include all production areas, pack houses and farm compounds.
3.1 Disposal of Pesticide Waste

The disposal of pesticide waste is a serious responsibility for growers. It is important that everything should be done to keep the amount of waste generated to a minimum by having:

- Good stock control so that purchases are only made when necessary and in accordance with requirements;
- Stock rotation; and
- Correct storage facilities.

3.2 Types of Waste

Pesticide waste is of four types:

- Concentrated products;
- Diluted pesticides, including washing/rinsing;
- Empty containers; and
- Contaminated clothing and other materials.

3.3 Concentrates

The disposal of concentrates can be minimized by careful consideration of the amounts purchased originally. However, excess or unwanted concentrates may become a problem when overordering has occurred or there has been a change in requirements. In this case attempts must be made to find a legitimate use for the products. Products that are in good condition may be accepted back by the supplier for resale to another producer. Where this is not possible, then dilution and application to fallow land or burial in a designated pit may need to be considered. In the case of out-of-date stock, the supplier may be able to help with disposal or the product should be buried in a designated disposal pit.

3.4 Dilute Pesticides

Unused spray mixture or tank washings can be sprayed over an area of crop not previously treated, or an area of wasteland. Wasteland chosen for this purpose must be marked clearly, be of little wildlife value and not liable to run-off or flooding after rainfall. Alternatively, the use of a soak-away pit well away from waterways and ditches may be considered. This must not be near watercourses and must be in areas that are inaccessible to children and livestock. Diluted pesticides should never be poured into a watercourse, ditch, sewer or drain.

3.5 Empty Pesticide Containers

If a choice exists, select pesticide products sold in packaging that can be easily disposed of. Containers must be thoroughly washed (triple rinsed) before disposal, and the washing added to the spray mixture being prepared.

Containers must be punctured or crushed to prevent their subsequent use as drinking water containers or for any other purpose.

Rinsed containers must be recorded and stored securely prior to disposal by burning or burial.

3.6 Contaminated Clothing

a. Heavily contaminated articles, which are beyond cleaning, should be burned or buried following procedures listed in Methods of Disposal.

b. Overalls and other personal protective equipment should be washed regularly, separately from other personal laundry, using soapy water. Washed clothing should then be thoroughly rinsed and dried before re-use.
c. Persons responsible for washing contaminated clothing should wear gloves and an apron to protect themselves from possible contamination.

3.7 Methods of Disposal for Pesticide Waste

Incineration.

a. Many pesticides need very high temperatures to destroy them therefore only clean (triple rinsed) paper or plastic containers should be burnt.

b. Sufficiently high temperatures cannot be achieved in a bonfire so as a general rule it is safer for pesticide containers to be burnt in incinerators designed for the purpose. Growers who wish to construct an incinerator on the farm should refer a suitable incinerator design.

c. Care must be taken that there is no risk of smoke and fumes drifting downwind to affect people, animals, houses or any other inhabited buildings or plants and there must be no risk of the fire getting out of hand and spreading.

d. The ashes from the bonfire must be buried as described in the following section since they may contain un-destroyed pesticide residues.

3.8 Burial

In the absence of an incinerator and where burning on the farm is not practical, pesticide waste may be disposed of by burial. Burial should be done in a small pit, with the following precautions strictly observed:

Drainage or seepage into watercourses or sources of water must be avoided. As a rule, sites should be at least 100 metres from all boreholes;

Burial must be deep enough, and the site adequately secured, to ensure that human and animal activities will not uncover the pesticide wastes;

The site must also be clearly marked with warning signs;

Burial sites should be marked on a site map and records kept of the amount and nature of materials buried.

Where suitable sites are not available on the farm then alternative arrangements should be made.

The disposal pit should ideally be sighted where the sub-soil will permit a limited but low permeation and biological degradation of pesticide; thus excessively sandy sites and the top of sloping sites should be avoided. The area chosen must not be subject to flooding.

The pit should be in the form of a bowl with a diameter of 2-3 metres and a depth of 1-1.5 metres. An additional area should be reserved alongside for a second or third pit for future use:

- concentrated wastes should be diluted with water before burial;
- containers should be punctured or crushed before disposal.

The waste should be spread to a depth of 5-10 cm and be intermixed with lime and compost to assist biological degradation. On completion of each deposit, a layer of compost or earth should cover the waste to prevent risk of contact and to provide a source of nutrients and microorganisms for biological degradation. Fill the pit and allow room for a final layer of 50 cm of compacted compost or soil to top it off. To avoid rapid drainage of water into the sub-soil the top should be planted with bushes. Subsequent pits should then be excavated and operated in a similar manner.
3.9 Management of Organic Waste

Organic waste can be composted to provide organic material for soil amelioration. Managers should ensure that:

- Organic waste is not contaminated with non-decomposable or toxic material;
- Organic waste is composted adequately and used for soil amelioration;
- Leachate from the composting process does not contaminate water supplies;
- Pests and diseases are not transmitted from the composting area back into the production area;
- Local nuisance flies, smell etc are kept to a minimum and rats are not encouraged;

3.10 Management of Waste Water

Removal and disposal of waste water should be planned, monitored and controlled:

- Contaminated surface water presents a risk to livestock and uninformed persons;
- Stagnant surface water will attract mosquitoes;
- Contaminated water can contribute to the pollution of domestic water supplies, aquifers and rivers;

Sites for the disposal of contaminated water should be at least 100m from surface water sources or boreholes.

Note: Greater distance will be needed where the soil is sandy or the water table high.

Contaminated water should be collected/contained and directed either into a soak away or into managed wetland. Efforts should be made to minimise the amount of water involved and the level of contamination. Contaminated water includes:

- sewage;
- pesticide sprayer washings;
- crate/bucket washings;
- flower water;
- run off from hydroponic production; and
- vegetable washings.

3.11 Management of Waste Plastic and Packaging

Significant environmental pollution occurs world wide as a result of the build-up or incineration of waste plastic and packaging. Management policy should minimize the generation of waste plastic and packaging and facilitate re-cycling or reuse wherever possible. Farm practices should include as relevant:

- high temperature incineration (Silsoe) of paper cardboard and plastic;
- selection of packaging that can be recycled in the receiving country;
- restricted use of chlorinated plastics;
- use of recycled paper and cardboard;
- careful storage so that spoilage is minimised;
3.12 Protection of the Ozone Layer and control of Greenhouse Gases

Ozone Depletion

Ozone depletion is recognized as having an adverse effect on the global climate. Growers are asked to consider how to reduce their impact on the ozone layer by responsible use of Methyl Bromide and selection of cooling units with environmentally acceptable refrigerants.

Methyl Bromide use should be restricted to areas where a problem e.g. high nematode count, has been identified.

Alternatives to the use of Methyl Bromide should be investigated.

Actual use should be phased out in line with the Montreal Protocol.

Refrigerants

New and replacement units should use environmentally friendly coolants.

Old units should be disposed of in an environmentally acceptable manner at the end of their life span.

4.0 Efficient Energy use

Energy use should be monitored and controlled:

Excessive use of fuel, petrol, diesel etc is expensive, wastes a non-renewable resource and contributes to the concentration of greenhouse gases in the environment;

Use of charcoal contributes to environmental degradation of the natural bush and to the production of greenhouse gases; and

Unnecessary use of electricity is costly and wastes a resource that could be used more constructively.

Good practices that will contribute to efficient energy use include:

- Restricting the use of vehicles to essential journeys and planning journeys so that jobs can be combined;
- Using zero or minimum tillage or the mounting of a combination of equipment so that several activities are achieved in one pass over the land;
- Maintenance of vehicles and equipment to ensure efficient operation;
- Maintenance of water supply systems to prevent wastage and reduce pumping;
- Efficient use of refrigeration units:
  - use of field shelters and water dips to remove field heat;
  - use of air curtains to prevent cold air escaping; and
  - restricted number of door openings size/frequency etc.

5.0 ENVIRONMENTAL POLICY

Each project is required to demonstrate commitment to maintaining and enhancing the environment around the farm site. Managers should be aware of the impact of their farm activities on the environment and all staff should be aware of the need to protect the...
environment. Training in the basic principles and practices of environmental protection is desirable. Practical methods of environmental protection include:

- planting trees;
- responsible collection of firewood;
- conservation of fuel and electricity;
- restricted use, i.e. only when necessary, of non-renewable environmental resources;
- restriction of the use of pesticides;
- responsible use of water;
- responsible use of fertiliser;
- responsible land use; and
- minimising waste and correct disposal.

After each ZEGA Audit an action plan should be produced that addresses priority areas for the implementation of CAP and Environmental protection and progress with implementation of the action plan must be demonstrated year on year.
Annex 3

IPM Research Undertaken at Mount Makulu

Master No: 4497
Title: Soyabean - Pyrenochaeta Glycines Nursery
Objectives: To screen soyabean breeding lines for different levels of tolerance or resistance to Pyrenochaeta glycines (red leaf blotch)
Justification: Soyabean is among the most important food legumes in Zambia. Pyrenochaeta glycines (red leaf blotch) is one of the major constraints to soyabean cultivation in the country. As the economic impact of the disease has become of increasing concern in Southern Africa, it is important to regularly screen soyabean breeding lines for different levels of tolerance or resistance to Pyrenochaeta glycines.

Master No: 5213
Title: Control of Pyrenochaeta Glycines on Soyabean
Objectives: To investigate the effectiveness of Iprodione In controlling Pyrenochaeta glycines (red leaf blotch)
Justification: Red Leaf Blotch, caused by Pyrenochaeta glycines is one of the most important diseases of soyabean in Zambia and is one of the major constraints to Soyabean Cultivation in the Country. The economic impact of this disease has become of increasing concern in Southern Africa.

Master No: 5611
Title: To Develop An Armoured Cricket Control Methods With Minimum Input of Insecticides.
Objectives: To find out the efficient and cheapest method of controlling the Armoured ground cricket with minimum input of insecticides.
Justification: Armoured ground cricket is a serious pest on cereals and non-cereals in Region I and II. Yield loss is estimated to be in the range of 10-60%. Insecticide control is possible but too expensive for small scale farmers. Previous studies indicate that control can be developed by planting early, clean weeding and using short duration cultivars

Master No: 5832
Title: Quantification of on-farm Post-harvest Food Losses
Objectives: To describe post harvest activities in different farming systems. To quantify food storage losses. To establish role of food losses in household food security. To establish major causes of food losses among different households and major farming system
Justification: Storage and processing losses have not been quantified. It is not clear what role or contribution they make towards food insecurity in small holder household.

Master No: 5857
Title: Sorghum Anthracnose Virulence Trial
Objectives: To monitor variability in colletotrichum graminicola populations. Identify staple sources of resistance to colletotrichum graminicola. To study the epidemiology of colletotrichum graminicola
Justification: Anthracnose of sorghum, caused by C. graminicola is a severe problem in high rainfall areas. This pathogen infects leaves, stalk, pedicules and the grain causing substantial loss to both grain and forage production.

Master No: 5858
Title: Use of Cassava Peels, Onion Scale Leaves In Controlling Insects In Stored Grain
Objectives: To investigate the effect of cassava peels, onion on mortality of stored insects. 2. To assess the effect of these treatments on grain viability.
Justification: Chemicals are less used by farmers in the rural areas due to high cost and non availability. As a result local materials are used to protect stored produce against insect infestation. It is believed that onion and cyanogenic glucosides (Cyanide) which is concentrated in the peels of cassava roots can be toxic to insects. There is need therefore to carry out this study.

Master No: 5859
Title: Comparision of Susceptibility of Zambian Sorghum Varieties To Weevil Attack

Global Development Solutions, LLC
Objectives: To have data on degree of resistance of sorghum varieties against weevil attack
Justification: High yielding varieties recently introduced to the farming community are susceptible to insect pests of stored grain. It is necessary to screen these varieties for resistance to storage insects. If the degree of resistance is ascertained, appropriate recommendations can be given to breeders; hence storage qualities can be incorporated in the varieties.

Master No: 5860
Title: Determination of The Degree of Resistance of Insect To Recommended Storage Insecticides
Objectives: To confirm reports of insects developing resistance to recommended storage insecticides
Justification: There have been reports of insects developing resistance to some storage insecticides, especially malathion dust which has been in use for a long time especially along the line of rail. It is therefore necessary to carry out the trial.

Master No: 5861
Title: Testing Cowpea Varieties For Resistance To Bruchid Attack In Storage
Objectives: To obtain preliminary information on the degree of resistance of cowpea varieties to cowpea beetles
Justification: There have been complaints from farmers who have been growing the recently released cowpea varieties that their storability is poor. Screening these varieties for resistance would therefore be of great importance because if the degree of resistance is ascertained, appropriate recommendations could be given to breeders who would incorporate the storage qualities in their breeding programme.

Master No: 5864
Title: Bean Stem Maggot Control By Orthene and Toona Ciliata In Common Beans Phaseolus Vulgaris
Objectives: To evaluate the scope for Orthene and T. ciliata against the bean stem maggot
Justification: 

Master No: 5866
Title: Crop Loss Assessment of Frogeye Leaf Spot In Soyabean
Objectives: To assess the crop loss caused by frogeye leaf spot
Justification: Frogeye leaf spot disease or Cercospora leaf spot occurs worldwide but is most common in warmer regions during warm, humid weather. One of the races (Race2) is seedborne. Literature mentions a yield loss of 15% The disease was reported in Zambia in the fifties. During the last two seasons it is suspected to have been a problem in soyabean in Northern Province. In order to establish if more profound research has to be carried out on this disease in Zambia, the effects caused by this disease have to be quantified.

Master No: 5867
Title: Economic Viability of Cotton/Cowpea Intercropping
Objectives: To evaluate if there is any beneficial effect of intercropping of cowpea in cotton since the insecticide spray drift from cotton is likely to offer protection against pests of cowpea.
Justification: Cowpea is prone to attack by a complex of insect pests, but direct protection by insecticide sprays is mostly uneconomical and brings about environmental or residue problems. It is likely that using the spray drift from cotton can benefit cowpea against the insect pest.

Master No: 5868
Title: Cowpea Aphid Resistant Varieties Trial
Objectives: To evaluate the aphid resistant varieties from the International Institute of Tropical Agriculture under the Zambian conditions.
Justification: Aphids, Aphis craccivora, are common in all cowpea growing areas in the country. The extent of avoidable yield loss due to sucking pests (mainly aphids) at Masekera has been estimated at 25 percent (Sohati and Sithanantham 1991). In addition, aphids are important as vectors of the cowpea aphid-borne mosaic virus (CAMV).

Master No: 5869
Title: Sorghum Long Smut Chemical Evaluation Trial (SLMCT)
Objectives: To determine the efficiency of seed dressing fungicides with potential to control sorghum smuts.
Justification: 

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Master No: 5901
Title: Field Evaluation of Seed Dressing Fungicides Efficiency Against Sorghum Downy Mildew
Objectives: To determine the efficiency of seed dressing fungicides with natural control sorghum downy mildew
Justification: Sorghum downy mildew caused by *peronosclerospora sorghi* is one of the destructive diseases and has the capacity for epiphytotics on susceptible genotypes under favourable conditions in the endemic areas. At present the recommended hybrids are showing some susceptibility to it hence there is need to supplement the resistance.

Master No: 5902
Title: International Sorghum Virus Nursery
Objectives: To monitor the spread of maize dwarf mosaic virus. Identify sources of resistance in sorghum Germplasm
Justification: Maize dwarf mosaic virus (MDMV) is the most important virus diseases of sorghum worldwide and occurs almost everywhere sorghum and johnson grass grow. However, in Zambia it has manifested its occurrence in reg. I & II. Maize dwarf mosaic virus is transmitted by aphids and can spread fast in good season causing serious loss to grain sorghum.

Master No: 5903
Title: Downy Mildew Pearl Millet Germplasm Screening
Objectives: To establish downy mildew sick plot.
Justification: Pearl millet down mildew is found in all the areas where this crop is grown. The actual yield-reduction potential of downy mildew is high. In the country this disease can be found mostly on farmers' fields hence the need to screen all the improved materials.

Master No: 5904
Title: Evaluation of Fungicides With Potential To Control Pearl Millet Downy Mildew and Smuts At Longe
Objectives: To establish the effectiveness of seed dressing fungicides to control pearl millet downy mildew and Smut
Justification: These two diseases are the main yield reducers of pearl millet yields both at station level and on the farmers' fields. The breeding program has put much emphasis on breeding for resistance. However, to supplement resistance it is necessary to have other control measures in place in case the resistance breaks.

Master No: 5905
Title: Evaluation of Seed Dressing Fungicides Against Sorghum Smuts.
Objectives: To select cultivars resistant to wheat diseases in Zambia
Justification: It is important to screen wheat lines for resistance to diseases prior to including the material in the yield trials. Some of these lines may possess the needed resistance genes which can be utilised in our local crossing block.

Master No: 5907
Title: Survey of Seed-borne Diseases on Legumes and Cereals In Regions I, II and III of Zambia
Objectives: To have an up date list of diseases for quarantine purposes. To enable the GVT to change Plant import and export regulations
Justification: An accurate disease identification is the first step in planning an effective and efficient disease control measure. Prevalent seed borne pathogens will run smoothly and other countries will be in a position to know what diseases are endemic in Zambia.

Master No: 5909
Title: Coffee Berry Disease Chemical Control Experiment
Objectives: To reduce the disastrous effects of CBD to coffee production
Justification: The two main varieties SL28&SL34 grown in Zambia are very susceptible to coffee berry disease. This can lead to 80% crop loss. Therefore there is need to find a chemical control strategy.

Master No: 5911
Title: Distribution and Severity of *Cercospora Angolensis* and Oidium Mangifera In Zambia
Objectives: To determine the distribution and severity of *C. angolensis* and Oidium Mangifera.
Justification: *Cercospora angolensis* and Oidium mangifer are very serious diseases on citrus and mango reported throughout the country. It attacks all the stages of the fruit and crop losses exceed 80% in many cases. Many farmers have even abandoned citrus growing because of this disease. Therefore it is important to establish the disease distribution and control practices by farmers.

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Master No: 5912
Title: Cowpea Aphid-borne Mosaic Virus Screening Nursery
Objectives: to identify good sources of CABMV for use in the cowpea hybridization programme
Justification: CABMV is an important disease in cowpea field loss in severe cases. In order to incorporate resistance (disease) good sources of resistance has to be sought. Moreover breeding for resistance mostly grown by resource poor farmers who cannot afford pesticides.

Master No: 5913
Title: Determination of Seed Borne Viruses
Objectives: To evaluate existing seed borne plant viruses in Zambia. To determine their importance
Justification: Seedborne viruses are important in disease epidemiology. The phytosanitary services and quarantine unit needs the information in order to determine which viruses not to allow entry into the country.

Master No: 5914
Title: Evaluation of BCMV Trials
Objectives: To determine Bean common Mosaic virus strains occurring in Zambia. To determine the level of virulence of the strains.
Justification: BCMV is a very important disease in beans and is capable of inflicting losses up to 90%. The best control method is the development of resistant varieties. The varieties being evaluated must therefore be challenged by all strains available in the country.

Master No: 5915
Title: Early Warning of Army Worm Outbreak By Using Pheromone Traps
Objectives: To develop and establish an early warning system for Army worm outbreaks
Justification: Past outbreaks were not quickly attended to due to lack of early warning.

Master No: 5916
Title: Characterization and Site Location of a Soil Pathotypes of Verticilium Dahlia, In Zambia
Objectives: To characterise and determine the spread of soil pathotypes for the purpose of verticilium dahlia, VD. Creating database for use in the quarantine enforcement.
Justification: Since the recognition of the presence of the pathogen in 1987 no effort has been made to determine the distribution pathotype characterization.

Master No: 5917
Title: Assessment of The Distribution and Impact of Sweet Potato Weevils On Sweet Potatoes In Zambia
Objectives: Determine the incidence and severity of sweet potato weevils. To determine its pest status. To determine control practices existing of farm level
Justification: Sweet potato is increasingly becoming an staple food but the reported incidences of weevil attacks.

Master No: 5918
Title: Screening For resistance/tolerance To Stemborers Chilo partellus and Busseola Fusca In certain Maize
Objectives: To identify maize genotype that possess tolerant traits to stemborers chilo partellus and busseola
Justification: Resistant genotypes are an important component of an IPM package for stemborers. There is need to identify source of genetic material in maize cultivars that bear resistant/tolerant genes to stemborers so that they can be incorporated in a breeding programme.

Master No: 5919
Title: Screening For Resilience To Maize Streak Virus In Selected Maize Genotypes In Zambia
Objectives: To establish a viable leafhopper colony cicadula leafhopper - a vector of MSV. 2. To identify sources of tolerance to maize streak virus (MSV) within certain maize genotypes
Justification: Resistant maize genotypes are an important component of an IPM package for stemborers. There is need to identify sources of genetic material in maize genotypes that can be incorporated in a breeding programme.

Master No: 5920
Title: The Effect of Intercropping in Maize on Population Dynamics of Stem Borers and Their Natural Enemies
Objectives: To determine crop combination that reduce or increase stemborer and natural enemy abundance
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Justification: Intercropping is regarded as the traditional means of reducing stemborer damage in cereal crops. There is need to know crop combinations which can be intercropped with maize in the traditional set up so as to limit stemborer damage without recourse to chemical pesticides.

Master No: 5921
Title: Evaluation of Active Ingredients (Insecticides) in Bollworm Control (Evaluation of deltamethrine (tablet
Objectives: To determine the efficacy and range of effectiveness of insecticides on bollworm control
Justification: The lower the dosage of application, the cheaper the insecticide. With the already high insecticide cost, a lower but effective insecticide dosage would be cheaper and affordable by many farmers.

Master No: 5923
Title: Effect of The Programme of Spray on the Control of Bollworms
Objectives: To determine the most economic pest control programme
Justification: Insecticide use according to calendar may lead to over use and unnecessarily high cost of plant protection. Application according to threshold levels of infestation could lead to cost saving and make pest control affordable for the farmer.

Master No: 5924
Title: On-farm Food Loss Assessment
Objectives: To describe post-harvest practices in different farming systems. To quantify and establish farm food storage losses. To establish major causes of food losses among different households in major farming systems.
Justification: It is important to carry out to improve the crude protein content of maize stover which ranges between 1 and 4%. The intercropping of maize with fodder legumes is one cheap way of improving the quality maize stover and therefore increase the productivity of cattle in Zambia.

Master No: 5925
Title: Use of Botanical Extracts As Pesticides Against Red Spidermites in Tomatoes
Objectives: To assess the effectiveness of some plant extracts in controlling red spidermites in tomatoes
Justification: The red spidermites is a pest of economic importance in tomato, potato and eggplants. Controlling them is the vexing problem facing vegetable growers. No control methods has proved effective against mites so far.

Master No: 5926
Title: Screening of Botanical Extracts In The Control of Diamond Back Moth In Cabbage
Objectives: To assess the suitability of some plant extracts in controlling backmoth in cabbage
Justification: Diamond back moth is a serious pest causing heavy losses on cabbage in summer months. Though chemical control is effective it is expensive and hazardous to the user and environment. Botanical extracts would offer a cheaper, safer and simple method of controlling the pest.

Master No: 5927
Title: Effect of Intercropping In Cotton on Pest Damage on Cowpea
Objectives: To evaluate the beneficial effects of intercropping cowpea in cotton
Justification: Cowpea is prone to attack by a complex of insect pests, but direct protection by insecticide sprays is mostly uneconomical. It is likely that using the spray drift from cotton can benefit cowpea against the insect pests.

Master No: 5928
Title: Studies on Aphids as Vectors of BCMV In Zambia
Objectives: To ascertain the role of aphids as vectors of BCMV and their relative efficiency of transmission of BCMV.
Justification: BCMV is probably the most important disease that limits dry bean production in Zambia. It is transmitted through the seed and is easily spread by aphids in the non-peristent manner. This research attempts to investigate the role of aphid species in BCMV transmission.

Master No: 5929
Title: Effect of Plant Extracts on Pest Incidence in Cowpea
Objectives: To determine the range of insect pests against which plant extracts are effective on cowpea
Justification: At the moment, the most feasible control measure against the pests of cowpea is the use of chemical insecticides. However, these chemicals are too expensive for most of the small scale farmers. Not only that but they are also unfriendly both to the users and the environment. In this

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trial, we are trying to evaluate the locally available plant extracts to control pests of cowpea.

Master No: 5975
Title: Survey For Plant Viruses
Objectives: 1. To diagnose and identify viruses infecting cucurbits
   2. To determine the identity and distribution of BCMV strains
   3. To study viruses occurring in maize and cowpeas
   4. To monitor the cassava uvg CMD pandemic movement in Zambia
   5. To establish viruses known so far to occur in Zambia
Justification: Effective management of viral diseases can only be possible if plant viruses are accurately identified and characterised. The survey findings will therefore positively contribute to this vital prerequisite.

Master No: 6001
Title: Breeding For Disease Resistance in Sunflower For Alternaria and Septoria
Objectives: To screen and evaluate all elite breeding S2 lines for resistance to septoria and alternaria helianthi.
   To quantify the effects of these diseases on yield oil content and other traits.
   To test for general combining ability of the crosses between local and wild germplasm.
Justification: No justification given on the project outline.

Master No: 6002
Title: Detailed Laboratory and Field Studies on Sclerotinia Sclerotiorum
Objectives: To study in the lab sclerotia interactions with trichordema spp.
   To evaluate in the field of sunflower breeding lines with artificial infestation of sclerotia
Justification: White rot is a serious disease once it attacks sunflower and this poses a serious threat to continued production of the crop countrywide.

Master No: 6003
Title: Laboratory and Field Evaluation of Sunflower Breeding Lines Against YRSVD
Objectives: To evaluate sunflower breeding lines for resistance to YRSVD after aphid transmission of the virus.
   To develop elite material resistant to the YRSVD.
Justification: Previous work has indicated a 25-30% yield reduction due to YRSVD. This sunflower breeding lines before they can be used in producing F1 hybrids for testing and trial release at National level.

Master No: 6004
Title: Polycross Progeny Selection - Sunflower
Objectives: 1. To develop a new composite sunflower variety possessing soft hulls
   2. To incorporate disease resistance genes through backcross from wild germplasm, tolerant cultivated germplasm and ability.
   3. To assess the performance and resistance of polycrosses against the major pathogens for general combining ability.
Justification: Currently grown composite sunflower varieties possess a hard hull difficult for vitilage level processing. Moreover the foreign germplasm show for soft hulliness is susceptible to most of the local diseases hence a backcross program will be needed to improve the disease resistance in the final polycross progeny to be released.

Master No: 6078
Title: Biological Control of Cassava Mealybug (Phenacoccus manihoti) and Green Mites (Mononychellus)
Objectives: To alleviate the food shortages and other losses due to cassava mealybug and green mites.
Justification: Cassava is a very important staple food in northern, Luapula and North-Western Province was severely damaged by cassava mealybug and green mites. The most vulnerable sectors of the population depended on cassava and they had little scope for switching to other crops. The progressive spread of cassava mealybug and green mites across the cassava belt from 1982-89 caused near famine conditions in the most severely affected areas.

Master No: 6079
Title: Control of Larger Grain Borer (protephanus Trunctus)
Objectives: To contain larger grain borer outbreak
Justification: The larger grain borer a serious pest of stored maize and dry cassava currently present in Nakonde, threatens spread to other areas of the country if urgent control measures are not put in place. The pest is capable of causing total loss of stored maize and cassava within only six months of storage.
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Master No: 6080
Title: Locust and Grasshopper Control and Surveillance
Objectives: To minimize agricultural losses due to locusts and grasshoppers. To monitor the outbreaks of these pests and carry out ground control using chemicals. To train relevant personnel on the dangers posed by these pests in the high risk areas. To explore the possibility of using pathogens to control these pests.
Justification: Locust and grasshopper infestations are on the increase and the existing resources available to IRLCO-CSA are no longer sufficient to monitor and control all migratory pest outbreaks in Zambia due to their increased commitments to its member countries. There is an urgent need to strengthen the Plant Protection unit to carry out small or outbreaks of these pests which IRLCO-CSA cannot attend to.

Master No: 6085
Title: Bio-efficiency of Seed Treated in Experimental Mobile Seed Dresser
Objectives: 1. To compare the performance of seed treated in the mobile seed dresser and ZAMSEED dressed seeds in the field.
2. To determine if the seeds are traumatized by the experimental mobile seed dresser.
Justification: Small scale farmers plant untreated seeds of crops which are in most cases not produced by local seed companies. There are also some varieties of certain crops which farmers are encouraged to keep seeds over a number of cropping seasons and planted untreated. It is very important for small scale farmers to plant treated seeds in order to prevent crop losses due to non-germination and caused by seed and soil pathogens.

Master No: 6091
Title: Screening Exotic and Local Wheat Germplasm For Disease Resistance - Disease Observation Nursery
Objectives: To select cultivars resistant to wheat diseases in Zambia
Justification: It is important to screen wheat lines for resistance to disease as this factor can cause a substantial yield loss if not checked.

Master No: 6140
Title: Effect of Alternating Insecticides Types On The Control of Bollworms and On Beneficial insects.
Objectives: 1. To determine the best regime of insecticide application when pyrethroids are alternated with insecticides from other families.
Justification: Continuous pyrethroid use might result in insects developing resistance. Limiting their use to a shorter period of the cycle would reduce chances of resistance thereby maintaining the cost of protection at manageable levels in the long run.

Master No: 6162
Title: Breeding For Downy Mildew Resistance
Objectives: 1. To develop resistant sunflower elite lines to downy mildew attack
2. To quantify the significance of this new disease through crop loss assessment
Justification: This disease downy mildew is new in Zambia hence there is need to assess its severity in order to develop sunflower lines that are resistant to the disease.

Master No: 6189
Title: Screening Sweet Potato Cultivars For Resistance To Weevils
Objectives: 1. To identify sweet potato cultivars resistant to the sweet potato weevil.
Justification: Since sweet potato has become an important source of carbohydrate from the tubers and other nutrients from the leaves which are used as vegetables it is imperative that the correct control measures to control the sweet potato weevil which is the most serious pest of this crop be identified. It is also necessary that resistant materials or cultivars be sourced.

Master No: 6435
Title: Finger Millet Blast Yield Loss Assessment
Objectives: n
Justification: n

Master No: 6437
Title: Screening of Finger Millet For Resistance Against Shoot Fly and Stem Borer and Determination of Date
Objectives: To select the resistant varieties and also determine the right date of planting
Justification: n
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Master No: 6438
Title: Screening of Pearl Millet For Resistance Against Shoot Fly and Determination of Date of Planting
Objectives: To select the resistant varieties to pearl millet shoot fly and to determine the right date of planting for the crop to escape damage due to this pest.
Justification: Pearl millet is one of the important crops grown in Western Province and is used as a staple food as well as for brewing. Insect pests are among other factors which reduce the yield. Therefore it is necessary to find ways of protecting it from insect damage by screening its materials for resistance against these pests.

Master No: 6500
Title: Verification of Pest Free Areas of White Tip Nematode of Rice
Objectives: To test rice varieties for pest-free areas of white tip nematode (Aphelenchoides besseyi).
Justification: The presence of nematodes in the seed helps in their spread to new areas due to movement and introduction of planting materials through man's activities. Most of the present varieties are foreign to our country. This particular activity will verify pest-free areas of Aphelenchoides besseyi. Such information greatly assists authorities when deciding on phytosanitary demands exerted by the increased volume of international trade as a result of liberalised market and due to awareness by business communities and governments of the need to satisfy the phytosanitary requirements.

Master No: 7629
Title: The Biology and Taxonomy of Some Indigenous Hymenopteran Parasitoids Associated with Some
Objectives: To discover and describe local parasitoids which may be responsible for natural control of some pests of our main crops.
Justification: Any future biological control programme will depend entirely on identification of parasitoids by using taxonomic characters as a basis of classification of pests and their parasitoids. Taxonomy and Biology is the basis of insect identification before any biological control programme can start. Most pests and parasitoids in Zambia have not been taxonomically and biologically identified. Biological control of cassava mealybug success gives hope for this study.

Master No: 9237
Title: Effect of Tephrosia vogelii and land preparation methods on mole attack to cassava.
Objectives: To evaluate the effect of land preparation on mole attack to cassava
To evaluate the effect of tephrosia vogelii as scattered plants/intercropped with cassava.
To evaluate the effect of tephrosia vogelii as a barrier when planted around the cassava field.
Justification: Cassava is a life saver crop which is tolerant of prolonged tropical droughts and able to grow very well in unfertilized marginal soils. It therefore, pays two important roles on food security and income generation for resource poor farmers in the root crop region of Zambia. Although a number of insect pests and diseases contribute to its yield loss, studies by Sichilima and Zulu showed that mole-rats are also very destructive to commercial tubers up to 46.8%. Efforts by farmers to control these rodents by several traditional methods including digging and trapping are found in effective as these rodents often escape through their complex burrows. According to the recently circulated brochure by Ugandan Scientists, Tephrosia vogelii (Ububa) is potentially observed controlling or repelling mole-rats from the root crop field after the period of one year after planting its seeds. This trial therefore will evaluate the effect of tephrosia vogelii and land preparation methods on the mole-attack to cassava in order to establish safer and affordable

Master No: 9238
Title: Ecological correlates and population dynamics of some rat species associated with a maize crop
Objectives: Identification of some rodent species in Zambia and describe their geographical distribution
Record rodents which are a threat to staple crops in different localities of the country
To develop the early warning systems and simulation tools on rodent pest management.
Justification: Major constraints on improved yield of staple crops in Zambia is drought and poor soils are aggravated by both pre-harvest and postharvest pest damage by insects and rodent species. Average losses of about 15% can be attributed to rats, making them quite important pest (Fransland and Stenseth, 1982). The indiscriminate use of rodenticides is neither efficient nor sustainable especially when farmers economic based strategies on rodent control and management can lead to effective and sustainable measures for resources for resources poor farmers. This Research work will therefore, investigate how the rodents damage to staple crops can be reduced through conceptual parameters of Habitat complexity behaviour and taxonomy of involved species. Based on the acquired knowledge above, early warning systems will be

Master No: 9239
Title: Effect of Field selection and Land Preparation Methods on Mole Attack to Cassava
Objectives: n
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Justification: n

Master No: 6215
Title: Survey of Field Pests of Cereal and Legume Crops and Their Natural Enemies
Objectives: 1. To quantify the abundance of cereal and legume pests in North-Western province
2. Identify natural enemies of such pests
Justification: Targeted crops are reported to have been attacked by unknown pests in the field during the last two seasons.

Master No: 6218
Title: Determination of Threshold Levels For Aphid Control
Objectives: 1. To determine the suitable threshold level for aphid control, the most effective dose of dimethoate and see whether such a programme is economic for the farmer.
Justification: Insect pest control according to threshold levels of infestation would reduce the cost of pest management substantially to contribute towards overall cost reduction and especially for the aphid which has assumed economic importance in recent years. Threshold level is an appropriate tool in decision making for effective control measures. It is thought that there would be a saving in the quantity of insecticides used when control is according to calendar dates.

Master No: 6234
Title: National Survey of Citrus Woolly Whitefly (CWWF)
Objectives: 1. To evaluate the distribution and seriousness of this pest in different agro-ecological zones.
Justification: Zambia has suffered from the introduced insect pests e.g. Cassava Mealybug and larger grain borer. Compared to these the citrus woolly whitefly (CWWF) research communities have looked for solutions of control using exotic parasitoids. A regional programme for control of these pests has been established and the first step of activities is the evaluation of the distribution and seriousness of the problem. Thereafter control measures will follow. The programme has limited funds to extend the survey to all provinces.

Master No: 6318
Title: Survey of Tomato Root-knot Nematode In Chibombo
Objectives: 1. To carry out a Diagnostic survey of tomato root-knot survey in Chibombo in order to establish prevalence and distribution of the pest. 2. To Establish need for root-knot nematode control trials in Chibombo in order to assist small scale producers to increase tomato yields.
Justification: Tomato production is an important source of cash income for many small scale producers in Zambia. Its increased consumption has tremendously hiked demand for the produce, but the yields obtained by these producers is still low due to several soil-borne pathogens mainly Root-Knot nematode. The nematode was recently noted in Chibombo. This survey aims to determine its distribution in the area and establish information for further research on the pest.

Master No: 6337
Title: Evaluation of insecticides for the Control of Sorghum Stem Borers
Objectives: To determine effective insecticides capable of controlling sorghum stem borers with minimum cause of phytotoxicity to the crop.
Justification: To find out and make recommendations to farmers the best insecticides capable of controlling sorghum stem borers effectively. Currently there are no tested recommended insecticides to farmers in Zambia to control Sorghum Stem Borers.

Master No: 6338
Title: Seasonality of Major Pests/inventory of Indigenous Natural Enemies
Objectives: To determine the major Brassica Pests and their indigenous natural enemies.
Justification: Brassicas are important food source of the nation. Therefore it is important to have knowledge of their pests and natural enemies involved in controlling these pests.

Master No: 6339
Title: Dissemination and Awareness of Citrus WWF and Control Methods
Objectives: To make Researchers, Extension staff and Farmers aware of the woolly whitefly a new exotic pest of citrus.
Justification: CWWF is a new exotic pest introduced in the country and only 2 people have knowledge about it. Therefore it is important to make other Researchers, Extension staff and farmers aware of its presence in order to prevent it from spreading to all parts of the country and get some knowledge on how to control it.

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Master No: 6342
Title: Early Leafspot Tolerant Trial
Objectives: 1. To evaluate the stability of leafspot resistance in groundnuts.
Justification: All presently cultivated varieties are susceptible to early leafspot. Leafspot reduces groundnut yields by 20-30%. It is imperative therefore that varieties tolerant to leafspot are identified for incorporation of the desired trait with high yielding varieties.

Master No: 6344
Title: Evaluation of Potential Fungicides For Seed Borne Diseases Control In Rice
Objectives: To evaluate the effectiveness of fungicides against rice seedborne diseases
Justification: Blast is often considered the most serious disease in rice because it spreads rapidly and highly destructive under favorable conditions. It affects plots at any stage of growth the disease is widely spaced in Zambia hence the need to find a control

Master No: 6346
Title: Rossete Resistant Groundnut Trial
Objectives: To identify Rossets resistance groundnut lines
Justification: Presently there is no rossete resistance groundnuts variety. In 1994/95 season 70% of groundnut in Eastern Province were destroyed by the disease. It is time therefore that a deliberate research is carried out to identify rosette resistance varieties to avoid catastrophies in future.

Master No: 6347
Title: Late Leaf Spot Disease Nursery
Objectives: To identify late leafspot resistance lines for use in host plant resistance activities.
Justification: Leafspot is a major disease of groundnuts in Zambia. Yield loss is about 20% from leafspot disease. Farmers cannot afford to spray against the disease. The alternative is to screen for tolerant lines that can be used in the breeding programme against late leafspot. The approach enhances exploitation of host plant resistance

Master No: 6365
Title: Evaluation of The Performance of a Pilot Mobile Seed Dressing Machine With Small Scale Farmers.
Objectives: 1. Determination of crop losses incurred by small scale farmers.
2. Promotion of awareness or Importance of seed treatment to small scale farmers.
Justification: Small scale farmers usually keep seeds of certain crops they grow and are planted without being chemically treated. As a result they incur heavy crop losses due to seed and seedling rots caused by seed and soil borne fungi and insects. Introducing farmers to such a practice will alleviate the problem of crop loss.

Master No: 6367
Title: Development of IPM For Control of Cercospora Angolensis of Citrus.
Objectives: 1. Screening of four chemicals (i.e. Benomy, Bravo, Dithane, m5% and Bresan to control C. Angolensis.
2. To determine appropriate cultural practices to reduce on control the disease.
Justification: Cercospora Angolensis is a very serious disease on citrus reportedly throughout the country. It attacks all the stages of the fruit and crop losses exceed 80% in many cases. Many growers have even abandoned citrus growing because of this disease. Breeding for resistance is a very long term process and therefore it is important to establish IPM strategies.

Master No: 6368
Title: Chemical Control of Mildrew On Mangoes.
Objectives: 1. To screen four chemicals (i.e. Bravo, Dithane, M45, Karathane and copper oxychloride) to control mildrews.
2. To determine the suitable spraying interval (i.e. 2 and 4 weeks).
Justification: Heavy mildrew of late have been causing heavy losses on mangoes in the country. It causes heavy flower fall, serious fruit and leaf spots. There are no proper recommended chemical control measures and therefore it is important to evaluate chemicals for control of this disease.

Master No: 6401
Title: On-farm Rosette Virus Evaluation.
Objectives: To verify the yield performance of Rosette tolerant groundnuts cultivars of farmers' fields.
Justification: The 1994/95 season Rosette outbreak had destroyed 90% of the groundnut crop in Eastern
Province. All the varieties cultivated are Rosette susceptible. A number of varieties have been identified. These varieties are Rosette tolerant and high yielding there is a need to verify the performance of these promising varieties on farmers’ fields.

**Master No:** 6407  
**Title:** Screening of Bean Varieties, Advanced Lines and New Collections Against Aluminium Toxicity  
**Objectives:** To screen Beans for Al toxicity.  
**Justification:** Lime application is unaffordable and difficult to small scale farmers in Zambia. The bean yields are quite low due to problem soils mainly due to Al toxicity. The present study therefore would generate material tolerant to Al toxicity and expected to reduce the cost of cultivation. These would be sustainable to bean production and later can be used as donor parents to transfer these genes to other local varieties.

**Master No:** 6428  
**Title:** Comparison of Improved and Local Sorghum Cultivars For Storage Qualities.  
**Objectives:** 1. To determine the hardness of improved and local sorghum cultivars and correlate it to storage quality.  
2. To ascertain the effect of kernel size on weevil attacks.  
3. To compare the storability of improved and local cultivars.  
**Justification:** Previous work has proved that Sorghum Cultivars differ in their susceptibility and attractiveness to stored products insects. This variation probably depends on physico-chemical structure of the grain. It is necessary to search for factors responsible for susceptibility so as to have this information available for future breeding programmes.

**Master No:** 6501  
**Title:** Survey of Seed Gall Nematode in Wheat.  
**Objectives:** To carry out a verification survey of Seed Gall Nematode in wheat and determine if it occurs in the wheat growing areas of Zambia.  
**Justification:** Recently there has been an increased importation of wheat seed for planting. The wheat is later exported as wheat bran used in animal feed. There are phytosanitary requirements to declare that certain pests do not occur in the production areas in the exporting country. Due to recent use of foreign wheat seed for planting, it is important to find if Seed Gall nematode occurs in order to fulfill demands and conditions of the importing country.

**Master No:** 6511  
**Title:** Distribution and Importance of Moles in Cassava in Northwestern Province of Zambia  
**Objectives:** To establish the distribution of moles.  
To gain the information on the scale of loss.  
To develop some ecologically sustainable and affordable control strategies for moles for small scale farmers.  
To increase the yield of cassava and sweet potatoes.  
**Justification:** Recent reports from few farmers in regions III have shown that moles are also important pests to cassava and sweet potato. There have been no work to establish the distribution and the magnitude of loss the moles cause on cassava and sweet potato instead of the obvious attack on the crops. There is need therefore, to carry out a survey in northwestern province to establish the importance of the rodent before control measures could be put in place. Apart from several other diseases and pests being production constraints of cassava and sweet potatoes, recent reports from some farmers in Northern and Luapula Provinces have shown that despite mole-attack is overlooked, they are also a serious problem which needs to be addressed. Work on rodents by Mwanjabe (1991) and Mmopelwa and Moruti (1991) and largely concentrated on the General species of Rodents than on Moles. The study by Jarvis and Sale (1971) in East Africa was just centered on the surrounding and burrow patterns of moles. No work has been carried out on moles in Zambia despite the severe damage they incure in cassava and sweet potato. There is need therefore, for a survey to establish the distribution and the magnitude of losses caused by rodents/moles in Zambia, Zulu (1991).

**Master No:** 6512  
**Title:** Efficacy of Plant Materials against Storage Insects  
**Objectives:** 1. To compare the effectiveness of three plant materials: neem, masekasi and guava leaf powder against Sitophilus spp.  
2. To determine the maximum period grain is protected from insect infestation.  
3. To assess the effect of these treatments on grain viability.  
**Justification:** Despite the approval for the use of synthetic insecticides concern remains over their use. Chemicals pollute the environment and are hazardous to use. Furthermore, insects are becoming increasingly resistant to insecticides. Consequently alternative methods for controlling insect
infestation are needed and various methods have already been investigated.

Master No: 6520
Title: Bio-control of Citrus Whooley Whitefly.
Objectives: 1. To implement a sustainable biological control strategy to contain this pest.
2. Initiate and maintain a culture of CWWF on potted caged citrus seedlings.
3. Import and mass rear the natural enemies of CWWF i.e. cale noacki.
4. Release these natural enemies into selected fields and assess their establishment, spread and impact on citrus wooly whitefly.

Justification: Repeated use of pesticides to control this pest is expensive, harmful to man and the environment and lead to outbreaks of secondary pests such as mealybug, scales and development of resistance. Biological control provides a ready alternative. Natural enemies have been imported and used successfully to control it. It is environmentally safe, specific and self sustaining once the natural enemies are established.

Master No: 6522
Title: Armoured Cricket Training
Objectives: 1. To make farmers aware of the damages caused by the armoured cricket.
2. To educate farmers different control methods in order to reduce or minimise damage caused by armoured crickets.

Justification: Armoured cricket is a serious pest of cereals and Non-Cereals in regions 1, 11 and part of the copperbelt (Mpongwe). Despite an outcry from the farming communities concerning the damage caused by this pest, no proper advice of its control has been given due to little knowledge available with the Agricultural officers in these affected areas. Hence the need to conduct field days or training courses.

Master No: 6523
Title: Development of Integrated Pest Management (IPM) package of control of blight (Alternaria sp.) of sweet potato.
Objectives: 1. Identification of feasible cultural practices to control the blight.
2. Screening of three chemicals (Zoom, Bravo and Dithane M45) with a view of incorporating the successful candidate in the IPM package.

Justification: Sweet potato leaves (Kalembla) is a very important crop more especially among the low income group. It serves both as a cash crop and as a food. Of late this crop has been attacked by a blight (Alternaria sp) and this has caused a lot of concern among growers. In order to alleviate these concerns it is therefore important to develop a feasible blight IPM package.

Master No: 6527
Title: Disemination and Enforcement of Fumigation Rules and Regulations.
Objectives: 1. Create a code of conduct for the practice of fumigation
2. To ensure that grain bran exports abide by International regulations
3. To train trainers in the Art of Fumigation practise
4. To monitor fumigations and this fumigators and their fumigation practise
5. Verification of fumigation certificates
6. Ensure that all grain imports met international standards.

Justification: Emphasis has been placed onto non-traditional and traditional exports which entails the nation to create export confidence in our foreign markets. Major crops for export are fresh cut flowers and vegetables. In recent past, the export of traditional crops has seen an upswing especially to the Democratic republic of Congo, Namibia and Tanzania. International regulations stipulate that exports must be free from moulds and live insects.

Master No: 6531
Title: Factors affecting control of cassava mealybug, phenacoccus manihotii, in Zambia
Objectives: 1. To investigate factors responsible for persistence of high mealy bug infestations.
2. To identify causes for the poor performance of Aphaenogyrus lopexi in some parts of Luapula Province.

Justification: Release and establishment of the parasitic wasp Aphaenogyrus lopexi have brought the pest population of the cassava Mealybug below warning levels in many parts of Zambia. The pest however, still continues to persist in high densities in some other parts of the country especially in Samfya district, despite the presence of A. lopexi. The factors responsible for these negative effects on biological control need to be investigated so that intervention strategies can be put in place.

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place and further experiments carried out for correct recommendation on control.

Master No: 6555
Title: Distribution and Importance of Cassava Root Rots and Termites.
Objectives:
To establish causal factors of root rots.
To determine distribution and importance of root rots and termites.
To develop the relevant control approaches to reduce damaged induced on Cassava.

Justification:
Root Rots are mainly due to attacks of the tuberous roots by various soil-borne pathogens often as a result of either injuries during cultivation practices as weeding and partial harvesting or when tubers overstay underground. Crop yield losses due to root rots can be up to more than 80%. During the last two years, severe Cassava root rots have been increasingly reported. However, no information is yet available on their cause, distribution and economic importance.

The study on termite control needs to be supplemented with research to determine the extent of distribution and damage due to termites as well as the biology of the pest. The factors influencing termite damage to Cassava also to be determined (farmers' perception of the problem).

Master No: 7604
Title: Comparison of dosage of cypermethrine at different spray frequencies for the control of boll worms.
Objectives:
1. To determine the optimal dosage of cypermethrine and the most effective frequency of application.

Justification:
Insecticides have differing persistence and effectiveness. It is thought that the commonly used insecticide on the market (cypermethrine) be assessed so as to find its optimal dose frequency and consequently help farmers improve the efficiency of insect pest control.

Master No: 7605
Title: Determination of Effective Dosage of Carbosulfan In Aphids (Aphis Gossypii) Control
Objectives:
To determine the effective dosage and the level of infestation for effective control.

Master No: 7606
Title: Response of Varieties To Pest Pressures Under Different Spray Regimes.
Objectives:
1. To precise results of the scouting method as a tool for spray timing
2. To compare the fixed standa spray regime to scouting.

Justification:
There are three varieties now released for commercial production. It is desirable that the two new entries be evaluated on their response to pest pressure especially F135 which is technologically superior to the others. It is also found necessary to emphasise the application of insecticides according to threshold levels as a means of reducing overall cost of production of the crop for the farmer.

Master No: 7607
Title: Comparison of Insecticide Application Techniques.
Objectives:
1. To compare the performance of the two available spray techniques on their control of pests
2. To compare the effectiveness of insecticides in controlling bollworms.

Justification:
Due to the effect of the drought in the last few years, water has become a problem in most of the cotton growing areas. Labour has also become limiting due to rural urban migration of the able bodied family members. The U.L.V. sprayer to be tested will reduce the labour burden of collecting alot of water which is required for the knapsack and also save on time and the high volume water requirement.

Master No: 7642
Title: Survey of White Grubs (Heterotrichia Serrata) and Gall Midge (Orseaola Oryzae).
Objectives:
To investigate the exact time when infest occurs.

Justification:
The unpredictable outbreak of insect pests in the growing area need a survey to forecast the safe periods of planting rice as these insect pests cause: The white grub in particular cause economic damage and the Gall Midge cause reduction in yield due to damage caused on the main stem during early vegetative phase.

Master No: 7677
Title: Population Dynamic of Maize Stem Borer and Their Natural Enemy. (New title:Population Dynamics of Maize Stem Borer and Their Natural Enemy)
Objectives:
Determine population dynamics of stem borers under diverse apps in farmers fields.

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Mass rear, release and monitor C. Sesaniae activity.

Justification: Cotesia Sesaniae is probably the best biocontrol candidate agent for the control of stemborers in Zambia as its resilient and better adapted to control site native stemborers. Results (Mugoya 1995; ICIPE 1992) have shown that it does exert 20 - 30% parasitism on maize stemborers during the 1992-94 cropping seasons. The populations and activity lag behind that of Stemborers hence its timely release will synchronize and append control of host larvae. This parasitoid does not dispaus against host. Rearing does not need sophisticated equipment and facilities. Through augmentative releases the poor carryover numbers in nature can be enhanced and its biological control resourcefulness restored.

Master No: 7687
Title: Control of Root-knot Nematode of Tomato With Natural Plant Extracts
Objectives: To develop practical root knot control package for small scale tomato producers
Justification: Control of Root Knot Nematode Can show a great deal difference between good and poor yields. Use of crop rotation chemicals and resistant seed can effectively control the pest. However, shortage of land and high and high cost of chemicals limit the use these control measures. Similarly resistant seed is expensive is expensive prone to breakdown and not readily available. Therefore, small scale farmers can greatly benefit and improve yields from the use of locally available medicinal plant extracts.

Master No: 7688
Title: Efficiency of Phorate as a Post-emergence Control Nematicide For Root-knot Nematodes.
Objectives: To evaluate phorate for its potential in post emergence efficiency In eradication of root-knot nematodes.
Justification: Until recently nematicides have been applied pre-plant. They require thorough soil preparation and unique appliances. Their phytotoxicity necessitates a waiting period between application and sowing of seeds. These requirements escalate production costs which result in only commercial farmers affording the use of the chemicals. Phorate is claimed to be a post-emergence nematicide which also works as a contact and systemic pesticide. Since it is not feasible to entirely abandon chemicals, it is essential to expose candidate pesticides to judicious evaluation before being recommended for use.

Master No: 7716
Title: Control of Aphids In Cowpeas Using Natural Plant Extracts
Objectives: To come up with an adaptive pest control measure to deal with aphid infestation in cowpeas
Justification: FSRT- in collaboration with the Food Legumes CRT, has been screening on farm a number of improved cowpeas varietiesover the years these early maturing and relatively high yielding have proved very popular with farmers across the province
Aphids can be controlled by a range of pesticides. However a number of factors make these unsuitable for use by small scale farmers: they are expensive, require special handling and are not available generally
Extracts from Tephrosia and Ooimun canum have been tried elsewhere with success to control pests like aphids, these are locally available

Master No: 7941
Title: Effect of Land Preparation and Time of Planting Cassava On Termite Damage
Objectives: 1. To determine the influence of cultural practices on termites in cassava.
2. To reduce damage to cassava due to termites.
3. To increase yield of cassava for small scale farmers.
Justification: Termites destroy cuttings and new cassava sprouts causing poor crop stand and considerable yield loss. Termite damage to cassava in Northern and Northwestern provinces is becoming alarming only chemical treatments have been advocated to control termites. These cannot be afforded by small scale farmers. Hence, the need to develop simple and sustainable approaches to limit termite damage.

Master No: 7942
Title: On-farm Demonstration and Evaluation of Selection of Planting Materials Technology To Increasing
Objectives: 1. To reduce effects of diseases and pests in cassava field
2. To increase yield and quality o planting materials in cassava.

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Justification: Many farmers do not select for propagation most vigorous and healthy cuttings despite numerous advantages. Cassava is vegetatively propagated and is inherently more susceptible to the maintenance, increase and dissemination of diseases and pests that induce crop losses. Implementation of cutting sanitation protocols will increase cassava yields by enhancing plant yield and reducing undesirable pests and diseases in a sustainable way.

Master No: 7943
Title: Biological Control of Cassava Green Mites In Southern Africa
Objectives: 1. To establish agro-ecologies to focus on for releases of natural enemies and monitoring impact.
2. To develop a Bio-Control package to minimize yield losses due to green mites.
3. To increase areas of spread of natural enemies to control the pest.
Justification: CGM has spread to cassava producing areas of Africa inducing yield loss estimated to be 10 - 80%. Natural enemies have been identified among which typhlodromalus aripe has established in Zambia. It reduces CGM by two thirds one established. Sarranet would contribute to distribution of this mite predator by supporting the distribution to other fields and evaluation of its impact.

Master No: 7953
Title: Micropropagation and Virus-screening of Five Zambian Cassava Clones.
Objectives: To screen five Zambian Cassava clones, LucS5, Luc78, Luc133, Luc289 and Luc327 against African Cassava Mosaic Virus (ACMV) using plant tissue culture and DAS-ELISA.
To plant virus tested cassava seed stocks in farmers fields and monitor ACMV re-infection in order to advise farmers when to renew where planting stocks,
Justification: Currently screening against virus in cassava can only be done visually and may not be as efficient as modern systems, which are more reliable such as modern techniques including DAS - ELISA and PGR techniques. Thermotherapy in combination with tissue culture can also be applied and later on virus tested using the above techniques. In the proposed activity we intend to screen against virus using tissue culture and DAS-ELISA. Virus tested material can later be supplied to farmers who will get much higher yields compared to planting virus infected seed.

Master No: 7964
Title: Bean Stem Maggot Resistance Reconfirmatory Nursery.
Objectives: To evaluate and confirm resistance in some pupative sources of resistance.
Justification: Bean stem maggot (BSM) is the most important pest of common bean in Zambia. It is effectively controled by a range of insecticides such as cypermethrin (20%EC 1ml/L) applied as a foliar spray at 2,7 and 14 days after plants emergence, diazion (60% EC 2ml/Kg) as a seed treatment and endosulfan (50%EC 2ml/Kg) seed treatment. However, endosulfan as a seed treatment provides the consistent protection against the BSM throughout the growing season. Most of these insecticides are too expensive for small scale resource poor farmers and the need to evaluate bean varieties that are resistant to the BMS.

Master No: 7965
Title: Strengthening of The Plant Health Inspection and Quarantine
Objectives: To derive a wholesome approach for plant quarantine and phytosanitary service to contribute to national economy by controlling, monitoring and regulating rules for plant movement. To enhance the understanding and functions of PQPS by traders, stakeholders, transporters, MAFF staff and the general public on long term benefits
Justification: Importance of the service has shown that it can contribute to the overall economy by controlling, monitoring and regulating rules for plant movement. To enhance the understanding and functions of PQPS by traders, stakeholders, transporters, MAFF staff and the general public on long term benefits

Master No: 7970
Title: Plant Disease Clinic
Objectives: 1. To identify pests and diseases affecting crop plants.
2. To provide control recommendations.
3. To create a diagnostic reference collection of specimens.
4. To provide services to the farming community and Researchers.
Justification: The farming community experiences a lot of problems caused by diseases and pests on their crops. To help the farmers in this case, it is therefore very important to establish and maintain a facility to identify diseases and pests of crops before control measures are recommended. It is also therefore necessary to have laboratories which are well equipped to facilitate all diagnostic activities.

Master No: 7971
Title: Positioning of plant health Inspectors at Borders
Objectives: 1. To check on phytosanitary standards on plant materials and plant parts entering the country.
2. To follow import regulations on all export commodities.

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3. To advise on control strategies in outlaying areas on all crop protection problems.

Justification:
1. To safeguard the Zambian Agriculture Industry from entrance exotic pests.
2. To control and regulate the movement of plant parts and plant materials without proper documentations.
3. To monitor, regulate and control the movement of noxious weeds.
4. To enforce the legislation and regulation in CAP 346/343 of Laws of Zambia.

Master No: 7977
Title: Effect of Land Preparation and Time of Planting Cassava on Root Rots.
Objectives:
1. To establish causative factors of root rots.
2. To determine the influence of cultural practices on root rots.
3. To develop relevant control approaches to reduce damage induced on Cassava.
4. To increase yield of Cassava for small scale farmers.

Justification: Root Rots are mainly due to attacks of the tubers roots by various soil-borne pathogens, often as a result of either injuries during cultivation practices as weeding and partial harvesting or when tuberous roots are left underground for a prolonged period. Some pathogens causing root rots can induce yield reduction of more than 80%. During the last two years severe Cassava root rots have been increasingly reported. However, no information is available in the country for their cause, distribution and economic importance.

Master No: 8131
Title: Co-ordination CARO Plant Protection and Quarantine
Objectives: No justification given

Justification: No objective given

Master No: 9012
Title: Distribution and Characterisation of ACMV & Cassava Brown Streak Virus and The Effect of the
Objectives: To gain information on the prevalence and magnitude of the disease and the characterisation of the viruses. To assess its influence on Cassava yield. To determine the relationship of symptom expression and plant growth and yield. To measure the rate of disease spread to map out control strategies.

Justification: The need for a survey on this new disease and its effect on yield is apparent as it is being reported in several countries in the region. The investigation will provide information on the epidemiology of the disease and its biology, thus suggesting control approaches to limit its spread.

Master No: 9013
Title: Effect of cassava mosaic disease (CMD) on cassava yield loss
Objectives: To assess the influence of the disease on Cassava yield. To determine the relationship between symptom expression and plant growth and yield components. To map out strategies for control of the disease. To establish relative importance of the disease under farmers conditions (yield loss through survey in farmers fields).

Justification: ACMV remains one of the major diseases that affect Cassava production in all Cassava producing areas of Southern Africa. Loss appraisal through comprehensive surveys and field trials constitutes the only way of determining the status of the disease and its magnitude at farmers conditions.

Master No: 9014
Title: Integrated Pest Management For Control of Cassava Mealybugs and Green Mite By Rotation and
Objectives: To monitor populations and influence of Cassava insect and mite pests under different cropping systems. To assess the influence of IPM on pest population with positive effects on Cassava yields. To establish influences of Pest Damage to Cassava Relative to soil fertility.

Justification: Although outstanding progress has been made in bio-control of CM using exotic natural enemies, CM is still causing severe damage and losses to Cassava in some areas known as hot spots areas. The concern about yield reduction from such long lasting infestation calls for use of appropriate integrated management strategies.

Master No: 9015
Title: Comparative Re-infection Rate of African Cassava Mosaic Virus In Plants of Resistant and
Objectives: To evaluate feasibility of crop sanitation as effective control measure for ACMV across the Southern Africa region. To establish sites with high disease pressure for breeding and low infection for multiplication and propagating cuttings. To understand the disease epidemiology and its vector relationship at various agro-ecological zones. Increased number of planting materials and improved varieties produced constitute key indicators for root crops contribution to overall socio-economic development to poor farmers. To achieve these, proper sites for screening and for multiplication of healthy planting materials should be
established. The trial will provide information on whether crop sanitation for ACMV stands for an effective control strategy throughout.

Master No: 9016
Title: Breeding For Multiple Resistance To Cassava Diseases and Pests
Objectives: To develop high yielding Cassava varieties with acceptable levels of resistance
Justification: Cassava and Sweet Potato diseases and pests are among the major constraints to increased production. Deployment of Resistant genes constitute the most economic way of controlling these biological constraints. This project in initiated to backup national breeder (root crops) in screening various lines for multiple resistance to diseases and pests.

Master No: 9019
Title: Biological Control of Cassava Green Mite In Southern Africa
Objectives: To establish ecological zones which needs to be focused on for the release of new bio-control agents and for monitoring their impact. To develop a bio-control package to minimise losses to Cassava by CGM. To reduce CGM with positive effect on Cassava yield.
Justification: Cassava Green Mite is increasingly become devastating pest to Cassava in Southern Africa. Thus declining considerably Cassava productivity. One of the ecologically sound control measures for pests is a classical bio-control using exotic or local natural enemies. This activity is being partly funded by SARRNET as most species earlier released against CGM have not proven efficient in controlling the pest.

Master No: 9035
Title: Evaluation of Tephrosia Vogelli In The Management of Stem Borers.
Objectives: To determine the minimum number of sprays and the crop stage at high spraying of T. Vogelli aqueous extract produces optimum reduction of stemborer population.
Justification: T. vogelii has a potential to provide a cheaper control option for inclusion in an IPM package. Correct timing of T. vogelii application is important because it should coincide with the crop age when Stalkborer larvae are still feeding on leaves and the number of sprays needed to maximise control and avoid wastage.

Master No: 9036
Title: Biological Control of Stem Borers Using Cotesia Sesamae Parasitoids.
Justification: Cotesia sesamae is probably the best biocontrol agent for the control of stem borers in Zambia as it is resilient and better adapted to control the native stemborer. (results (Magoya, 1995; ICIPE 1992) have shown that it does exert 20-30% parasitism on maize stem borers during the 1992-1994 cropping season the population ad lags behind that of stem borers hence its timely release will synchronise and and append control of host larvae This parasitoide does not diapouse together with hosts. Rearing does not need sophiscated equipments or facilities. Through augmentative release the poor carry over umbers In nature can be enhanced and its biological

Master No: 9115
Title: Distribution and Importance of storage Pests of grains and pulses in North Western Province of Zambia
Objectives: To establish the Distribution of Major storage pests in the Province. To gain information on the extent of loss they cause to stored grain and pulses
Justification: Various insects or rodents pests are categorically responsible for yield reduction in field crops, storage cribs, bins or sillos. Depending on the pest species and prevailing environmental conditions of the area, Yield loss can be variable. Although every stage of crop loss is still unbearable for the farmer, post harvest Loses can be more devastating considering the fact that these losses occur when so much scarce resources are already used. Prevention of such losses can be achieved through timely provision of technical advice on botanical seed dressing and storage engineering Research (Zulu, 1997-98; Sakufwia and Mahone, 1996). Currently Substantial amount of work is done and still being addressed by the national Lager Grain Borer and containment team (Suman et al 1998). Concerted effot is therefore, still needed to identify both major and minor storage pests in the North Western Province of Zambia in oder to document the magnitude of yield

Master No: 9116
Title: Effects of Tephrosia Vogelli and Land Preparation Methods on More Attack to Sweet Potato
Objectives: Evaluation of effect of land preparation on mole attack to sweet potato
Justification: To establish affordable Rodent control measures for small scale

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Master No: 9117
Title: Effects of Fields Selection and Land Preparation Methods on Mole Attack to Cassava.
Objectives: To evaluate the effect of land preparation methods on mole attack to Cassava.
Justification: Currently major loss in yield to moles hard to control.

Master No: 9118
Title: Yield Loss Assessment due to Weed Competition in Rainfed Low Land Rice.
Objectives: To reduce the frequency of weed but without any significant reduction in yield.
Justification: No data available on yield reduction in rainfed low land rice attributed to weed.

Master No: 9130
Title: Plant Virology diagnostics services
Objectives: 1. To provide diagnostics and virus disease control advisory services to farmers and other stakeholders
2. To identify and evaluate seed borne viruses occurring in Zambia
Justification: The prerequisite to any disease control require positive identification of causal agents. Therefore, there is need to strengthen plant virus disease diagnostic services that will assist farmers to identify viruses affecting the crop plants

Master No: 9131
Title: Distribution and importance of cassava Root Rots and Termites
Objectives: n
Justification: n

Master No: 9132
Title: Effect of Land Preparation and Time of Harvesting Cassava on Root Rots
Objectives: n
Justification: n

Master No: 9136
Title: Effects of curing Kraal Manure on weed Infestation and Maize Yield
Objectives: n
Justification: n

Master No: 9137
Title: Maintenance of Rhizobium Germplasm
Objectives: n
Justification: n

Master No: 9143
Title: Control of Cecospora Angolensis on Citrus By Use Of Agro-Chemicals.
Objectives: n
Justification: n

Master No: 9144
Title: Screening of Coffee Varieties for CBD Resistance.
Objectives: n
Justification: n

Master No: 9148
Title: Kenaf Screening.
Objectives: n
Justification: n

Master No: 9153
Title: Multi-Crop Gap Filling Germplasm Collection in Shagombo and Lukulu-Kalabo Areas.
Objectives: 1. Collect germplasm of local species and their wild relatives from areas that were not covered by previous collection missions due to remoteness and inaccessibility.
2. Conserve the fullest range possible of genetic diversity of crop species and their wild relatives.
3. Make available for possible use, the conserved germplasm.
Justification: 1. Shagombo and the rural parts of Lukulu and Kalabo are some of the areas that were not previously covered in collection mission due to inaccessibility and remoteness.
2. Local inhabitants of two areas have been growing crops for their survival and livelihood and hence some diversity in various crop spp is expected to be found.

Master No: 9154
Title: Effects of Tephrosia Vogelli and Land prepreparation methods on Mole Attack to Cassava
Objectives: n
Justification: n

Master No: 9155
Title: Effect of land preparation on Mole Attack.
Objectives: n
Justification: n

Master No: 9161
Title: Biocontrol of the Citrus Wooly Whitefly.
Objectives: n
Justification: n

Master No: 9162
Title: Strengthening and Maintenance of Reference Collection.
Objectives: n
Justification: n

Master No: 9163
Title: Collection and Identification of Red Spider Mite Species in Zambia.
Objectives: n
Justification: n

Master No: 9164
Title: Establishment of Linkage with Weed Control Relevant Institution to Revamp Weed Science.
Objectives: n
Justification: n

Master No: 9166
Title: Virus Diseases Seed Testing.
Objectives: n
Justification: n

Master No: 9168
Title: Plant Virology Clinic.
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Objectives: 
Justification: 

Master No: 9172
Title: Pest Monitoring Using Geographical Information System (GIS).
Objectives: 
Justification: 

Master No: 9188
Title: Establishment of Linkages with relevant Institutions to revamp Weed Science
Objectives: To establish linkage with relevant institutions to revamp weed science research in Zambia
Justification: The establishment of linkages with weed control related organisations will form the basis for weed control particularly in the area of biological weed control

Master No: 9203
Title: Investigation on Natural Enemies of Lucerna Psylid, their spread and impact
Objectives: 1. To collect and rear natural enemies of lucerna
2. Quantification of natural enemies
3. Identification of natural enemies
4. Spread and impact assessment
Justification: Lucerna is one of the important leguminous trees used in Agroforestry on improved fallows. The tree is attacked by several insect pests of which one of the most important is the lucerna psylid. In order to control/manage this pest it is necessary to use environmentally friendly strategies of which one of them is biological control.

Master No: 9204
Title: Field screening of cowpea for resistance to aphid cracciora
Objectives: To identify cowpea lines resistant to aphid cracciora
Justification: The black cowpea aphid aphid cracciora koch is considered one of the most important pests of cowpea wherever the crop is grown especially in low rainfall regions. They cause not only direct damage by feeding on the plants sucking the sap, but also transmit virus diseases such as the aphid-borne mosaic virus. In case of severe infestation, the yield losses can be substantial.

Master No: 9211
Title: Updating Weed Species Distribution and Determine their Abundance in Zambia
Objectives: 1. Study the behaviour of Weeds
2. Collect data for use in ecological weed management research
3. Document the present weed species composition and their abundance.
Justification: Zambia is divided into 3 Agro-Ecological Zones. In each Zone there are different weather patterns and level of soil fertility which have influence on weed grown and adaptability. Aparently there are 10 important arable weed that are commonly found in Zambia. They infest the crops and cause crop losses, but their very little is presently known about their distribution due to succession and shifts in Weed Flora. The information on species abundance is also not available. It is therefore necessary that the survey is carried out to up date the information on weed distribution and determine their abundance in each zone.

Master No: 9252
Title: Implementation of classical Biological Control of the Cassava Green Mite in Zambia.
Objectives: To rear and release CGM natural enemies and multiply varieties preferred by these natural enemies
To monitor CGM and predator populations and measure the predator's impact on the pest and cassava yield
To evaluate breeder lines and farmers' clones for desirable characteristics
To train farmers and create awareness among all stakeholders
Justification: Cassava plays a vital role in the stabilisation of food security in the rural parts of Northern, North-western and Western Province of Zambia. The advent of the cassava Green Mite (CGM) in the early 1980s has since threatened production of the crop and subsequently food security in...
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these marginal areas where cassava is often the main staple food.

Predators in the family phytoseiidae are the most effective natural enemies against CGM. To date all efforts to have these predators established seem to have failed for a number of reasons which include lack of adaptation to the zambia environment. However Typhlodromalus aripo has shown great potential to establish and control CGM.

Master No: 9253  
Title: Evaluating the Potential of indigenous predators as control agents against the cassava green mite  
Objectives:  
To identify indigenous predators that can be used in the control of cassava green mites.  
To assess the predatory potential of selected predators for the control of cassava green mites.  
To develop suitable rearing methods of promising candidate predators  
Justification: The cassava green mite Mononychellus tanajoa is one of the most serious arthropod pests attacking cassava in Zambia. Predators in the family Phytoseiidae are the most effective natural enemies against CGM. To date all efforts have been directed at introduction of exotic predatory mites. These have however failed to establish in the areas where they have been released. Surveys in Luapula indicate that there are a number of predatory mites especially in the Euselus genus and Iphiseius degenerans that are found in close association with the pest.

Master No: 9254  
Title: Evaluation of tomato cultivars for resistance to Red spider Mites (Tetranychus spp).  
Objectives:  
To identify tomato cultivars with tolerance to Red Spider Mites.  
To assess the tomato cultivars for yield and desirable agronomic and quality attributes.  
Justification: Red Spider Mites (RSM) are among the most important pests of tomato and other solanaceous vegetables in Zambia. Mites cause the most severe quantitative yield in the hot dry season (August to October) as well as in the hot rainy season (November to March). Control of RSM has proved rather difficult for small-scale vegetable growers due to poor agronomic practices and narrow range of available control options. Though previous research by the vegetable research programme identified several acaricides that are effective against RSM, these pesticides have largely been out of reach for most small-scale vegetable growers due to their high cost and unavailability on the market. Acaricides like other chemical pesticides are highly toxic and thus pose a health risk to both the small growers and the unsuspecting consumer in addition to other negative effects on non-target organisms such as natural enemies. There is thus need to find alternative effective control tactics in the management of RSM. Some tomato accessions are reported to have some resistance or tolerance to RSM, an aspect that can be exploited in an affordable, effective and environmentally friendly management approach. Moreover, the use of resistant varieties is compatible with other IPM components such as biological control. Resistant cultivars should therefore be identified and evaluated.

Master No: 9260  
Title: Evaluation of Selected Acaricides against Red Spider Mites (RSM) in Tomatoes  
Objectives:  
To evaluate the effect of the acaricides in reducing tomato yield losses due to RSM.  
Justification: Acaricides (standard names) vertemic and talstar have been reported to be effective in reducing RSM damage and subsequent yield losses in tomato. Though some farmers are already using the two pesticides in Zambia, their ability to reduce mite damage and maintain yields has not yet been recorded. It is therefore necessary to evaluate these acaricides so as to establish their efficacy as well as their residual effect on RSM. The information generated from the trial could be utilised directly by farmers to control mites.

Master No: 9261  
Title: Evaluation of Tomato cultivars for Resistance to Red Spider Mites (Tetranychus spp).  
Objectives:  
1. To identify tomato cultivars with tolerance to red spider mites.  
2. To assess the tomato cultivars for yield and desirable agronomic and quality attributes.  
Justification: Red Spider Mites (RSM) are among the most important pests of tomatoes and other solanaceous vegetables in Zambia. Mites cause the most severe quantitative yield losses in the hot dry season (August to October) as well as in the hot rainy season (November-March). Control of RSM has proved rather difficult for small-scale vegetable growers due to poor agronomic practices and a narrow range of available control options. Though previous research by the vegetable research programme identified several acaricides that are effective against RSM, these pesticides have largely been out of reach for most small-scale vegetable growers due to their high cost and unavailability on the market. Acaricides like other chemical pesticides are highly toxic and thus pose a health risk to both small-scale growers and unsuspecting consumers in addition to other negative effects on the non-target organisms such as natural enemies. There is thus need to find alternative effective control tactics in the management of RSM.
Title: Integrated management practices for control of maize grey leaf spot (Cercospora zeae-maydis)

Objectives: 1. Identify sources of resistance,
2. Monitoring the distribution
3. Conduct public awareness to the disease
4. Determine potential fungicides to control the disease
5. Monitor disease in advance in conservation farming system

Justification: 1. New introduced disease
2. Spreading at high rate
3. Most destructive amongst leaf diseases
4. Few resistant hybrids on the market
5. Recommended chemicals not tested in the country

Master No: 9297
Title: Effect of pollen pressure, viasibility, pre- and post-flowering weather conditions on the development of sorghum ergot

Objectives: To determine the effect of pollen pressure viability, pre- and post-flowering weather conditions on the development of sorghum ergot
To determine suitable planting dates

Justification: Ergot is one of the limiting factors in the production of sorghum hybrid seed?
Reduces seed quality
Reduces germination percentage
Has export implications

Master No: 9304
Title: Integrated Management of Cabbage diamond Back Moth (DBM) Plutella Xylotella L. (Leppidoptera)

Objectives: 1. To use Bio-pesticide or bio-compatible Pesticides; Evaluate them on-farm for the control of Diamond Back moth.
2. Assess the efficiency of a microbial pesticide, Bacillus Thuringenesis (BT)
3. Introduce new Natural Enemies; Evaluate those already introduced
4. Evaluate the effect of intercropping of cabbage with calendula, calendula officinalis.

Justification: Diamondback moth - A serious pest of cabbage; causes losses up to 100% in severe cases. Vegetable (Cabbage included) major employer of women and men. It’s a good security crop, hence DBM should greatly threaten the crop. ODM is no exception. Integrated management of this pest is being advocated against this background

Master No: 9307
Title: Management of Larger Grain Borer, P. Trunccaatus Hom (Colleoptera: Bossstrichidae) using

Objectives: To test the efficacy of chemical insecticides on the market on bulk stored grain
To compare the efficacy of chemical insecticides with that of actelic super dust (containing Pirimiphos - Methyl 1.6% cd Permethrln 0.3%

Justification: Larger Grain Borer - a serious pest of stored maize and dried cassava losses due to this pest - rage of 34-70% over a 3-6 months storage period currently only one bleary grain protect at control both Bosstrichidae, where larger grain borer belongs and the normal spectrum of storage pests. This was created a monopoly in pricing cd exaggerates scarcity. There is an urgent need to avail

Master No: 9308
Title: Development of an IPM Package for the control Citrus Red Scale, Aonidiella aurantii (Mushel) Heripea:

Objectives: 1. Evaluate distribution and infestation extent of Citrus Red Scale in the main citrus growing areas in Zambia
2. To screen possible local biological control of agents of A. Aurantii
3. Evaluate current recommended pesticides for efficacy and occurrence of resistance by the pest

Justification: The growing of citrus particularly among the rural population and the peri-urban small-holder farmers, provides an important income generating overview for the resource poor (categories in addition to traditional rate of dietary supplementation. Unlike other pests Citrus Red Scale is a major pest of citrus and the carpert recommended control measures are ineffective in controlling its spread. An IPM package for the control of this pest in different agro-ecological readiness of Zambia be both small-scale farmers and recommend farmers, other related problems related to the pest will be generated from the study.

Master No: 9309
Title: Population fluctuations of key insect pests on cowpea

Objectives: To study the population dynamics of the key insect pests on cowpea

Justification: Cowpea is an important food legume crop grown by many small-scale farmers in low rainfall areas, it also plays an important role in the household food security as a cheap source of protein.

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This crop is attacked by a complex of insect pests whose population dynamics need to be studied.

Master No: 9310
Title: Population dynamics of key insect pests on pigeon pea
Objectives: To determine the population dynamics of the key insect pests of pigeon pea
Justification: For any crop assessment due to a particular pest, it is important to identify the pest population levels and evaluate the damage by the individual pest. This basic study may lead to the development of more effective income of control which is within the means of the local farmers.

Master No: 9311
Title: Dispersal of Typhlodanuelus aripo De leon on different cassava varieties
Objectives: 1. Evaluate population numbers of Typhlodromalus aripo on different varieties
2. Evaluate factors influencing the dispersal of Typhlodromalus aripo.
Justification: Cassava (Manihot Esculenta) has more food energy per given area than any other crop except sugar-cane. It is a good crop. In Zambia it provides for two million people a source of carbohydrate in the rural parts of Luapula, North-western and Western provinces in Zambia, a phytosel - aripo is establishing in samfya, Kazembe, Nkalengwe and Mansa, paving the way for a successful biological control of M. nartiora.

Master No: 9315
Title: Survey of Winter (Irrigated) Wheat Diseases prevalent in Zambia
Objectives: To survey major wheat growing areas in Zambia in order to assess occurrence distribution and severity of common (or important) prevalent diseases (particularly fungal and bacterial) in those localities.
Justification: Wheat is fast becoming one of the major cereals grown in Zambia and many varieties are adaptable to a wide range of climatic conditions. The survey should go a long way in identifying common diseases of wheat in Zambia and thereby advising farmers (including small scale ones) or control recommendations.

Master No: 9316
Title: Establishment of a plant disease clinic and a Plant Pathology Herbarium at NIRS
Objectives: To provide a plant disease diagnostic service at Nanga Research as well as to cater for surrounding areas.
Justification: There is need for a plant disease clinic at other stations in accordance with Decentralisation Policies.

Master No: 9320
Title: Population dynamics of key insect pests on pigeon pea
Objectives: To determine the population dynamics of the key insect pests of pigeon pea.
Justification: For any crop assessment due to a particular pest, it is important to identify the pest population levels and evaluate the damage by the individual pest. This basic study may lead to the development of more effective income of control which is within the means of the local farmers.

Master No: 9331
Title: Virus Disease Seed
Objectives: 1. Screening seeds for viruses
2. Identifying of seed borne viruses
3. Documentation of seed borne viruses
Justification: Most, if not all, economically important crops may become affected with viruses. In most cases, viruses cause a reduction in seed yield and quality. Certain plant viruses are subjected to quarantine. In order to avoid exporting affected seed, it is necessary to do routine virus disease seed testing. From this routine checking of viruses, we shall be able to document all seed borne viruses in the country.

Master No: 9336
Title: Development and Evaluation of Clay/Mud as Mortar in Brick-bin construction
Objectives: To ascertain the effectiveness of using clay as a bonding material in constructing brick bins. To reduce the input cost of constructing the brick-bins by using less cement.
Justification: The cost of cement which is an important component in making cement mortar has in recent years more than doubled making it almost impossible for smallholder farmers to purchase it especially in rural Zambia. Consequently, it has become difficult for small holder farmers to invest in on-farm storage.

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structures especially the brick-bin. Therefore, without a cheaper alternative to cement mortar the adoption of the brick-bin will remain modest among the resource poor farmers.

Master No: 9350
Title: Effect of Termiticides and Hand Weeding on Termite (Termite: Isoptera) Management in Wheat
Objectives: To Strengthen the role of the insectarium of the Entomology Section
Justification: Termites evolved from cockroaches about 150 million years ago. This long legacy gives termites their astounding tenacity and adaptability. The worker caste are the ones that causes the damage and therefore most important in developing a control strategy. Cellulose is the decisive nutritional requirement for termites which they derive from wood, stalk and leaves.

Master No: 9351
Title: Biological Control of Cereal Stem Borers in Zambia
Objectives: To release Cotesia flavipes for the control of Chilo partellus in Luangwa, Seshe and Sinazongwe
Justification: Maize, Sorghum and Millet play an important role in the diet of many Zambian. However, several insect pests are known to infest these cereals. According to Kuhlman and Dedert (1987) the maize stalk borer, Butteosa fusca (Fuller) (Lepidoptera: Noctuidae) can cause losses approximately 10% of the total maize crop. They further said that some research has shown that the presence of one to two larvae per plant may reduce yield by as much as 28%. In addition to B. fusca, there are two important stem borers of cereals - Chilo partellus (Swinhoe) (Lepidoptera: Crambidae) and Sesamia calamistis Hampson (Lepidoptera: Noctuidae). Chilo partellus invaded Africa from Asia sometime before 1930 when it was first found in Malawi (Tams, 1932).

Master No: 9352
Title: Chickpea screening against Heliothis sp. in Zambia
Objectives: To screen the chickpea lines against Heliothis sp.
Justification: Chickpeas (Cicer arietinum L.) are an important source of cheap protein (17%), though not widely cultivated in the country. It is also an important legume which can play a major role as cash crops. The crop can be grown during the winter season preceding a cereal crop. Many households do not grow legumes during the cool season because the temperature is too low.

Master No: 9353
Title: On farm evaluation of some Botanicals for control of major pests on Cowpea
Objectives: To evaluate the effect of botanical leaf extracts in comparison with commercial insecticides for control of flower/pod damaging insects on cowpea
Justification: Cowpea provides proteins to most households in Eastern Province and a part from that, small-scale farmers produce it as a cash crop yet it is very susceptible to many pests. There is need to find botanical leaf extracts which can easily be available to farmers. Moreover, all inorganic insecticides are expensive and hazardous to peasant farmers.

Master No: 9354
Title: Assessing the possibility of the use of Neoseiulus kidaeaeus for the biological control of the Red spider
Objectives: To assess possibility of establishing N. kidaeaeus in tomato fields and its efficiency in control of RSM
Justification: Mites cause the most quantitative yield losses to tomato and other solanaceous vegetables in Zambia. Biological control by use of predatory mites has proved not only economically feasible but also compatible with other control tactics such as cultural practices and biotechnology.

Master No: 9355
Title: Integrated pest management for small scale vegetable production in the Luapula valley
Objectives: To collect baseline data on ecology and biomics of major vegetable pest and diseases in the Luapula valley. To divide low input control strategies for major pests and diseases. To train agricultural extension officers and farmers in various aspects of IPM. To train farmers on how to make crude formulations from locally available materials, for pest control and how to construct simple hand made spray tools from easily obtainable and cheap materials. To train farmers on use of spray equipment, its maintenance and safety procedures. To identify vegetable varieties tolerant to pests and diseases. Pests and diseases are among the major constraints limiting all year round vegetable production in the Luapula Valley. It has been apparent from recent discussions with farmers and field staff that though they are aware of losses caused by pests and diseases, they cannot specify which pests or diseases are causing damage to their crops. Farmers are also unable to differentiate between pests and diseases. There is also common perception by all communities visited that pest and disease problems can only be solved by use of pesticides. The farmers appeared to be unaware
of the potential hazards that improper handling of pesticides.

Master No: 9356
Title: Determination of Critical Period of Weed Competition in Cassava Production
Objectives: To determine the critical period of weed control in cassava production to avoid unnecessary crop losses due to weed interference.
Justification: Apparently, cassava is weeded once towards the end of the rainy season. This practice has not only denied the farmers the valuable economic prosperity, but has also denied the farmers good yields to improve their food security. The situation therefore calls for determination of appropriate weeding times to avoid unnecessary crop losses that occur as a result of weed interference.

Master No: 9357
Title: Development and Evaluation of Different Types of Foundations for the Mud-grass Bin for Grain
Objectives: To promote low cost solid-walled storage structure as an alternative for farmers with limited resources.
To develop a foundation type suitable for a mud-straw storage structure
Justification: The mud-straw silo types of solid wall-bin was first developed in China and has performed well in terms of storing grain at farm level. This technology was however, introduced in Zambia in 1985. Since then no tests have been carried out to determine its effectiveness when built on a raised platform.
There has been an increasing need to provide a variety of cost effective on-farm storage structures for grain storage appropriate for small-holder farmers considering the high input cost

Master No: 9354
Title: Evaluation of Spray Lances in the Control of Red Spider Mites (Tetranychus spp.) in Tomatoes
Objectives: To assess the efficacy of spray lances in reducing mite damage in tomatoes
Justification: Red Spider mites cause enormous reduction in quality and quantity in tomatoes and other solanaceous crops. The aggregatory behaviour of mites underneath the leaves with their ability to enclose themselves in a web have been reported to be a major limiting factor in the effectiveness of contact acaricides. Studies done at natural resources institute (NRI) and elsewhere in the world suggest that acaricides effectiveness can be enhanced by improved targeting of spray mist by use of v-lances. There is need to evaluate these spray lances. So as to assess its ability to assisting to reduce yield losses caused by mites.

Master No: 9365
Title: Population Dynamics/Incidence of Aphids on Cowpea + Groundnuts and Identification of Natural Enemies
Objectives: To assess the levels of population density of aphids and the onset of natural enemies
To identify the natural enemies.
Justification: Aphids cause yield losses of between 60-80% through sucking sap from stem tissues, tender growing shoots, leaves, flowers and virus disease which cause stunting and distortion of foliage and stem. It is very important to know population dynamics of this pest and its natural enemies so that in future it could be controlled using biological control agents.

Master No: 9366
Title: Integrated pest management for small scale vegetable production in the Luapula valley
Objectives: n
Justification: n

Master No: 9367
Title: Damage levels and ecological studies of some rat species associated with maize crop
Objectives: n
Justification: n

Master No: 9368
Title: Production of Virus-tested cassava cuttings in Zambia
Objectives: To produce virus-free cassava clones
To micropropagate and distribute planting materials
To conserve virus-free cassava germplasm collections
Justification: Pearl millet downy mildew is prevalent in all areas where susceptible local varieties are grown. The yield loss potential can reach 80%. It is necessary that resistant sources be identified for use
in the breeding programme.

Master No: 9369
Title: Identification and control of diseases of rain fed and irrigated tomato (Lycopersici esculentum)
Objectives: To identify pathogens/strains affecting tomato production in Zambia
To evaluate the efficacy of fungicides
Justification: Heavy losses (up to 100%) are incurred due to diseases by both small and large scale farmers
who are involved in tomato production in Zambia. They have been an increase of
pathogens/strains (Mt. Makulu pers. Comm. (this can be attributed to a number of factors; some of
these are liberalization of seed market which has led to importation of seed from different parts of
the world. This may have resulted in the introduction of new diseases previously not found in the
country. Use of the same pesticide (s) from year to year may also result in change in sensitivity
of a pathogen, which results in decreased sensitivity to a fungicide. Proper identification of
pathogens/strains and correct control measures is the key to reduction of expenses on inputs.

Master No: 9370
Title: Occurrence of Tomato spotted wilt virus in paprika (TSWV) in Zambia
Objectives: To identify TSWV in paprika
To evaluate the prevalence of the virus in different sites
Justification: TSVW causes huge losses in a number of crops of which tomato is no exception (CABI, 2000).
Losses may be as high as 100%. Symptoms such as stunting and yellowing of the whole plant,
leaf distortion, irregular fruit ripening have been observed in tomato samples in farmer's fields in
Zambia (Mt. Makulu pers. comm.) It is important to correctly identify the virus to avoid losses.
Currently there is no scientific report on TSVW in Zambia. The research when completed will
contribute to the viral database and empower farmers on how to reduce crop losses

Master No: 9371
Title: Survey of Cucurbits (Cucubita pepo) and sunflower (Helianthus annuus) viruses in Zambia
Objectives: To identify viruses affecting growth of the two crops
To determine the virus strains for the two crops
To evaluate the prevalence of the viruses affecting the two crops
Justification: Viruses In both cucurbits and sunflower cause severe losses. Symptoms (leafe distortion,
stunted growth and blotches) have been observed In Mount Makulu, Kabwe and Choma.
There has never been any research on the viruses affecting the growth of the two crops
particularly on sunflower. Correct diagnosis of the pathogen affecting yield levels will lead to
application of correct remedies and this will ultimately reduce crop losses and market quality. This
will also avail important information to the plant breeders as well as stakeholders in crop protection

Master No: 9372
Title: Management of tomato fungal diseases using mulch
Objectives: To investigate the effect of mulching on the incidence and severity of some of the common fungal
diseases of tomatoes in Zambia
Justification: Tomato is one of the most important vegetable crops in Zambia and its market value is increased
when grown during the rainy season. The four diseases, namely: Early Blight (Alternaria solani); Late Blight (Phytophthora infestatans);
Septoria Leaf Spot (Septorda lycopersic) and Buckeye Rot (Phytophthora nicotianae var.
parasitica) are quite common during the rainy season in most varieties of tomatoes

Master No: 9373
Title: Screening of Resistance to Major Cassava Pests and Diseases
Objectives: To backstop the breeders in the development of resistant varieties
To reduce yield losses that are induced by pest/disease attack
Justification: Cassava mosaic disease, Mealybug, Green mite and termites are major threats to cassava
production in Zambia and in the sub-saharan region. Most local cultivars are low yielding and
susceptible to major pest and diseases. Hence the need to develop high yielding cassava varieties
with acceptable levels of resistance.
## Annex 4

### Pesticide List and Formulation Based on Selected Crops to be Highlighted During the Initial Phase of the Project

<table>
<thead>
<tr>
<th>Crop</th>
<th>Family</th>
<th>Target Pest</th>
<th>USE Restrictions</th>
<th>Ph. Group</th>
<th>REG NO</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sorghum</strong></td>
<td><strong>Sorghum</strong></td>
<td><strong>Sorghum</strong></td>
<td><strong>Sorghum</strong></td>
<td><strong>Sorghum</strong></td>
<td><strong>Sorghum</strong></td>
</tr>
<tr>
<td><strong>Maize</strong></td>
<td><strong>Maize</strong></td>
<td><strong>Maize</strong></td>
<td><strong>Maize</strong></td>
<td><strong>Maize</strong></td>
<td><strong>Maize</strong></td>
</tr>
<tr>
<td><strong>Rice</strong></td>
<td><strong>Rice</strong></td>
<td><strong>Rice</strong></td>
<td><strong>Rice</strong></td>
<td><strong>Rice</strong></td>
<td><strong>Rice</strong></td>
</tr>
<tr>
<td><strong>Other Crops</strong></td>
<td><strong>Other Crops</strong></td>
<td><strong>Other Crops</strong></td>
<td><strong>Other Crops</strong></td>
<td><strong>Other Crops</strong></td>
<td><strong>Other Crops</strong></td>
</tr>
</tbody>
</table>

**KEY**
- **P** = Plant registration
- **F** = Fungus registration
- **A** = Animal registration
- **G** = General registration
- **B** = Broad Leased Market

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## Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

### Table of Crop Insecticides

<table>
<thead>
<tr>
<th>Crop</th>
<th>Insecticide</th>
<th>Active Ingredient</th>
<th>Family</th>
<th>Target Pests</th>
<th>Restrictions</th>
<th>Origin</th>
<th>REG NO.</th>
</tr>
</thead>
</table>

- **Key**
  - (G)—Kenyan registration by the Pest Control Products Board (PCPB)
  - (SA)—South Africa registration
  - (UK)—United Kingdom registration
  - (USA)—United States of America registration
  - (FR)—French registration
  - (Z)—Zimbabwe registration

### Global Development Solutions, LLC

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**Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Pest Name</th>
<th>Active ingredient</th>
<th>Family</th>
<th>Target Pest</th>
<th>Use Restrictions</th>
<th>PK Code</th>
<th>REG No.</th>
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<tbody>
<tr>
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</table>

**Key**
- SC: Canadian registration by the Pest Control Products Board (PCPB)
- SA: South Africa registration
- UK: United Kingdom registration
- FR: French registration
- US: United States of America registration

**Abbreviations**
- B: Borehole
- RH: Rice Head
- NA: Not applicable
- F: Field
- A: Air
- S: Soil
- Aphis: Aphis
- Bemisia: Bemisia
- Bollworm: Helicoverpa armigera
- Bt: Bacillus thuringiensis
- Bean leaf blight: Phakopsora pachyrhizi
- Leaf blight: Alternaria
d- Whitetail spider mite: Tetranychus urticae
- Thrips: Thrips
- Leaf miner: Liriomyza

---

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## Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

<table>
<thead>
<tr>
<th>Crop Name</th>
<th>Family</th>
<th>Active Ingredient</th>
<th>FAMILY</th>
<th>TARGET PEST</th>
<th>USE RESTRICTIONS</th>
<th>REG. NR.</th>
<th>SRC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungicides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper Sulfate</td>
<td>Copper Sulfate</td>
<td>Copper acetate</td>
<td>Copper</td>
<td>B. Gl</td>
<td>Not Listed</td>
<td>1254125</td>
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<tr>
<td>Pesticide</td>
<td>Pesticide</td>
<td>Propiconazole</td>
<td>Propiconazole</td>
<td>E. Gl</td>
<td>Not Listed</td>
<td>5736203</td>
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<tr>
<td>Herbicides</td>
<td>Herbicides</td>
<td>Imazethapyr</td>
<td>Imazethapyr</td>
<td>A. Gr</td>
<td>Not Listed</td>
<td>1321349</td>
<td></td>
</tr>
<tr>
<td>Insecticides</td>
<td>Insecticides</td>
<td>Imidacloprid</td>
<td>Imidacloprid</td>
<td>L. Hg</td>
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<td>1297764</td>
<td></td>
</tr>
</tbody>
</table>

**KEY**
- (K) Kenyan registration by the Pesticide Control Board (PCB)
- (SA) South Africa registration
- (UK) United Kingdom registration
- (EU) European registration
- (FR) French registration
- (BA) Brazil registration
- (IL) India registration
- (US) USA registration

<table>
<thead>
<tr>
<th>A</th>
<th>Acpidae</th>
<th>B</th>
<th>Bacteroides</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB</td>
<td>Beef Brs.</td>
<td>B. Gl</td>
<td>Bacterial Anthrax</td>
</tr>
<tr>
<td>Ce</td>
<td>Cantharidae</td>
<td>B. Gl</td>
<td>Bacterial Anthrax</td>
</tr>
<tr>
<td>CN</td>
<td>Capitulidae</td>
<td>B. Gl</td>
<td>Bacterial Anthrax</td>
</tr>
<tr>
<td>Lc</td>
<td>Leaf Miner</td>
<td>Fm</td>
<td>Predatory Insect</td>
</tr>
<tr>
<td>RP</td>
<td>Running Insect Pests</td>
<td>Th</td>
<td>Ticks</td>
</tr>
<tr>
<td>RMS</td>
<td>Red Spider Mite</td>
<td>B</td>
<td>Bacteroides</td>
</tr>
<tr>
<td>Crop</td>
<td>Trade Name</td>
<td>Manufacturer</td>
<td>Active Ingredient</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>--------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Maize</td>
<td>Salute</td>
<td>Syngenta</td>
<td>Fludioxonil</td>
</tr>
<tr>
<td>Cotton</td>
<td>Bahril</td>
<td>Bayer CropScience</td>
<td>Bacillus subtilis</td>
</tr>
<tr>
<td>Sugarbeet</td>
<td>Desio</td>
<td>Monsanto</td>
<td>Metalaxyl</td>
</tr>
</tbody>
</table>

**Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)**

**KEY**

[A]: South Africa registration
[B]: United Kingdom registration
[USA]: United States of America registration
[F]: French registration
[N]: Norwegian registration

<table>
<thead>
<tr>
<th>(USA)</th>
<th>(South Africa)</th>
<th>(UK)</th>
<th>(France)</th>
<th>(Norway)</th>
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</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Active Ingredient Families:**

- Fenvalerate
- Fipronil
- Imidacloprid
- Thiamethoxam

**Target Pests:**

- Bacterial leaf blight
- Root rot
**Crop** | **Stage**
---|---
Herbicides

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Manufacturer</th>
<th>Active Ingredient</th>
<th>Family</th>
<th>Target</th>
<th>Usage Restrictions</th>
<th>Origin</th>
<th>REG No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bident</td>
<td>CLEO</td>
<td>Cyanazine</td>
<td>Triazine</td>
<td>GLW</td>
<td>Pre-emergence</td>
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</tr>
<tr>
<td>Esumo</td>
<td>CLEO</td>
<td>EPTC</td>
<td>Chlorothalonil</td>
<td>GLW</td>
<td>Pre-emergence</td>
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<tr>
<td>Leena</td>
<td>CLEO</td>
<td>Atrazine</td>
<td>Atrazine</td>
<td>GLW</td>
<td>Pre-emergence</td>
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<td>3977</td>
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<td>Linura</td>
<td>CLEO</td>
<td>Linuron</td>
<td>Linuron</td>
<td>GLW</td>
<td>Pre-Post-em</td>
<td>USA</td>
<td>2887</td>
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<tr>
<td>Sorben</td>
<td>CLEO</td>
<td>Metazole</td>
<td>Metazole</td>
<td>GLW</td>
<td>Pre-emergence</td>
<td>USA</td>
<td>6749</td>
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Fungicides

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Manufacturer</th>
<th>Active Ingredient</th>
<th>Family</th>
<th>Target</th>
<th>Usage Restrictions</th>
<th>Origin</th>
<th>REG No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absor</td>
<td>CLEO</td>
<td>Oxamocarb</td>
<td>Oxamocarb</td>
<td>GLW</td>
<td>Pre-emergence</td>
<td>USA</td>
<td>6132</td>
</tr>
</tbody>
</table>

Insecticides

<table>
<thead>
<tr>
<th>Trade Name</th>
<th>Manufacturer</th>
<th>Active Ingredient</th>
<th>Family</th>
<th>Target</th>
<th>Usage Restrictions</th>
<th>Origin</th>
<th>REG No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backpack</td>
<td>CLEO</td>
<td>Thiodan</td>
<td>Thiodan</td>
<td>GLW</td>
<td>Pre-emergence</td>
<td>USA</td>
<td>40219</td>
</tr>
<tr>
<td>Gauze</td>
<td>CLEO</td>
<td>Bluestar</td>
<td>Bluestar</td>
<td>GLW</td>
<td>Pre-emergence</td>
<td>USA</td>
<td>3A995</td>
</tr>
<tr>
<td>Kacho</td>
<td>CLEO</td>
<td>Kanzan-2</td>
<td>Kanzan-2</td>
<td>GLW</td>
<td>Pre-emergence</td>
<td>USA</td>
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<tr>
<td>Stock</td>
<td>CLEO</td>
<td>Stockstar</td>
<td>Stockstar</td>
<td>GLW</td>
<td>Pre-emergence</td>
<td>USA</td>
<td>40219</td>
</tr>
</tbody>
</table>

**KEY**

- [K]Kenyan registration by the Kenya Plant Protection Board (KPPB)
- [SA] South Africa registration
- [UK] United Kingdom registration
- [EU] European Union registration
- [FR] French registration
- [SP] Spanish registration

*Crop*: Grass; *Stage*: B = Broad-leaved Weeds; *Cy* = Crops; *GL* = General Leaf Spot; *A* = Aphids; *Th* = Thrips; *Gr* = Grass; *Bo* = Borer; *Cy* = Crops; *Lo* = Long Leaf Spot; *St* = Stalk Borer; *LS* = Leaf Spot.
Annex 5

ZEGA Guideline for Banned and Restricted Pesticides

National governments and international institutions have been concerned about pesticides for decades and try to ban the most hazardous ones. WHO, FAO, UN and the EU have done studies or made overviews of products whose sale and use have been banned, restricted, withdrawn, severely restricted or not approved by governments world-wide.

The general opinion is that users must:

- Try and avoid pesticides containing active ingredients that are considered to be extremely or highly hazardous (WHO classification class la and lb, Table 1).

- Try to avoid active ingredients whose use is forbidden by the EU Directive 79/117 which lists active ingredients of pesticides for which marketing and application is forbidden in the EU (Table 1).

- Try to avoid Persistent Organic Pollutants, POPs, as classified by the UN Economic Commission for Europe (UNECE). (Table 1). These are on to be banned in the near future.

- Not use any of the active ingredients that are on the list developed in 1994 by the Department for Policy Co-ordination and Sustainable Development from the UN. This list gives an overview of products whose consumption and/or sale have been, restricted, withdrawn, severely restricted or not approved by governments world-wide (Table 1).

Technical products not included in the WHO classification and believed to be obsolete or discontinued for use as pesticides are listed in Table 2.

The solubility, half life and soil absorption index of agricultural chemicals help predict the potential for leaching into underground water and run off with surface water. These chemical characteristics have to be considered alongside the soil characteristics to be able to predict run off and leaching potential.

Table 3 lists pesticides with a large leaching potential.
Table 4 lists pesticides with large run off potential.
Table 5 lists substances that are most dangerous to the Aquatic environment.
To minimise the risk of pollution these products should be used only when necessary.
Table 1.  List of pesticides that should be avoided if possible:

<table>
<thead>
<tr>
<th>Pesticides according to:</th>
<th>WHO</th>
<th>79/117/EEC</th>
<th>POPs</th>
<th>UN</th>
<th>Banned in EC</th>
</tr>
</thead>
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### Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

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**Herbicides and fungicides**

Global Development Solutions, LLC
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### Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

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### Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

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<tr>
<td>Acetylene</td>
<td></td>
<td>x</td>
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<tr>
<td>Acrylonite</td>
<td></td>
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<tr>
<td>Arsenic acid and arsenates</td>
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<td>x</td>
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<tr>
<td>Bromomethane</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Fumirion (with mercury)</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Safrole</td>
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<tr>
<td><strong>Multiple-use pesticides</strong></td>
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<tr>
<td>(more than two uses)</td>
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</tr>
<tr>
<td>Aldicarb</td>
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<tr>
<td>Carbaryl</td>
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<td>Chloroform</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>DNOC</td>
<td>I b</td>
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<tr>
<td>Metaphos</td>
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<tr>
<td>Parathion</td>
<td>I a</td>
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<tr>
<td>Parathion methyl</td>
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<td>Pentachlorophenol</td>
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<td>Phenarsazine chloride</td>
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<td>Quintozene</td>
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<tr>
<td>Selenium and selenium compounds</td>
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<td>X</td>
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<td>Thiofos</td>
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<tr>
<td>Triazophos</td>
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<td>2,4-Dinitrophenol</td>
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<td><strong>Nematicides</strong></td>
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<tr>
<td>Chlorpropylate</td>
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<tr>
<td>Fenamiphos</td>
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<tr>
<td>Thionazin</td>
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<tr>
<td>Zinophos</td>
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<tr>
<td>1,2-Dibromo-3-Chloropropane (DBCP)</td>
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<td><strong>Rodenticides</strong></td>
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<tr>
<td>Aluminium phosphidex</td>
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Global Development Solutions, LLC
## Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

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<th>WHO</th>
<th>79/117/EEC</th>
<th>POPs</th>
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<th>Banned in EC</th>
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<td><strong>Calcium cyanide</strong></td>
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<td><strong>Difenacoum</strong></td>
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<td><strong>Fluoroacetamide</strong></td>
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<td><strong>Phosacetin</strong></td>
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<tr>
<td><strong>Phosphine</strong></td>
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</tr>
<tr>
<td><strong>Pirimethane</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Red squill</strong></td>
<td>1a</td>
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<tr>
<td><strong>Scilliroside</strong></td>
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<tr>
<td><strong>Sodium arsenate</strong></td>
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<td><strong>Pesticides according to WHO 79/117/EEC POPs UN Banned in EC</strong></td>
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<tr>
<td><strong>Rodenticides</strong></td>
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<tr>
<td><strong>Sodium cyanide</strong></td>
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</tr>
<tr>
<td><strong>Sodium fluoride</strong></td>
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<tr>
<td><strong>Sodium fluoracetate</strong></td>
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<td></td>
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</tr>
<tr>
<td><strong>Strychnine</strong></td>
<td>1b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strychnine and salts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Strychnine nitrate</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Strychnine sulfate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thallium and thallium compounds</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Thallium sulphate</strong></td>
<td>1b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Warfarin</strong></td>
<td>1b</td>
<td></td>
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</tr>
<tr>
<td><strong>Zinc phosphide</strong></td>
<td>1b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Larvicides</strong></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Lead arsenate</strong></td>
<td>1b</td>
<td></td>
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</tr>
<tr>
<td><strong>Paris green (copper arsenic complex)</strong></td>
<td>1b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Plant growth regulators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maleic hydrazide</strong></td>
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</table>

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Growers should note that use of the following products may also be restricted in the future as a result of:

- customer resistance
- environmental impact
- risk to worker welfare

### Active ingredient

<table>
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<tr>
<th>Active ingredient</th>
<th>Trade name</th>
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<tbody>
<tr>
<td>Aldicarb</td>
<td>Various, e.g. Temik</td>
</tr>
<tr>
<td>Benomyl</td>
<td>Various, e.g. Benlate</td>
</tr>
<tr>
<td>Chlorpyrifos</td>
<td>Dursban</td>
</tr>
<tr>
<td>Dichlorvos</td>
<td>Various, e.g. DDVP</td>
</tr>
<tr>
<td>Endosulfan</td>
<td>Various, e.g. Thiodan</td>
</tr>
<tr>
<td>EDB</td>
<td>EDB</td>
</tr>
<tr>
<td>Methamidaphos</td>
<td>Tamaron</td>
</tr>
<tr>
<td>Methiocarb</td>
<td>Mesurol</td>
</tr>
<tr>
<td>Methomyl</td>
<td>Lannate</td>
</tr>
<tr>
<td>Methyl bromide</td>
<td>Methyl bromide</td>
</tr>
<tr>
<td>Monocrotophos</td>
<td>Azodrin</td>
</tr>
<tr>
<td>Oxamyl</td>
<td>Vydate</td>
</tr>
<tr>
<td>Triazophos</td>
<td>Hostathion</td>
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</table>

Use of alternative products should be given serious consideration.

Other products may be added to this list as information becomes available. Growers are encouraged to read the trade press for up to date concerns and restrictions.

### Table 2: Technical Products not included in the classification and believed to be obsolete or discontinued for use as pesticides

<table>
<thead>
<tr>
<th>allyxycarb</th>
<th>dinococoton</th>
<th>2-methoxymethyl mercury chloride (DS 66)</th>
</tr>
</thead>
<tbody>
<tr>
<td>amidithion</td>
<td>endosifon</td>
<td>methylmercury dicyandimide ethidithion</td>
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<td>amarite</td>
<td>erbon</td>
<td>mexacarbate</td>
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<tr>
<td>atratone</td>
<td>ethoate-methyl</td>
<td>mirex (EHC 44; HSG 39)</td>
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<tr>
<td>azothoate</td>
<td>ethyleneglycol</td>
<td>morfamquat</td>
</tr>
<tr>
<td>bia(richloracetate)</td>
<td>EXD</td>
<td>mirex (EHC 44; HSG 39)</td>
</tr>
<tr>
<td>barium carbonate</td>
<td>fenazaflor</td>
<td>nitrilcarb</td>
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<tr>
<td>benodanil</td>
<td>flurotrimazole</td>
<td>noruron</td>
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<tr>
<td>benquinox</td>
<td>fluenetil</td>
<td>oxapyrazon</td>
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<td>flurotrimazole</td>
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<td>fothietan</td>
<td>parafururon</td>
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<td>butonate</td>
<td>glyodin</td>
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<td>pheno benzuron</td>
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<td>carbamorph</td>
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<td>isopropyl isome</td>
<td>isobornyl-thiocyanatoacetate pydanon</td>
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<td>(EHC 66; HGS 2)</td>
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Annex 6

Registered Chemicals in Zambia

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<td>TOUCHDOWN</td>
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<td>TILT 250 EC</td>
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<td>IMPORTATION OF SUMISCLEX SC</td>
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<td>IMPORTATION OF TIARA 60WG</td>
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<td>IMPORTATION OF TELDOR 500SC</td>
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<tr>
<td>IMPORTATION OF TAMARON 800 SL</td>
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<td>IMPORTATION OF SENCOR 430SC</td>
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<tr>
<td>IMPORTATION OF REPULSE 5.75 GR</td>
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<tr>
<td>IMPORTATION OF NEMACUR 400 EC</td>
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</table>

Global Development Solutions, LLC
<p>| IMPORTATION OF PROSPER 500 EC  |
| IMPORTATION OF NEMACUR 10 GR  |
| IMPORTATION OF MONCEREN GT 390 FS |
| IMPORTATION OF GAUCHO 70 WS  |
| IMPORTATION OF GAUCHO 600FS  |
| IMPORTATION OF FOLICUR 250 EW |
| IMPORTATION OF DISYSTON 5 GR  |
| IMPORTATION OF DIPTEREX 95 SP |
| IMPORTATION OF CURATERR 10 GR |
| IMPORTATION OF CONFIDOR 350 SC |
| IMPORTATION OF CONFIDOR 200 SL |
| IMPORTATION OF BULLDOCK 0.50 EC |
| IMPORTATION OF BULLDOCK 0.50 GR |
| IMPORTATION OF BAYTAN 15 DS  |
| IMPORTATION OF BAYLETON 250 EC |
| IMPORTATION OF BAYFIDAN 250 EC |
| IMPORTATION OF BAYFIDAN 1 GR  |
| IMPORTATION OF TOPAS 100EC   |
| IMPORTATION OF SCORE 250EC |
| IMPORTATION OF SCORE 250EC   |
| IMPORTATION OF ORTIVA 250SC  |
| IMPORTATION OF KARATE SEC   |
| IMPORTATION OF FUSILADE SUPER 125EC |
| IMPORTATION OF GRAMOXONE 200SL |
| IMPORTATION OF BRAVO 500FW   |
| IMPORTATION OF ACTELIC 50 EC |
| IMPORTATION OF ACTELIC SUPER DUST |
| IMPORTATION OF ACTELIC SUPER EC |
| IMPORTATION OF CHESS 50WG    |
| IMPORTATION OF SELECTRON 500EC |
| IMPORTATION OF DUAL MAGNUM 960EC |
| IMPORTATION OF GESAPAX 500SC |
| IMPORTATION OF GESAPRIM 90WG |
| IMPORTATION OF ICON 10WP     |
| IMPORTATION OF ICON 2.5CS    |
| IMPORTATION OF MATCH 050 EC  |
| IMPORTATION OF PEGASUS 500 SC |
| IMPORTATION OF POLYTRIN C440EC |
| IMPORTATION OF REGLONE 250EC |
| IMPORTATION OF RIDOMIL GOLD MZ 68WP |
| TRANSPORTER OF PETROLEUM PRODUCT |
| STORAGE OF CHEMICALS          |
| STORAGE OF SULPHONIC ACID     |
| IMPORTATION OF PROWL          |
| IMPORTATION OF FUNGINEX (DENARIN) |</p>
<table>
<thead>
<tr>
<th>Product Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMPORTATION OF 2,4-D, AMINE 480 SL</td>
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<tr>
<td>IMPORTATION OF ALDICARB</td>
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<tr>
<td>AMETRYN 500SC</td>
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<tr>
<td>ATRAZINE 500SC</td>
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<td>DURSBAN 4E</td>
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<td>CYPERMETHRIN EC</td>
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<td>DIURON 800 SC</td>
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<tr>
<td>ETHEPHON 480 SL</td>
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<tr>
<td>SANVALERATE 200 EC</td>
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<tr>
<td>MAMBA 360 SL</td>
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<tr>
<td>IMPORTATION OF ANT KILL (ANTBAIT)</td>
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<tr>
<td>IMPORTATION OF TARGET NEST KILL COCKROACH</td>
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<tr>
<td>IMPORTATION OF NICO SOAP FORMULATION</td>
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<td>IMPORTATION OF PUMA SUPA</td>
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<td>CAPTAN</td>
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<tr>
<td>MOZICON TM 10WP</td>
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<tr>
<td>IMP. OF COPPER OXYCHLORIDE</td>
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<tr>
<td>IMPORTATION OF TRONIC</td>
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<td>IMPORTATION OF LINEX DF</td>
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<td>IMPORTATION OF FUNGICOP</td>
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<td>IMPORTATION OF MULTIFEED</td>
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<td>IMPORTATION OF SPEAR 200SL</td>
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<tr>
<td>IMPORTATION OF ETHYL ALCOHOL</td>
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<tr>
<td>IMPORTATION OF HYBROXIDE</td>
</tr>
<tr>
<td>SUPER GUARD 50%</td>
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<tr>
<td>BEEF UP AS</td>
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<td>SUPER GUARD DUST</td>
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<tr>
<td>BEEFABUFF</td>
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<tr>
<td>MSMA 800</td>
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<tr>
<td>MEOTHRIN</td>
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<tr>
<td>CLEAR OUT 360</td>
</tr>
<tr>
<td>AVI-FENVALERATE 20%</td>
</tr>
<tr>
<td>AVI-MONOCROTOPHOS 40%</td>
</tr>
<tr>
<td>GRAMOXONE</td>
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<tr>
<td>CARADATE 80TDI</td>
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<tr>
<td>IMPORTATION OF INK</td>
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<tr>
<td>IMPORTATION OF LINEAR SULPHONIC ACID</td>
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<tr>
<td>IMPORTATION OF GUARD</td>
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<tr>
<td>NIMROD</td>
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<tr>
<td>EXPORT. OF SANSULFAN 350 EC,KARATE WG 3.75,</td>
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<tr>
<td>IMPORTATION OF OXYCHLORIDE</td>
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<tr>
<td>IMPORTATION OF NOVACLORPRID 70 WS</td>
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<tr>
<td>CITRIC ACID</td>
</tr>
<tr>
<td>SODIUM BENZOATE</td>
</tr>
<tr>
<td>PEANUTFLO,SOYFLO,MOLYFLO,FRONTIER</td>
</tr>
</tbody>
</table>

Global Development Solutions, LLC
IMPORTATION OF TARGET MOSQUITO COILS

TARGET RAT KILL
Annex 7

Environmental Protection and Pollution Control Act

Supplement to the Republic of Zambia Government Gazette dated the 28th January, 1994

GOVERNMENT OF ZAMBIA

STATUTORY INSTRUMENT NO. 20 OF 1994

The Environmental Protection and Pollution Control Act
(Act No. 12 of 1990)


IN EXERCISE of the powers contained in sections fifty-eight, sixty three and ninety-six of the Environmental Protection and Pollution Control Act and in consultation with the Council, the following Regulations are hereby made:

PART I

PRELIMINARY

1. These Regulations may be cited as the Pesticides and Toxic Substances Regulations, 1994. In these Regulations unless the context Interpretation otherwise requires-

"application" means the way and means of using the pesticide or toxic substance on its intended target as prescribed by the manufacturers;

"banned pesticide or toxic substance" means a pesticide or toxic substance for which all registered uses are prohibited or for which requests for registration have not been granted;

"bunding" means an upraised area surrounding the floor of a warehouse to contain any spillage and washing from pesticides or toxic substances and from cleaning water of the pesticides and toxic substances;

"chemical treatment" means the reaction of a pesticide or toxic substance with another under optimum conditions of pH, temperature and others;

"dangerous poison" shall have the same meaning as highly hazardous according to the World Health Organisation classification;

"disposal" means the final location of pesticides or toxic substances, their wastes or contaminated packaging materials, by burial, chemical or thermal destruction;
"experimental pesticides or toxic substances" means a pesticide or toxic substance to be assessed in Zambia for primary biological activity, and not available to the public for sale or use;

"incineration" means the subjecting of a pesticide or toxic substance to an appropriate high temperature for a specified period of time to achieve complete destruction;

"Inspectorate" means the Environmental Inspectorate established under section eight-one of the Act;

"label" means the written, printed or graphic matter on, or attached to, the pesticide and toxic substance; or the immediate container thereof and the outside container or wrapper of the retail package of the pesticide or toxic substance;

"packaging" means the container together with the protective wrapping used to carry and or store pesticides and toxic substances or their products for wholesale and retail distribution to users.

"packaging material" means the material with which the container is made of;

"pesticide" means a substance or mixture of substances or organisms intended for controlling, repelling or mitigating any pest, and a substance or mixture of substances intended for use as a plant regulator, defoliant or desfoliant;

"protective clothing" means any cloth, material or device designed to provide protection from pesticides or toxic substances when they are handled or applied;

"recognised research institution" means a research institution recognised by the Minister as competent to carry out research into pesticide or toxic substance use;

"repacking" means the transfer of pesticide from any commercial package into any other, usually smaller container for subsequent sale;

"residue" means any substances in food, soil agricultural commodities or animal feed resulting from the use of pesticides and toxic substances and includes any derivatives of a pesticide or toxic substance considered to be of toxicological significance;

"severely restricted" means a pesticide or toxic substance whose general registered uses are prohibited but whose certain registered uses are permitted under these regulations;

"toxic substance" means a poisonous substance which causes significant adverse physiological effects to man, animal or the environment;

"toxicity" means a physiological or biological property which determines the capacity of a substance to injure or harm living organism by being absorbed in the body;
"trader" means anyone engaged in the trade of pesticides or toxic substances and includes the conduct of export, import and sale;

"very dangerous poison" shall have the same meaning as extremely hazardous according to WHO classification;

"withholding period" is the period between the last application of the product and the harvest of plant products, grazing of treated areas and slaughter of treated animals for food.

PART II
REGISTRATION

3. (1) A person intending to manufacture, import, export, improve, or process a new pesticide or toxic substance shall apply for registration to the Inspectorate in Form PTS I of the First Schedule and shall pay the appropriate application fee set out in the Second Schedule.

(2) The application referred to in sub-regulation (1) shall -

(a) indicate the categories of use of the proposed pesticide or toxic substance;

(b) indicate the trade mark, chemical identity, molecular structure, an estimate of the amounts, by-products, processing, disposal of the pesticide or toxic substance and any test data relating to health and environmental effects;

(c) be accompanied by a copy of the approved label or a facsimile thereof.

(3) The application under this Regulation shall be made at least ninety days before importing, exporting or the commencement of manufacturing, processing or reprocessing activities of the pesticides or toxic substance.

(4) A person who has manufactured imported or processed a pesticide or toxic substance in use before the commencement of these Regulations shall apply for registration under this regulation within thirty days from the commencement of these Regulations.

(5) The proprietary rights in the data and information referred to in paragraphs (a) and of sub regulation (2) (b) shall be duly protected.
4. (1) The Inspectorate shall register a pesticide or a toxic substance and issue a certificate of registration in Form PTS 2 if satisfied that the pesticide or toxic substance which is the subject of the application is suitable and effective for the purposes for which it is intended without causing damage to the environment; and

(2) A certificate of registration shall be:-

(a) valid for thirty-six months and renewed for a like period. Provided that the Inspectorate may limit the validity of registration for any period less than thirty-six months but not less than six months; and

(b) subject to the conditions determined by the Inspectorate.

5. (1) No person, except a recognised research or educational institution, shall import into Zambia, any experimental pesticide and toxic substance which is not registered under these regulation without authority from the Inspectorate on Form PTS 4 set out in the First Schedule.

(2) An application to import any experimental pesticide and toxic substance shall be made in Form PTS 3 set out in the First Schedule and shall be accompanied by the appropriate fee.

(3) Any recognised research or educational institution which imports an experimental pesticide and toxic substance shall not later than seven days after the arrival of the pesticide or toxic substance in Zambia, complete in triplicate and forward to the Inspectorate Form PTS 5 set out in the First Schedule.

(4) No experimental pesticide and toxic substance shall be offered to any person other than a person approved by the Inspectorate to participate in the experimentation.

(5) No plants or products treated with experimental pesticide or toxic substance shall be sold or disposed of or consumed without the written authority of the Inspectorate.
(6) The label affixed to a container in which a pesticide or toxic substance is imported for purposes of experiment, shall be clearly marked with the words “FOR EXPERIMENTAL USES ONLY-NOT FOR SALE”.

6. (1) No person shall transport pesticides or toxic substances unless they are registered under these Regulations.

(2) Any person who transports the pesticides and toxic substances shall use vehicles with clear warning signs with symbols set out in the Third Schedule.

(3) A person who transports pesticides and toxic substances shall only transport pesticides and toxic substances which are:

(a) clearly labelled in accordance with these Regulations;
(b) in packaging that will not allow leakage or spillage of product during loading, transportation and off loading;
(c) not loaded in the same space with food stuffs, goods intended for human or animal consumption or a container for human and animal use or clothing;
(d) conveyed by drivers who carry First Aid Equipment and have the necessary basic handling and poisoning information on pesticides and toxic substances; and
(e) in accordance with the guidelines set out in the Fourth Schedule.

(4) No person shall transport severely restricted pesticides or toxic substances

(a) without the consent in writing of the Inspectorate;
(b) which are not labelled in accordance with these Regulations;
(c) which results in deliberate disposal, or spillage into the environment.
PART III

LABELLING AND PACKAGING

7. (1) No person shall sell any pesticide or toxic substance without a label which has been approved by the Inspectorate and which is securely fixed to the container.

(2) The Inspectorate shall not approve a label for a pesticide or toxic substance unless it states:

(a) the name and address of the company producing and distributing the pesticide or toxic substance;
(b) the trade name and formulation of the pesticide or toxic substance;
(c) the common name of pesticide or toxic substance;
(d) the quantity by mass or volume of the pesticide or toxic substance;
(e) the use for which the pesticide or toxic substance is registered;
(f) the directions for use;
(g) the withholding period;
(h) in pictograms in accordance with the Fifth Schedule instructions and warnings on safe use of the pesticide or toxic substance;
(i) the hazard warnings of the contents of the pesticide or toxic substance in accordance with the warnings set out in Part I and II of the Third Schedule;
(j) warning against the reuse of containers and instructions for safe disposal of surplus or expired pesticide or toxic substance or decontamination of empty containers in accordance with the Eighth Schedule;
(k) first aid instructions and medical advice on treatment;
(I) the date of manufacture and the date of expiry;

(m) the net contents of the pesticide or toxic substance; and

(n) any other information the Inspectorate may require.

(3) The label on a pesticide or toxic substance shall be large enough to be read easily and shall be of durable quality.

(4) No pesticide or toxic substance shall be transported within Zambia to a destination where will be further processed, packed or repacked for retail trade without the label affixed in accordance with sub-regulations (1) and (2).

(5) No person shall use a label which contains inaccurate or untrue claims relating to the safety, non-toxicity or harmlessness or composition of the pesticide or toxic substance.

8. (1) No person shall pack a pesticide or toxic substance in a container which:

(a) will react chemically or physically with the substance it is to contain; and

(b) is not of sufficient strength for handling and transportation to prevent the escape of the pesticide or toxic substance.

(2) No person shall repack, decant or dispense any pesticide or toxic substance into food or beverage containers.

(3) No person shall load for transportation any packages which are damaged, severely corroded or which show evidence of leakage.

(4) No person shall use very dangerous or dangerous pesticides or toxic substances which are set out in Part III of the Third Schedule or open the container and repack such a substance any other container, unless there is adequate provision for:-

(a) all the persons involved are made aware of the hazardous nature of the pesticide or toxic substance and take all the necessary precautions in the handling of that substance, including the wearing of appropriate protective clothing; and

(b) appropriate measures for the safety of any other person who may be at risk from exposure to that substance; and
(c) immediate availability of facilities for the administration of the appropriate First Aid treatment, and the right personnel to deal with emergency situations.

(5) No person other than the person in whose name a pesticide or toxic substance is registered in terms of these regulations may open the container of that pesticide or toxic substance and repack it for sale.

(6) The Inspectorate may direct any person in whose name a pesticide or toxic substance is registered in terms of these regulations to submit for its inspection and approval the container of that pesticide or toxic substance.

PART IV  
GENERAL HANDLING, USE AND SAFETY  

9. (1) A person who uses a pesticide or toxic substance, in the form of dust, vapours or very small spray droplets, the container of which bears or is required to bear a label with a warning "very dangerous poison" or "dangerous poison" or where application of the pesticide or toxic substance is in confined places, shall use suitable and effective cartridge type respirators, or masks with special canisters, in accordance with the Seventh Schedule.

(2) A person who fumigates or applies a pesticide or toxic substance, the container of which bears or is required to bear a label with a warning "very dangerous poison" or "dangerous poison" shall use a suitable respirator so that none of the contaminated ambient air is inhaled.

(3) No person shall authorize or order the wearing of a respirator when the canister or cartridge has exceeded the service life specified by the manufacturer.

(4) No woman who is pregnant or child under 16 years of age shall be employed in the handling of pesticides or toxic substances.

(5) All manufacturers, formulators and those involved in the repacking of pesticides or toxic substances shall -
Pest Management Plan for Zambia: Support for Economic Expansion and Diversification Project (SEEDS)

(a) display or make available a copy of this Regulation to employees involved in the handling of pesticides or toxic substances;

(b) cause their employees involved in the handling of pesticides or toxic substances to undergo medical check-ups once every six months to assess the levels of pesticides or toxic substances and their effects;

(c) provide washing facilities for persons handling pesticides or toxic substances;

(d) install dust and vapour extractors; and

(e) install adequate, suitable and accessible fire extinguishers in the handling areas.

(6) No person shall be allowed to eat, drink or smoke whilst handling pesticides or toxic substances.

(7) Any person who contravenes any provision of these regulations shall be guilty of an offence.

PART V

STORAGE AND DISPOSAL

10 (1) Pesticides and toxic substances shall be stored in a warehouse in accordance with the Sixth Schedule.

(2) Pesticides and toxic substances shall be stored-out-doors only if:

(a) they are fenced and locked;

(b) the floor of the storage area is made of concrete and is bunded;

(c) hazard and safety signs are displayed at appropriate places.

11. Pesticides and toxic substances shall be disposed in accordance with:- toxic substances.
10. (1) Pesticides and toxic substances shall be stored in a warehouse in accordance with the Sixth Schedule.

(2) Pesticides and toxic substances shall be stored outdoors only if:

(a) they are fenced and locked;

(b) the floor of the storage area is made of concrete and is bunded;

(c) hazard and safety signs are displayed at appropriate places.

11. Pesticides and toxic substances shall be disposed in accordance with toxic

PART V
MISCELLANEOUS

12. (1) The Minister, may by statutory order and in consultation with the Council, ban or severely restrict the use of, any pesticide or toxic substance specified in such notice.

(2) The pesticides or toxic substances which are substance banned under this regulation shall:

(a) be withdrawn from sale and all other uses within six months from the date of publication of the statutory order;

(b) be exported only with the approval of the Inspectorate and on such conditions as it may determine.

13. The Inspectorate shall maintain a register of the registered pesticides and toxic substances and of banned and severely restricted pesticides and toxic substances.

14. (1) Any person who has in possession of surplus expired pesticides or toxic substances shall within three months of the commencement of these regulations inform the Inspectorate in Form PTS 6 of the First Schedule.

(2) Any person who manufactures, imports or processes pesticides or toxic substances registered under these Regulations shall submit a record of quantities used and not used and associated storage or other problems relating to the pesticides or toxic substances to the Inspectorate every six months from the date of registration.
Enforcement notice 15 (1) If the Inspectorate has reasonable cause to believe that a person is contravening any of the provisions of these Regulations or a condition of the registration, the Inspectorate shall serve an enforcement notice on that person.

(2) An enforcement notice shall -

(a) state the belief regarding the contravention or the likely contravention of the provisions of these Regulations or a condition of the licence and specify the matters constituting the contravention or making it likely that the contravention will arise, as the case may be;

(b) specify the steps that have to be taken to remedy the contravention or avoid the contravention, as the case may be;

(c) specify the time limit within which the steps described under paragraph (b) have to be taken.

16. Any person who contravenes any of the provisions of these Regulations or a condition of registration after an enforcement notice has been issued under Regulation 15:-

(a) shall have the registration cancelled; and

(b) shall be guilty of an offence and shall be liable upon conviction to a fine or conviction as set out in section ninety-one of the Act.
Pollution Control (Pesticides And Toxic Substances) Regulations, 1994
APPLICATION FOR REGISTRATION OF PESTICIDE OR TOXIC SUBSTANCES (Regulations 3)
(To be completed in triplicate)

TO: The Chief Inspector, (Pollution Control)
Environmental Council
PO Box 35131
LUSAKA

1. Name of Applicant: .................................................................

2. Address of Applicant,
   (a) Postal: ...................................................................................
   (b) Business: ..............................................................................

3. Type of Pesticide (insecticide, herbicide, fungicide, etc)
or toxic substances (e.g. cyanide, benzene):..........................

B. Information to be submitted with this application for all pesticides, toxic substances and for which registration is sought:

   1. Trade Name: ...........................................................................

   2. Full Chemical name of each ingredient: ..................................

   3. Common name of each active ingredient: ...............................
4. The empirical and structural formula for each active ingredient: ...........................................

5. Formulation (type of formulation: wettable powder, emulsifiable concentrate, etc.): .................................................................

6. Percentage of purity on a mass-by-mass or mass by volume basis (specify) of each active ingredient and other ingredients (including inert matter) in the pesticide/toxic substance stating which or percentage applies to each ingredient: ........................................................................................................

7. Physical and chemical properties of each ingredient with specific reference to type of formulation

7.1 Appearance..........................................................................................................................

7.2 Density (for liquids only):.................................................................................................

7.3 Flammability: liquids flash point ..................................................................................

7.4 Wettabililty (for dispersible powders)............................................................................

7.5 Suspensibility (for dispersible powders, suspension concentrates).................................

7.6 Emulsion stability (for emulsifiable concentrates)............................................................

7.7 Corrosiveness....................................................................................................................

Global Development Solutions, LLC
7.8 Known incompatibilities with other products (specify).................................
........................................................................................................................................
........................................................................................................................................

8. Size of containers in which pesticides of toxic substance is to be sold and the net weight or volume:........................................................................................................
........................................................................................................................................
........................................................................................................................................

9. Nature of containers in which pesticide or toxic substance is to be sold:..............

10. Stability of formulation:-
(a) on storage (at temperature of 25°C ± 3°C):............................................................
.........................................................................................................................................
(b) on dilution:..................................................................................................................
........................................................................................................................................
........................................................................................................................................
(c) Shelf life in general:..................................................................................................
........................................................................................................................................
........................................................................................................................................

11. Corrosiveness of equipment:..................................................................................
........................................................................................................................................
........................................................................................................................................

12. Phytotoxicity:.............................................................................................................
........................................................................................................................................
........................................................................................................................................

13. Safety precautions to be observed in handling, use and storage:.........................
........................................................................................................................................
........................................................................................................................................

14. Hazard to wildlife:.................................................................................................

15. Residue data:............................................................................................................

16. Proposed use:............................................................................................................

17. Directions of use:......................................................................................................

18. Directions for safe disposal of expired Pesticide or Toxic substance:....................
........................................................................................................................................
........................................................................................................................................

Global Development Solutions, LLC
19. Directions for safe disposal of used container: 


20. Biological effectiveness and benefit in use: 


I hereby apply for the registration, under the Pesticides and Toxic Substances Regulations, 1993 of the Pesticide/Toxic Substances of which particulars are given above, and I certify that these particulars are to the best of my knowledge, true and correct.

Date

Signature of applicant and official stamp.
NUMBER:

To: .................................................................................................................................

of: .................................................................................................................................

is hereby registered as a .....................................................................................................

Registration is from ............................................................. 19...........................................

to ................................................................................. 19...............................................

Registration is subject to the following conditions

It is hereby:-

(a) Certified that the Pesticide/Toxic Substance referred to in Form PST I has been registered, and

(b) approval has been granted of the labels and advertisements which are attached hereto,

and which are to be used in connection with the said Pesticide/Toxic substance.

Date and Official stamp
(Pollution Control)

Global Development Solutions, LLC

Chief Inspector
Inspectorate
APPLICATION TO IMPORT EXPERIMENTAL PESTICIDE OR TOXIC SUBSTANCE
TO BE USED ONLY FOR EXPERIMENTATION
(Regulation 5 (2))

(To be completed in triplicate)

To: The Chief Inspector (Pollution Control)
Environmental Council
P O Box 35131
LUSAKA

1. Name of applicant:..........................................................................................................

2. Address of applicant:
   (a) Postal:...................................................................................................................
       ..............................................................................................................................
   (b) Business:..........................................................................................................
       ..............................................................................................................................

3. Active ingredient:..........................................................................................................

4. Toxicological data; and animals (state type of animal)
   (a) Oral LD 50:..........................................................................................................
   (b) Dermal LD 50:....................................................................................................
   (c) Inhalation LD 50:...............................................................................................
6. Trade Name: ..............................................................................................................
7. Common Name: ........................................................................................................
8. Approximate quantity: .............................................................................................
9. Intended use: .............................................................................................................

..................................................................................................................................
..................................................................................................................................

10. Proposed duration of experiment (commencing date and finishing date)..........
.................................................................................................................................

11. Location of trials: ...................................................................................................

12. Person conducting trials and academic qualification: ........................................
.................................................................................................................................

13. Name of Manufacturer: ........................................................................................
.................................................................................................................................

14. Address of Manufacturer .....................................................................................
.................................................................................................................................

I hereby apply for importing, under the Pollution Control Pesticide and Toxic Substances Regulation, 1994 the Pesticides/Toxic Substances for experimental purposes particulars of which are given above.

.................................................................................................................................

Date
Signature of applicant and

Official stamp.
For Official use only:-

Date application received:.................................................................

Experimental Registration Number:...................................................

The Application to import:................................................................. has /not been approved.

Reasons for non-approval:.................................................................

...........................................................................................................

Date Chief Inspector (Pollution Control) ...........................................

Inspectorate

Global Development Solutions, LLC

130
REPUBLIC OF ZAMBIA
ENVIRONMENTAL COUNCIL

Pollution Control (Pesticides And Toxic Substances) Regulations, 1994

AUTHORITY TO IMPORT EXPERIMENTAL PESTICIDES OR TOXIC SUBSTANCES
(Regulation 5)

NUMBER:
To: ........................................................................................................................................
of ...........................................................................................................................................
Date of application received ..................................................................................................

I hereby certify that authority to import Pesticide/Toxic Substance ..............................................
for experimental purposes only has been granted.
The experimental registration number is: ..................................................................................
The registration expires on: ...................................................................................... and is subject to the following conditions:
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

The application to import .......................................................... has /not been approved.
Reasons for non approval ......................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

Date
Chief Inspector (Pollution Control) Inspectorate
REPUBLIC OF ZAMBIA
ENVIRONMENTAL COUNCIL

FORMS PTS 5

Pollution Control (Pesticides And Toxic Substances) Regulation, 1994

NOTICE OF IMPORT OF EXPERIMENTAL PESTICIDE OR TOXIC SUBSTANCES
(Regulation 5 (3))

(To be submitted in triplicate)

TO: The Chief Inspector (Pollution Control)
Environmental Council
PO Box 35131
LUSAKA

1. Name of Research Institute

2. Address of the Research Institute:
   (a) Postal
   (b) Business

3. Type of pesticide/Toxic substances (insecticide, herbicide, rodenticide/cyanide, benzene etc)

4. Registration number

5. Trade name

6. Common name

7. Approximate quantity

8. Expiry date

Global Development Solutions, LLC
9. Proposed use ...........................................................................................................
.................................................................................................................................
.................................................................................................................................
.................................................................................................................................
.................................................................................................................................
.................................................................................................................................
.................................................................................................................................
.................................................................................................................................
Date 
.................................................................................................................................
Signature of scientist and official stamp.

REPUBLIC OF ZAMBIA
ENVIRONMENTAL COUNCIL

FORM PTS 6

Pollution Control (Pesticides And Toxic Substances) Regulations, 1994
NOTICE OF POSSESSION OF EXPIRED PESTICIDES OR TOXIC SUBSTANCES
(Regulation 14 (1))
(To be submitted in triplicate)

To: The Chief Inspector (Pollution Control)
Environmental Council
PO Box 35131
LUSAKA

1. Name of owner of expired pesticide or toxic substance.................................

2. Address:
   (a) Postal ...........................................................................................................
   (b) Business ......................................................................................................

3. Type of Pesticide or Toxic substances .............................................................
.................................................................................................................................
.................................................................................................................................

4. Trade name ......................................................................................................

5. Full chemical name ........................................................................................
6. Common name of each active ingredient ..........................................................

7. Formulation ........................................................................................................

8. Toxicology Data on Humans and laboratory animals (specify)
   (a) Oral LD50 ........................................................................................................
   (b) Dermal LD50 ....................................................................................................
   (c) Inhalation LD50 .................................................................................................

9. Phyto-toxicity ........................................................................................................

10. Quantity of expired Pesticide or toxic substance ..............................................

11. Instructions on handling precautions .................................................................

12. Directions for safe disposal .................................................................................

13. Pesticide or toxic substances registration number .............................................

I hereby notify you of the above expired pesticides/toxic substances in my possession. The pesticides/toxic
substances expired before use because ........................................................................

Date
Signature of applicant and
official stamp
For official use only:

Date notification received ................................................................................................

Date Registration number checked ....................................................................................

Your notification has been received and the inspectorate (state action) ........................

---------------------------------------------------------------------------------

THIRD SCHEDULE

(Regulation 6 and 7)

SYMBOLS FOR WARNING SIGNS FOR VEHICLES

TRANSPORTING PESTICIDE OR TOXIC SUBSTANCES

Part I

B

1. The hazardous-warning signs that shall be used on hazard-warning panels and compartment labels during transportation of toxic substances are set out in part II.

2. The hazard-warning signs that shall be used when transporting pesticides are set out in part III.

3. Each hazard-warning panel for pesticides and toxic substances shall be in form of an equilateral triangle and a square set with its sides at an angle of 45 to the verticle respectively and the length of the sides shall be -

   a) in the case of signs on hazard-warning panels, 200 milli-metres or

   b) in the case Of signs on compartments labels 95 millimetres.

4. Signs for hazard-warning panels shall, for any part of the sign that is not black, have a black border at least 5 millimetre wide.
### Part II

#### Toxic

<table>
<thead>
<tr>
<th>Description of sign</th>
<th>Symbol</th>
<th>Lettering</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable liquids</td>
<td>Black</td>
<td>Black</td>
<td>Red</td>
</tr>
<tr>
<td>Flammable gases</td>
<td>Black</td>
<td>Black</td>
<td>Red</td>
</tr>
<tr>
<td>Flammable solid</td>
<td>Black</td>
<td>Black</td>
<td>White with vertical red stripes</td>
</tr>
<tr>
<td>Corrosive substances</td>
<td>Black</td>
<td>Black</td>
<td>White, upper half black, lower half</td>
</tr>
<tr>
<td>Toxic gases</td>
<td>Black</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>Organic peroxides</td>
<td>Black</td>
<td>Black</td>
<td>Yellow</td>
</tr>
<tr>
<td>Oxidising substances</td>
<td>Black</td>
<td>Black</td>
<td>White, upper half combustible, lower half</td>
</tr>
<tr>
<td>Substances emitting</td>
<td>Black</td>
<td>Black</td>
<td>White, upper half combustible, lower half</td>
</tr>
<tr>
<td>Spontaneously</td>
<td>Black</td>
<td>Black</td>
<td>Red, lower half, white</td>
</tr>
</tbody>
</table>

#### Harmful substances

<table>
<thead>
<tr>
<th>Pesticide Toxicity</th>
<th>Colour code</th>
<th>Warning</th>
<th>Additional</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Acute oral LD50</td>
<td>Red</td>
<td>Very dangerous skull and cross bones up to 50 mg/kg</td>
<td></td>
</tr>
<tr>
<td>(ii) Acute dermal LD50</td>
<td>Red</td>
<td>Very dangerous skull and cross bones up to 200 mg/kg; skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(iii) Acute inhalation LC50</td>
<td>Red</td>
<td>Dangerous skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(iv) Acute oral LD50 51-500 mg/kg</td>
<td>Purple</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(v) Acute dermal LD50 201-2,000 mg/kg</td>
<td>Purple</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(vi) Acute inhalation LD50 201-2,000 mg/m³/4h</td>
<td>Purple</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(vii) Acute oral LD50 501-5,000 mg/kg</td>
<td>Purple</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(viii) Acute dermal LD50 2,001 mg/kg</td>
<td>Amber</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
<tr>
<td>(ix) Acute inhalation LC50 2,001-20,000 mg/m³/4h</td>
<td>Amber</td>
<td>Poison skull and cross bones</td>
<td></td>
</tr>
</tbody>
</table>
### Pesticide Toxicity

<table>
<thead>
<tr>
<th>Pesticide Toxicity</th>
<th>Colour code</th>
<th>Warning</th>
<th>Additional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute oral LD50 greater than 20,000mg/kg</td>
<td>Green</td>
<td>Harmful</td>
<td>if swallowed</td>
</tr>
<tr>
<td>Acute dermal LD50 greater than 20,000mg/kg</td>
<td>Green</td>
<td>Harmful</td>
<td></td>
</tr>
<tr>
<td>Acute inhalation LC50 greater than 20,000mg/m³</td>
<td>Green</td>
<td>Harmful</td>
<td></td>
</tr>
<tr>
<td>Acute inhalation LC50 greater than 20,000mg/m³</td>
<td>Green</td>
<td>Harmful</td>
<td></td>
</tr>
</tbody>
</table>

Pesticides shall be classified according to colour symbol and warning it carries:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Very dangerous poison</td>
</tr>
<tr>
<td>Purple</td>
<td>Dangerous poison</td>
</tr>
<tr>
<td>Amber</td>
<td>Poison</td>
</tr>
<tr>
<td>Green</td>
<td>Harmful</td>
</tr>
</tbody>
</table>

#### FOURTH SCHEDULE

*(Regulation 6 (3))*

**GUIDELINES FOR TRANSPORTATION OF PESTICIDES AND TOXIC SUBSTANCES**

1. Ensure that the emergency procedure information relating to the pesticide(s) or toxic substances card is in the vehicle.
2. Ensure that all hazard warnings are displayed, not obstructed and that they are kept clean at all times.
3. Follow the route as advised by the transporter or operator.
4. Ensure that the vehicle is not left unattended at any time.
5. Ensure that the vehicle has certificate of fitness.
6. Ensure that the First Aid Equipment is in the vehicle.
FIFTH SCHEDULE

(Regulation 7 (2) (d))

PICTOGRAMS (FAO, WHO AND GIFAP)

The following pictograms shall be put on labels to complete labelling. They will be put on labels either as singly or in combination with appropriate ones to give complete instructions.

A pictogram showing a product kept safety by key and lock

Pictogram showing instructions on washing.

Pictogram to show that product is dangerous to animals.

Dangerous to aquatic animals

Instructions to wear protective gloves

Instructions to use complete face shield

Instructions to use respirators

SIXTH SCHEDULE

(Regulation 10)

1. Warehousing and storage

a) The pesticide and toxic substances warehouse should be located away from homes, highly populated areas, drinking water sources and areas liable to flooding.

b) The floors in the building should be of concrete with a load bearing capacity sufficient to withstand the weight of the stock, racking and any mechanical handling equipment to be used. Floors should be impervious to liquids free from cracks and smooth to facilitate cleaning.

c) The building should be designed such that escape in case of emergency should be possible from any enclosed area in at least two directions. Emergency exits should be clearly marked.

d) The warehouse should have access from at least two sides to facilitate fire fighting, regardless of wind direction and also facilitate easy escape from any enclosed area.

e) Bunding is the physical retention of fire fighting water or spillage. All warehouses constructed above ground level should have special provision for bunding. This can be achieved, for example by constructing ramps across external doorways of existing warehouses.
f) The building should permit reasonable movement of materials and enough space to allow hygienic working conditions and clear access to fire-fighting equipment.

g) The walls of the warehouse should be of non-flammable type and all pipings and electrical wiring should be sealed.

h) The roof of the warehouse should be able to effectively keep out rain, be able to provide both ventilation to allow fumes and heat to escape in case of fire and at the same time provide protective against direct sunlight.

i) The warehouse should have drains which should not be directly linked to waterways or public sewers. They should instead be linked by a closed system, to an evaporation tank.

j) The evaporation tank should be emptied from time to time depending on the accumulation of solid waste. It should be covered during the rainy season to avoid filling by rain water.

2. a) All products should be stored under lock and key with proper warning signs displayed clearly to keep away unauthorised persons. Pesticides and toxic substances must be stored in a separate warehouse, away from any other goods especially foods and stockfeeds.

b) Before storing any pesticides ensure that they are properly labelled and are of good quality and acceptable condition. If any of the products are not in good condition, do not store them together with other products but take appropriate action.

c) If pesticides and toxic substances are to be stored inside the warehouse, stacking heights should not exceed three metres unless the use of racking prevents overloading of the lower tiers.

d) Persons loading pesticides and toxic substances in the warehouse should pay special attention to "THIS SIDE UP" signs on cartoned packs.

e) Pesticides and toxic substances should be stored separately, preferably according to their use in the field e.g. herbicides, insecticides etc. The objective of this is to prevent cross contamination as well as minimise the risk of fire and consequent environmental contamination often presented by mixed storage arrangements.

3. a) All stocks in the warehouse should be frequently inspected for leakages, caking of powders, pulverisation of granules, sedimentation or gelling of liquids, change in colour due to oxidation, dampness of packages and corrosion or deterioration of containers. All leakages must be treated as being extremely toxic.

b) Spillages should not be cleaned out with water. They must be swept up and kept in a special labelled container awaiting safe disposal. Liquids should first be absorbed by saw dust, earth or any other absorbent before being swept up.

c) Every warehouse must have an emergency spills treatment kit consisting of a PVC apron, neoprene gloves, a gas mask, a brush or broom, a dust pan, an empty clearly labelled container (for collecting wastes) a container of swadust and a spade.

d) Always strictly follow the rule "First-in First-out" i.e. new stocks should be moved to the rear.

EIGHTH SCHEDULE
(Regulation 9)

PROTECTIVE CLOTHING AND EQUIPMENT

Global Development Solutions, L.L.C
A. Any person involved in the manufacture and formulation of pesticides or toxic substances must ensure that the following protective clothing are available to the employees:

(i) acid resistant or chemical resistant overalls or dust coats with buttons to the neck;
(ii) acid resistant or chemical resistant trousers and coat or suit;
(iii) PVC gloves;
(iv) PVC aprons;
(v) rubber boots;
(vi) respirator canisters with filters specific for dusts, mists, fumes, gases and vapour;
(vii) face shields covering eyes and face;

B. To clean-up spills the following should be available:

(i) absorbent material (saw dust, sand, earth or powdered lime);
(ii) washing detergent;
(iii) brooms;
(iv) shovels, spades;
(v) funnels.

When self contained breathing apparatus is to be used only persons properly trained and experienced in the correct procedure should be allowed to use them.
EIGHTH SCHEDULE
(Regulation 11)

DISPOSAL OPTIONS

Pesticides and toxic substances wastes, those which are expired, spillage and leftover diluted product and packaging material can be disposed of in the following manner:

1. **Product Use By Recycling**

   If an alternative use exists the product may be re-used or may be reformulated for the purpose for which it is included to be used.

2. **High Temperature Incineration (High Temperature Thermal Oxidation)**

   Should be considered when disposing of most pesticides and toxic substances, but should **NOT** be used when disposing:

   (a) inorganic materials;

   (b) Organic products containing heavy metals such as mercury and lead;

3. **Chemical Treatment**

   To be used as a disposal technology for a few specific unformulated pesticides and some other toxic substances. The products of decomposition from such treatment should not present toxic or environmental hazard.

4. **Long Term Storage**

   Certain compounds cannot be disposed of safely using existing technology. Such compounds include those containing heavy metals and in particular, organo-mercury compounds. The only available option is to contain and store these products safely until a suitably acceptable disposal technology is developed. A full risk analysis should be made for all materials stored to ensure maximum safety over the longest foreseeable period of time.

5. **Landfill (For Incinerator Ash And Slag Only)**

   Landfilling is not an acceptable disposal option for pesticides and toxic wastes which can be leached. Incinerator ash and slag can be disposed of at approved landfill sites.
6 Waste Solidification/Fixation

The process involves the mixing of chemical and other waste with building materials such as cement, silicates and polymers, causing the mixtures to solidify into an impervious mass. Waste treated in this way can be disposed of at a landfill. This should be applicable to inorganic wastes. Organic wastes could easily leach into ground water with time, and should therefore not be used in disposing organic pesticides or toxic substances.

7 Packaging Materials Disposal

Contaminated packaging material shall be disposed as follows:

(a) Contaminated Packaging Material

Cartons, boxes and bags should be cut and rendered non-usable. The waste should be over-packed in plastic bags to minimise the risk of exposure during handling. Disposal of these should be carried out by either:

(i) Burning in a simple incinerator, or on a hot fire in isolated area downwind of the nearest habitation.

(ii) Burial in an approved landfill.

(b) Small Packs

Small packaging shall be drained well to reduce residues to a minimum by triple-rinsing with water or an appropriate solvent such as diesel fuel. The triple rinsed packaging material should be made unusable by shredding or crushing. Combustible packaging material should be incinerated as described in 8 (2a).

Non-combustible crushed containers should be buried in a landfill site.

Small packs which cannot be or have not been triple rinsed should be over-packed in strong polyethylene bags or preferably 200 litre steel drums for disposal as toxic wastes.

(c) Large Containers;

Effort must be made to drain the maximum amount of residue from each container prior to triple rinsing with water or a suitable solvent and disposed as follows:

(i) Steel Drums

Triple-rinsed and drained drums should be crushed, to render them unusable and disposed of by either:

STEEL SMELTING - This is the preferred option. Where the drums are processed at high temperature for metal recovery.

BURIAL - Burial in an approved landfill site at least one metre below ground level.

(ii) Plastic Drums

After triple rinsing, plastic drums must be punctured and shredded to avoid any form of reuse and packed for disposal by burial at approved landfill sites. Large quantities of plastic wastes must not be burned except in approved incinerators with flue-gas scrubbing facilities.
8. *Export* - Where no "safe disposal" facilities exist in Zambia, export of pesticide and toxic wastes to another country with facilities can be done.
9. **Return To Manufacturer** - Where a manufacturer is willing to accept pesticides or toxic substances wastes or expired obsolete stocks, this will be accepted as a disposal option.

**SECOND SCHEDULE**  
(Regulation 3)

**PRESCRIBED FEES**

<table>
<thead>
<tr>
<th>Description</th>
<th>Kwacha</th>
<th>(1,000 US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application for registration of pesticide or toxic substance</td>
<td>525,000</td>
<td>1,000 US$</td>
</tr>
</tbody>
</table>

LUSAKA  
22nd December, 1993

**Natural Resources** [MENR]

DR. C. KALIMA  
Minister of Environment and Natural Resources

Global Development Solutions, LLC
Annex 8

Environmental Council Of Zambia Guidelines

ENVIRONMENTAL COUNCIL OF ZAMBIA

PESTICIDES AND TOXIC SUBSTANCES
GENERAL HANDLING GUIDELINES

IMPORTATION

a) The requirements for labelling as set out in the pesticides and toxic substances Regulations No 20 of 1994 are complied with.
b) The packaging materials are the ones approved and in sizes not exceeding Environmental Council of Zambia recommendations for each product.
c) The storage warehouse meets the requirements for safety as specified by the minimum safety requirements of the pesticides and toxic substances Regulations No 20 of 1994.
d) That the transporter is provided with material safety data sheets for each product.
e) In transportation or storage appropriate hazard symbols shall be displayed at all times in accordance with the requirements of the pesticides and toxic substances regulations No 20 of 1994.
f) In case of an emergency such as an accident in use or in storage, that such an accident is reported to the Environmental Council of Zambia and other relevant authorities.

DISTRIBUTION

a) There shall be a clear partition between agrochemicals and other substances on display.
b) Can be revoked by the Environmental Council of Zambia within one month of giving such notice.
c) Shall only procure chemicals from dealers registered with Environmental Council of Zambia and shall produce certificate of registration.
d) The requirements for labelling as set out in the pesticides and toxic substances Regulations No 20 of 1994 are complied with.
e) The packaging materials are the ones approved and in sizes not exceeding Environmental Council of Zambia recommendations for each product.
f) The storage warehouse meets the requirements for safety as specified by the minimum safety requirements of the pesticides and toxic substances Regulations No 20 of 1994.

g) During distribution of Agrochemicals it must be ensured that the chemicals are properly packed and arranged that possible chances of cross mixing or spillage /leakage of chemicals will not be present to avoid any unnecessary risks.

h) The vehicle in use for distribution of agrochemicals must be solely used for this purpose alone not any other.

i) Vehicle used in the distribution of agrochemicals must have a canopy or a tent to cover on top to avoid particulates of the chemicals mixing with air thus posing a danger to human health and the environment.

STORAGE

Warehousing and storage

a) The pesticide and toxic substances warehouse should be located away from homes, highly populated areas, drinking water sources and areas liable to flooding.

b) The floors in the building should be of concrete with a load bearing capacity sufficient to withstand the weight of the stock, racking and any mechanical handling equipment to be used. Floors should be impervious to liquids free from cracks and smooth to facilitate cleaning.

c) The building should be designed such that escape in case of emergency should be possible from any enclosed area in at least two directions. Emergency exits should be clearly marked.

d) Bunding is the physical retention of water or spillage. All warehouses constructed above ground level should have special provision for bunding. This can be achieved, for example by constructing ramps across external doorways of existing warehouses.

e) The building should permit reasonable movement of materials and enough space to allow hygienic working conditions and clear access to fire-fighting equipment.

f) The walls of the warehouse should be of non-flammable type and all piping and electrical wiring should be encased or sealed.

g) The roof of the warehouse should be able to effectively keep out rain, be able to provide both ventilation to allow cumulative fumes and heat to escape and at the same time provide protective against direct sunlight.

h) The warehouse should have drains, which should not be directly linked to waterways or public sewers. They should instead be linked by a closed system, to an evaporation tank.

i) The evaporation tank should be emptied from time to time depending on the accumulation of solid waste. It should be covered during the rainy season to avoid filling by rainwater.

j) All products should be stored under lock and key with proper warning signs displayed clearly to keep away unauthorised persons. Pesticides and toxic
substances must be stored in a separate warehouse, away from any other goods especially foods and stock feeds.

k) Before storing any pesticides ensure that they are properly labelled and are of good quality and acceptable condition. If any of the products are not in good condition, do not store them together with other products but take appropriate action.

l) If pesticides and toxic substances are to be stacked inside the warehouse, stacking heights should not exceed three metres unless the use of racking prevents overloading of the lower tiers.

m) Persons loading pesticides and toxic substances in the warehouse should pay special attention to "THIS SIDE UP" signs on cartoned packs.

n) Pesticides and toxic substances should be stored separately, preferably according to their use in the field e.g. herbicides, insecticides etc. The objective of this is to prevent cross contamination as well as minimise the risk of fire and consequent environmental contamination often presented by mixed storage arrangements.

o) All stocks in the warehouse should be frequently inspected for leakages, caking of powders, pulverisation of granules, sedimentation or gelling of liquids, change in colour due to oxidation, dampness of packages and corrosion or deterioration of containers. All leakages must be treated as being extremely toxic.

p) Spillages should not be cleaned out with water. They must be swept up and kept in a special labelled container awaiting safe disposal. Liquids should first be absorbed by saw dust, earth or any other absorbent before being swept up.

q) Every warehouse must have an emergency spills treatment kit consisting of a PVC apron, neoprene gloves, a gas mask, a brush or broom, a dust pan, an empty clearly labelled container (for collecting wastes) a container of sawdust and a spade.

r) Always strictly follow the rule "First-in First-out" i.e. new stocks should be moved to the rear

PEST CONTROL/ FUMIGATION

(1) A person who uses a pesticide, in the form of dust, vapours or very small spray droplets, the container of which bears or is required to bear a label with a warning "very dangerous poison" or "dangerous poison" or where application of the pesticide or toxic substance is in confined places, shall use suitable and effective cartridge type respirators, or masks with special canisters, in accordance with the Seventh Schedule.

(2) A person who fumigates or applies a pesticide, the container of which bears or is required to bear a label with a warning "very dangerous poison" or "dangerous poison" shall use a suitable respirator or mask so that none of the contaminated ambient air is inhaled.

(3) No person shall authorize or order the wearing of a damaged mask or respirator when the canister or cartridge has exceeded the service life specified by the manufacturer.

(4) No woman who is pregnant or child under 16 years of age shall be employed in the handling of pesticides or toxic substances.
(5) No person shall be allowed to eat, drink or smoke whilst handling pesticides.

**STORAGE AND DISPOSAL**

(6) Pesticides shall be stored in accordance with the regulations guiding the storage of pesticides.

(7) Pesticides shall be disposed in accordance with Pesticides and toxic substances.

**PROTECTIVE CLOTHING AND EQUIPMENT**

(8) Any person involved in the manufacture and formulation of pesticides or toxic substances must ensure that the following protective clothing are available to the employees:

- (i) acid resistant or chemical resistant overalls or dust coats with buttons to the neck;
- (ii) acid resistant or chemical resistant trousers and coat or suit;
- (iii) PVC gloves;
- (iv) PVC aprons;
- (v) rubber boots;
- (vi) respirator canisters with filters specific for dusts, mists, fumes, gases and vapour;
- (vii) face shields covering eyes and face;

(9) To clean-up spills the following should be available:

- (i) absorbent material (sawdust, sand, earth or powdered lime);
- (ii) washing detergent;
- (iii) brooms;
- (iv) shovels, spades;
- (v) funnels.

When self contained breathing apparatus is to be used only persons properly trained and experienced in the correct procedure should be allowed to use them.

**TRANSPORTATION**

1. The hazardous-warning signs that shall be used on Hazard-Warning Panels and compartment labels during transportation of toxic substances are set out in part II of the Third Schedule in the SI No. 20 of 1994 of the EPPCA No. 12 of 1990.

2. Each hazard-warning panel for pesticides and toxic substances shall be in form of an equilateral triangle and a square set with its sides at an angle of 45 to the vertical respectively and the length of the sides shall be:

   a) In the case of signs on hazard-warning panels, 200 milli-metres or
   b) In the case of signs on compartments labels 95 millimetres.

3. Signs for hazard-warning panels shall, for any part of the sign that is not black, have a black border at least 5 millimetres wide.
4. During transportation of the petroleum products it must be ensured that the products are properly packed and arranged such that possible chances of cross mixing or spillage /leakage of chemicals will not be present and hence avoid any unnecessary risks.

5. The vehicle in use for transportation of petroleum products must be solely used for this purpose alone not any other.

6. Vehicle used in the transportation of petroleum products must have a canopy or a tent to cover on top to avoid particulates of the chemicals mixing with air thus posing a danger to human health and the environment.

7. Contravention of any provision of these regulations shall mean being guilty of an offence with the possibility of withdrawal of the license and Prosecution.

8. Emergency provisions should be provided and claim fully aware of procedures and reporting systems.
Annex 9

WHO Toxicology ratings for pesticide products in use by the ZEGA membership

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Product</th>
<th>WHO Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fungicides</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benomyl</td>
<td>Benlate 50 WG</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Bitertanol</td>
<td>Baycor EC</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Bupirimate</td>
<td>Nimrod</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>Bravo 50 SC</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Copper Oxycide</td>
<td>Copper Oxycide</td>
<td>III</td>
</tr>
<tr>
<td>Cupric Hydroxide</td>
<td>Kocide</td>
<td>III</td>
</tr>
<tr>
<td>Cymoxanil &amp; Propineb</td>
<td>Miltaaz</td>
<td>III</td>
</tr>
<tr>
<td>Dichlofluanid</td>
<td>Euparen</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Diethofencarb &amp; Carbendazim</td>
<td>Sumico L</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Dimethomorph &amp; Mancozeb</td>
<td>Acrobat MZ</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Dodecophene Acetate</td>
<td>Metatox</td>
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</tr>
<tr>
<td>Fosetyl Aluminium &amp; Mancozeb</td>
<td>Alliette</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Fosetyl Aluminium</td>
<td>Mikal M</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Hexaconazole</td>
<td>Anvil</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Iprodione</td>
<td>Rovral fio</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Mancozeb</td>
<td>Dithane M45</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Metalaxyl &amp; Mancozeb</td>
<td>Ridomil MZ</td>
<td>III</td>
</tr>
<tr>
<td>Penconazole</td>
<td>Topaz</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Procymidone</td>
<td>Sumisclax</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Propamocarb HCL</td>
<td>Previcur</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Pyrimethanil</td>
<td>Scala</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Quaternary Ammonium</td>
<td>Sporekill</td>
<td>not classified in the WHO list</td>
</tr>
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</table>

Global Development Solutions, LLC
<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Product</th>
<th>WHO Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiophanate Methyl</td>
<td>Topsin Flo EC</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
<tr>
<td>Triflumizole</td>
<td>Rocket</td>
<td></td>
</tr>
<tr>
<td>Triforine</td>
<td>Funginex 200 EC</td>
<td>Unlikely to present acute hazard in normal use</td>
</tr>
</tbody>
</table>

**Insecticides, Acaricides & Nematicides**

- Abamectin: Vertimec 018 EC (not classified in the WHO list)
- Acephate: Orthene (II)
- Aldicarb: Temik 15 GR (Ia)
- Alphacypermethrin: Fastac (II)
- Amitraz: Mitac (III)
- Bifenthrin: Talstar 100 EC (II)
- Carbofuran: Curatter 10 GR (Ib)
- Carbosulfan: Marshall Suscon (II)
- Chlordane: Termidan (II)
- Chlorfenapyr: Secure (not classified in the WHO list)
- Chlorpyrifos: Dursban (II)
- Clofentezine: Apollo (unlikely to present acute hazard in normal use)
- Dichlorvos: DDVP (Dedevap) (Ib)
- Dinocap: Pentac Flo / WP (III)
- Endosulfan: Thiodan EC (II)
- Fenamiphos: Nemacur 400 EC (Ia)
- Fenbutatin Oxide: Torque (unlikely to present acute hazard in normal use)
- Flufenoxuron: Cascade (unlikely to present acute hazard in normal use)
- Hexythiazox: Nissuron (unlikely to present acute hazard in normal use)
- Lambda Cyalothrin: Karate 2.5 EC (II)
- Malathion: Malathion 40 EC (III)
- Methiocarb: Mesurol 80 EC (II)
- Methomyl: Lannate 200 WS (Ib)
- Methyl Bromide: Methyl Bromide (not classified in the WHO list)
<table>
<thead>
<tr>
<th>Insecticides</th>
<th>Active Ingredient</th>
<th>Pesticide Name</th>
<th>Hazard Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monocrotophos</td>
<td>Azodrin 40 WSC</td>
<td>1b</td>
<td></td>
</tr>
<tr>
<td>Oxamyl</td>
<td>Vydate 20 SL</td>
<td>1b</td>
<td></td>
</tr>
<tr>
<td>Phorate</td>
<td>Phorate</td>
<td>1a</td>
<td></td>
</tr>
<tr>
<td>Propargite</td>
<td>Omite</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Sulphur</td>
<td>Sulphur</td>
<td>unlikely to present acute hazard in normal use</td>
<td></td>
</tr>
</tbody>
</table>

**Herbicides**

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Active Ingredient</th>
<th>Pesticide Name</th>
<th>Hazard Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrazine</td>
<td>Gesaprim 500 FW</td>
<td>unlikely to present acute hazard in normal use</td>
<td></td>
</tr>
<tr>
<td>Bendioxide (Bentazone)</td>
<td>Basagran</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Fluazifop-P-butyl</td>
<td>Fusilade</td>
<td>unlikely to present acute hazard in normal use</td>
<td></td>
</tr>
<tr>
<td>Glyphosate</td>
<td>Round up</td>
<td>unlikely to present acute hazard in normal use</td>
<td></td>
</tr>
<tr>
<td>Linuron</td>
<td>Linuron</td>
<td>unlikely to present acute hazard in normal use</td>
<td></td>
</tr>
<tr>
<td>Metalochlor</td>
<td>Dual</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Paraquat</td>
<td>Gramoxone</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
Annex 10

Staff Training Requirements to Meet EUREP GAP

Staff training and assessment is essential if GAP is to be implemented on the farm. Training should be on-going and can be provided by a series of in-service short courses supplemented by in-house training from Project Managers.

Key points that should be included in training are listed below and NZTT courses relevant to this chapter of the Code are listed in Table 1. Training for pesticide users should include as relevant to roles and responsibilities:

- safe working practise
- correct application of the chemical
- calibration and sprayer set up
- maintenance of protective clothing
- record keeping of all operations
- action to be taken in the event of a failure or breakdown of the equipment or accident or spillage.
- disposal of containers and pesticide waste
- storekeeping
- transporting pesticides

Training for irrigators and fertigators should include as relevant to their roles and responsibilities:

- operation and basic maintenance
- assessment of soil moisture and EC
- assessment of plant requirements for water
- record keeping

Training for crop supervisors, crop scouts and farm staff should include as relevant to their roles and responsibilities:

- farm hygiene and cultural control of pests and diseases
- crop scouting techniques
- pest and disease identification

Training for farm managers and internal auditing

- introduction to implementing and auditing GAP

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## Farm Staff Training Courses Relevant to the Implementation of GAP

<table>
<thead>
<tr>
<th>Course</th>
<th>Staff Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop/ Greenhouse Supervisor</td>
<td></td>
</tr>
<tr>
<td>Supervision or supervision skills</td>
<td></td>
</tr>
<tr>
<td>Safe Use of Pesticides</td>
<td></td>
</tr>
<tr>
<td>Effective Spraying</td>
<td></td>
</tr>
<tr>
<td>Supervision of Spraying</td>
<td></td>
</tr>
<tr>
<td>Instructors Certificate in the Safe Use of Pesticides</td>
<td></td>
</tr>
<tr>
<td>Introduction to Crop Scouting</td>
<td></td>
</tr>
<tr>
<td>Senior Crop Scout Course</td>
<td></td>
</tr>
<tr>
<td>Transport of Pesticides</td>
<td></td>
</tr>
<tr>
<td>Introduction to Soil Management</td>
<td></td>
</tr>
<tr>
<td>Introduction to irrigation and fertigation</td>
<td></td>
</tr>
<tr>
<td>Pesticide storekeeping</td>
<td></td>
</tr>
<tr>
<td>Cultural control of pests and diseases</td>
<td></td>
</tr>
<tr>
<td>Record keeping</td>
<td></td>
</tr>
<tr>
<td>Introduction to implementing and auditing GAP</td>
<td></td>
</tr>
</tbody>
</table>

Global Development Solutions, LLC