agriculture, forestry & fisheries

Department:
Agriculture, forestry & fisheries
REPUBLIC OF SOUTH AFRICA

GUIDELINES ON THE MANAGEMENT OF THE RISK OF AGRICULTURAL REMEDIES ON INSECT POLLINATORS

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ABSTRACT

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SUMMARY

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1. Introduction and aims

The aim of this document is to address some of the concerns surrounding insect pollinator protection and preservation. It is well known and documented that the world's insect pollinators are under threat. The results of the decline of this essential ecological service, could lead to a dramatic decrease in the world's food production. In order for South Africa to help preserve and protect its insect pollinators, each sector needs to play their role. The Department of Agriculture, Forestry and Fisheries (DAFF) are the custodians of the Fertilizers, farm feeds, agricultural remedies and stock remedies Act 36 of 1947. This document has been drafted with both the actions that can be taken in terms of Act 36 of 1947, and suggestions on other measures that can be taken to preserve and protect our insect pollinators.

2. Role of insect pollinators and threats to these pollinators

According to Oxford English dictionary, pollination is the transfer of pollen to a flower or a plant and so fertilize it. The insect pollinators that perform this function are rewarded with essential nutrition in the form of the pollen and nectar. This is a symbiotic relationship with benefits and ensures the survival of both the pollinator and the plants it pollinates. The number of different types of insect pollinators is diverse and insect pollinators can be found across the vertebrate and invertebrates groups. In recent years, worldwide declines in managed and non-managed insect pollinators have led to an increased global dialogue and focus on the potential factors that may be causing these declines.

It is well known that some 35% of human diets and at least 80% of flowering plants are dependent on insect pollinators. Insect pollinators therefore provide a vital ecosystem service and by doing this, they are contributing to the world's production of food. This role is emphasized in the production of high value crops such as fruits, vegetables and nuts. There have been many estimates of the monetary value on the impact the pollinator have on the global economy. For example; the European Union estimates about $19.8 billion, North America about $20.1 billion and South Africa $3.2 billion, with the deciduous fruit industry making up about $358 million. Due to its importance in crop production and our ability to survey and track its status, the honey bee (*Apis mellifera*), has been at the center of these concerns. A number of factors have been hypothesized as potential contributors to insect pollinator declines. These declines are in the view of most experts, a result of a combination of multiple stressors. At this time, no single factor has been identified conclusively as the cause. The potential common factors suggested to contribute to global declines include: 1. Poor nutrition, land use and habitat, 2. queen failure and genetic weakness, 3. parasites and diseases, 4. beekeeping practices, 5. Pesticides

2.1. Nutrition, land use and habitat

Poor nutrition in South African insect pollinators can be contributed to commercial monoculture agriculture. Monoculture farming results in a very species poor environment, and therefore there are fewer species of food plants for insect pollinators to diversify their diets. In addition, almost none of the commercial grown crops in South Africa are indigenous, but our honey bees are mainly supported by these crops. The destruction of the natural areas around planted cultivations also lower the number of food plants available to the insect pollinators. pollinators. *Eucalyptus* trees, indigenous trees and shrubs, agricultural crops, urban gardens and even roadside weeds can provide the pollen (protein) and nectar (carbohydrates) that honey bees need to build a strong and healthy colony.

Mitigation for poor nutrition

- ✓ All landowners have a role to play in pollinator nutrition, and can contribute by allowing beekeepers access to secure sites to keep hives and by planting bee-friendly plants in gardens, for windbreaks and when rehabilitating land after development.
- ✓ Complimentary crops like lavender, basil, clover and vetch should be considered, as these all provide good pollinator nutrition.

- ✓ In order to diversify these pollinators' diets, the conservation of *Eucalyptus* trees may be considered. It has already been recognized that *Eucalyptus* trees are good habitat for bees, and several species (e.g. *Corymbia ficifolia* and *Eucalyptus gomphocephala)* are not listed as Alien or Invasive Species. The six *Eucalyptus* species listed under the NEMBA regulations can be demarcated as Category 2 invasive species as bee forage areas, wind rows, or woodlots. However *Eucalyptus* trees occurring within riparian areas, protected areas or ecosystems identified for conservation purposes must be removed.
- ✓ The removal of natural vegetation around agricultural areas should be avoided.

In addition, almost none of the commercial grown crops in South Africa are indigenous and yet our honey bees and other insect pollinators are supported and fed mainly on these crops. The destruction of the natural areas around planted cultivations also lower the number of flowering plants available to the insect pollinators.

Mitigation for poor nutrition

- ✓ In order to diversify these insect pollinators' diets, the consideration of conservation of eucalyptus trees may be considered. It has already been recognized that eucalyptus trees are a good habitat for honey bees. Eucalyptus can be demarcated as Category 2 invasive species under the National Biodiversity Management Act (NEMBA) as bee forage areas, wind rows, or woodlots. However eucalyptus trees occurring within riparian areas, protected areas or ecosystems identified for conservation purposes must be removed. It is worth noting that *Eucalyptus ficifolia* and *Eucalyptus gomphocephala* are not listed as Alien or Invasive species. Further information can be obtained from the Department of Environmental Affairs (DEA) and the South African National Biodiversity Institute (SANBI).
- ✓ The removal of natural vegetation around agricultural areas should be avoided.
- ✓ Planting of indigenous plants that are important to beekeepers. These could include fynbos species (e.g. ericas, proteas, buchus and mesembs); aloe species (e.g. *Aloe greatheadii*); indigenous thorn trees (e.g. *Vachellia karroo* (sweet thorn) and *Ziziphus mucronata* (buffalo thorn). The latter two provide important winter forage for honey bees and other insect pollinators in the northern regions of South Africa.

2.2. Queen failure and genetic weakness

There are South African scientists currently doing research on some of these topics and they are being supported through the DST/NRF initiatives. Latest developments on these and other research topics can be provided by the University of Pretoria (UP) and other academic researchers, specifically the Pollination and Threats to Pollinators working groups.

2.3. Parasites and diseases (fungi, bacteria, viruses)

There are many parasites and diseases that affect insect pollinators. The most well-known ones are *Varroa destructor* mite and the viruses it transmits and American foulbrood disease which affect honey bees. In the case, where a stock remedy or agricultural remedy can be used to help control the problem, these products must be registered before being sold and used.

2.4. Beekeeping Practices

From a regulatory point of view, good beekeeping practice can be supported by the regulation of information placed on a label to inform the user. This may include instructions to a user to inform a beekeeper to remove all hives from the surrounding areas before treatment begins with a particular agricultural remedy. There is also a requirement that any persons doing bee-keeping activities must be registered with the DAFF as per the Agricultural Pest Act, 1983 (Act 36 of 1983), where "beekeepers" means a natural person who keeps, owns or is in charge of honey-bees in beehives for

commercial or recreational purposes, and includes a person who removes, eradicates or relocates colonies.

2.5. Pesticides (Agricultural Remedies)

Pesticides or Agricultural remedies have been considered as one of the negative factors contributing to the decline of insect pollinator species. There is uncertainty or contradictory views regarding the extent to which these pesticides contribute to the decline in pollinator health, the existing knowledge on the effects of pesticides on honey bees and other insect pollinators, as well as bee-loss incidents associated with pesticide exposure have highlighted the need for regulatory agencies including South Africa to advance their ability to assess the potential risk that pesticides pose to insect pollinators and to improve their tools to mitigate risks to them.

This is discussed in detail in the next section below.

3. Agricultural Remedies (Pesticides) and the role of Act 36 of 1947

Due to the inherent nature of Pesticides or Agricultural remedies, these products have the potential to contribute to the decline of insect pollinator species. If one refers to an 'agricultural remedy' in the Fertilizers, farm feeds, agricultural remedies and stock remedies Act 36 of 1947, the definition is given as: “means any chemical substance or biological remedy, or any mixture or combination of any substance or remedy intended or offered to be used- (a) for the destruction, control, repelling, attraction or prevention of any undesired microbe, alga, nematode, fungus, insect, plant, vertebrate, invertebrate, or any product thereof”. The Act not only makes provision that these products should destroy, control, repel, attract or prevent insects, but also that they do it effectively.

Most agricultural remedies may only be registered for use against a specific insect on a specific crop. It certainly does not mean that these remedies are not capable of harming a pollinator insect. This concern has been raised all over the world and has been highly publicized. In South Africa it has also been shown that many of our crops are not only dependent on bee pollinators, but some crops are also pollinated by other insect pollinators. However, the information currently available is not comprehensive and therefore an approach of protecting the honey bee will serve to protect some of these insects as well, i.e. most of the other known insect pollinators would be exposed to the risks in the same way as the honey bee.

Information and advice available to the DAFF suggests that, in South Africa, there is also uncertainty or contradictory views regarding the extent to which pesticides contribute to the decline in pollinator health, due to the lack of research in this area. Incidents of beekeepers losing bee colonies as a result of pesticide use do occur, but this most often arises because there has been a break-down in communication between the farmer and the affected beekeeper.

This situation is one that South Africa shares with Australia. The DAFF is working cooperatively with other government departments (for example: Department of Environmental Affairs (DEA), Department of Health (DoH)), the chemical industry, growers associations and other stake holders to encourage more research to clarify the real impact that agricultural remedies may have on insect pollinators. The DAFF believes that the risks posed by currently-registered agricultural remedy use patterns can be appropriately managed by adopting a range of regulatory, industry stewardship, product restrictions or bans where the risk is not manageable and educational measures aimed at bee keepers and farmers through different media.

3.1. Global status of Neonicotinoid pesticides

This group of pesticides has been a subject of debate internationally with various regulators having arrived at different regulatory approaches which are summarized below.

3.1.1. European Union Commission

- ✓ The use of plant protection products containing imidacloprid, clothianidin and thiamethoxam should be prohibited for seed, granular soil treatment and foliar applications in crops attractive to honey bees, except for uses in greenhouses, for winter cereals and uses in open air fields after flowering
- ✓ Crops which are harvested before flowering are not considered attractive to honey bees.
- ✓ Uses should be limited to professional uses.
- ✓ At the latest within two years, the Commission will review the conditions of approval of the three neonicotinoids to take into account relevant scientific and technical developments.
- ✓ These restrictions apply from 1 December 2013, following a period of grace of 2 months from the date of withdrawal of authorizations on 30 September 2013.

3.1.2. United States Environmental Protection Agency (EPA)

- ✓ Petition to ban Neonicotinoid use rejected by EPA in 2012, because scientific data did not support the correlation between honey bee deaths and Neonicotinoids
- ✓ EPA and United States Department of Agriculture (USDA) continue to indicate that they cannot conclude that pesticides are the main cause of bee losses

3.1.3. Australian Pesticides and Veterinary Medicines Authority (APVMA)

- ✓ "On the basis of information available to it, the APVMA is currently of the view that the introduction of the neonicotinoids has led to an overall reduction in the risks to the agricultural environment from the application of pesticides. This view is also balanced with the advice that Australian honey bee populations are not in decline, despite the increased use of this group of pesticides in agriculture and horticulture since the mid-1990s."

3.1.4 South Africa Department of Forestry and Fisheries (DAFF) (Regulatory by means of a gazette)

There were proposals to regulate (by means of a gazette) for the following:

- ✓ Neonicotinoids are not to be applied using aerial applications.
- ✓ The Neonicotinoids that are registered on fruit trees for foliar application on fruit trees must be applied only after petal drop - that means after honey bees have lost their foraging interest in orchards.
- ✓ Prohibit neonicotinoid pesticides and pesticides that are classed as highly toxic for foliar application in cotton.

For any the latest developments, updates or any additional information, please refer to above mentioned organization's websites.

4. The Risk Assessment Process to be used in the registration process under Act 36 of 1947

The data requirements for Agricultural remedies registration has been clearly described in the 'Guidelines on the data and documents required for registration of agricultural remedies in South Africa - 2015' and the 'Guideline of the registration process for agricultural remedies - 2015'. As part of this assessment, environmental impact data is provided for the product, this includes data such as the LD_{50} oral and dermal values for the honey bees. These LD_{50} values for honey bees can be generated according to the Organisation for Economic Co-operation and Development (OECD) guidelines.

4.1. Toxicology data requirements for honey bees

Data requirements as per the OECD guidelines, are required for South African agricultural remedy registration. Based on these data and the contact LD_{50} value, the remedy will be classified as non-toxic (LD_{50} ≥11 µg/bee), moderately toxic (10.9 > LD_{50} >2 µg/bee), or highly toxic (<2 µg/bee) (as per USEPA. 2012, Ecological Effects Test Guidelines OCSPP 850.3030). These bee toxicity data must be generated in conformance with the OECD guidelines (OECD Guidelines for the Testing of Chemicals. Test Number 214). This classification of toxicology of an agricultural remedy will lead to the inclusion of various label statements as described in section 5.

It is also required that all agricultural remedies that have a toxicology class: moderately toxic (10.9 > LD_{50} >2 µg/bee), or highly toxic (<2 µg/bee), additional toxicology data will be required for any residues that may be present in pollen and nectar. This requirement will be for all application methods, and for products applied to a crop before flowering. No product in either of these two classes may be applied during flowering regardless of application method. This will be applied to all applications, regardless of the type of application submitted i.e., it will also be applied to generic, new molecule, label amendments etc. applications.

Mitigation Label Statements

Highly toxic (<2 µg/bee) = *Toxic to honey bees.* + hazard symbol inserted on toxicology class colour band.
Moderately toxic (10.9 > LD50 >2 µg/bee) = *Dangerous to honey bees* + hazard symbol inserted on toxicology class colour band.
Non-toxic (LD50 ≥11 µg/bee) = no hazard statement.

4.2. Routes of exposure

Risk assessment methods due to exposure will be based on the OECD risk assessment. This includes the assessment of the route of exposure and the mitigation statements that would be required.

Routes of exposure of insect pollinators to pesticides are as follows:

- exposure via contact—either from spray deposits (i.e. overspray or spray drift) or from dust particles when honey bees and other insect pollinators are either foraging the treated crop, weeds in the field, plants in field margin and the adjacent crop;
- consumption of nectar and /or pollen—from the treated crop, weeds in the field, plants in field margin, the adjacent crop or succeeding crop/permanent crop the following year;
- consumption of water (i.e. surface water, puddles and possibly guttation fluid);
- risk from metabolites present in pollen and nectar.

4.2.1 Contact with pesticides

a) Contact with seed-treatment dusts

There have been cases in the world where honey bees and other insect pollinators have been poisoned by exposure to pesticide dust from treated seed. The dust can be emitted into the air by vacuum-pneumatic seeders and then settles on nearby flowering plants.

Mitigation:

- ✓ The quality of the seed dressing must be of a good standard (registered stickers and binders etc.), which would minimize the release of the abraded seed coating as fine dust should be used. Seed treatment should be conducted in accordance to the seed treatment guidelines (to be developed by the office of the registrar in due course).
- ✓ Growers are to use a pneumatic seeding machine that is both in good working order and designed to minimize the output of pesticide dust
- ✓ Seed can only be sown if the wind speed at planting does not exceed 5 m/sec

- ✓ The treated seeds and any dust they produce must be completely incorporated in the soil
- ✓ The farmer/farm manager must notify beekeepers with hives located within 60 m of the sowing area, at least 48 h before seeding.

b) Contact with foliar sprays

Honey bees and other insect pollinators can be acutely poisoned by contact with pesticide sprays, either during spraying or to the un-dried spray on plant surfaces. One of the biggest drawbacks of placing honey bees near any agricultural crop is the possibility of colonies or field honey bees being affected by pesticides. Pesticides should be kept to a minimum while hives remain on the property. Most poisoning occurs when pesticides are applied to flowering crops, pastures and weeds. It is strongly recommended that growers take the following steps to prevent or reduce bee losses:

Mitigation

- ✓ Select the least harmful pesticide for honey bees and other insect pollinators and spray late in the afternoon or at night
- ✓ Do not spray in conditions where spray might drift onto adjacent fields supporting foraging honey bees and other insect pollinators
- ✓ Dispose of waste chemical or used containers correctly
- ✓ Always warn nearby beekeepers of your intention to spray in time for steps to be taken to protect the honey bees. Adhere to label statements regarding restrictions for managed bee pollination.
- ✓ Always advise nearby farmers.

4.2.2. Systemic residues in plants

a) *Systemic exposure through seed treatments*

There has been an extensive debate in the literature on whether the systemic levels of pesticides occurring in nectar and pollen following seed-treatment with pesticides are detrimental to insect pollinators. The evidence is that they do not present an acute poisoning problem, but whether the levels are high enough (either alone or in combination with other pesticides to which honey bees and other insect pollinators might be exposed) to subtly affect bee behaviour (and ultimately affect colony health) is a subject of intense ongoing research. Should more information become available, the Registrar may insist on the inclusion of relevant data.

b) *Systemic exposure through soil-incorporated granules, soil drenches etc.*

Systemic plant residues may arise from the use of pesticides incorporated in the soil at planting and from soil drenches. DAFF registrations already require residue data determining the amount of pesticide residues in crops.

c) *Systemic exposure through foliar sprays*

Most systemic pesticide residues will be largely confined to the leaves. For mitigation of this type of risk, refer to the specific crop requirements as listed in section 7.

After the evaluation of the exposure route has taken place, specific crop requirements in section 7 must also be applied. Upon conclusion of the evaluation, appropriate pollinator protection statements must be used on the product label. The following statements can be used where appropriate, either as a single statement or as a combination statement as needed.

Mitigation Label Statements for application methods and crop type

To protect honey bees and pollinating insects do not apply to crop plants when in flower / Do not use where honey bees are actively foraging / Do not apply when flowering weeds are present / Remove weeds or kill before flowering / Do not apply before (state time) / Foliar application of this product is prohibited from onset of flowering until flowering is complete when honey bees are on-site under contract.

When including such a statement, any conflict between the proposed use pattern of the chemical and the advice on bee hazard should be avoided either by restricting the label, changing use patterns, timing of applications or product bans etc.

There is also a requirement for the revision of existing labels to update them with the above label requirements based on the proposed hazard descriptions. ie. non-toxic (LD_{50} ≥11 µg/bee), moderately toxic (10.9 > LD_{50} >2 µg/bee), or highly toxic (<2 µg/bee) and appropriate mitigation statements. This will be done at renewal of already registered products.

4.3 Application of pesticides to sites with honey bees present under contract for pollination services

The following will be adhered to:

- ✓ To prohibit the foliar application of acutely toxic products during bloom for sites with honey bees on-site under contract, unless the application is done with an emergency written agreement between the bee keepers and the farmer. Such agreements should be forwarded to the office of the Registrar of Act 36 of 1947 by means of an application either by the farmer or beekeeper.

5. Non labeling pollinator protection measures that can be taken in accordance with Act 36 of 1947.

- Banning of problematic pesticides (based on peer reviewed research done in SA or elsewhere in the globe)
- Outlaw certain methods of pesticides applications where the risk to insect pollinators is significantly higher (based on peer reviewed research done in SA or elsewhere in the globe)
- New mitigation statements as raised by stakeholders.
- New mitigation statements as raised by developments in technology such as spray technologies.
- Stewardship documents for high risk crops to be developed by all parties concerned.
- The use of Antibiotics/Veterinary medicines to maintain bee health. These are especially important for the control of viruses and bacteria that affect honey bees and other insect pollinators.

6. Use of IPM

6.1. Integrated Pest Management (IPM), which combines appropriate methods such as biological, cultural and mechanical control to reduce pests such as weeds, insects and diseases to acceptable levels while causing the least impact on the insect pollinators, must be used in all agricultural practices with the aim of reducing unnecessary pesticide applications.

7. Crop specific mitigations

South African top 20 crops of highest economic importance, ranked from highest to lowest are:
1. Maize/Sweetcorn, 2. Deciduous fruit, 3.Citrus fruit, 4.Sugar cane, 5. Potatoes, 6. Wheat, 7. Viticulture, 8. Pasture grasses/Hay, 9. Subtropical fruit, 10. Soya Beans, 11. Sunflower seeds, 12. Tomatoes, 13. Onions, 14. Flowers & bulbs, 15. Barley, 16.Groundnuts, 17. Dry beans, 18. Tobacco, 19. Dried fruit 20. Grain sorghum. Other crops that are of economic importance grown in South Africa, ranked from highest to lowest are: Beetroot, Nuts, Cotton, Cabbage, Canola, Sweet potatoes, Lettuce, Oats, Wattle bark, Carrots, Green Beans, Rooibos, Gem squashes, Cauliflower, Pumpkins, Chicory root, Green peas, Tea & Lucerne seed.

7.1. Maize (*Zea mays*)

In South Africa, maize is the highest ranking crop in terms of area under cultivation and economic value. In the year 2011/2012, the crop's gross value was approximately 29% of the total gross value for all commercial crops. Maize can be harvested at maturity when its kernels are dry and it can be stored for stock feed. Sweet corn is maize which is high in sugar and is harvested before maturity for human consumption. Human food uses including breakfast cereals, snack foods and for starch extraction.

In maize, insect pollinators can be subjected to pesticides through all routes of exposure. However, maize is a wind pollinated crop and it is not reliant on insect pollination for seed set or yield improvement. Most wind pollinated plants have low levels of protein in their pollen, and maize has pollen has been confirmed to be a low quality pollen. There is also no nectar in maize. Maize also does not produce any brightly coloured flowers or scents that could be attractive to most insect pollinators. It is known that bee hive strength can be reduced if maize is the only source of pollen. Given this information, it can be argued that agricultural remedies that are directly applied to maize as contact pesticides or even those that have a systemic action should pose a low risk to insect pollinators. However, there are other exposure routes that may expose insect pollinators such as the pesticide dust from treated seed that may be released into the air during vacuum-pneumatic planting of the maize seed. This dust has the potential to poison flying insect pollinators directly or to deposit on nearby flowering plants and come in contact with insect pollinators. There is a significantly greater potential for dust generation during maize seeding because of the increasing use of vacuum seeders and fans which vent directly to the air. Maize is planted from October to December (sometimes extended) in South Africa, which corresponds to the time of year when insect pollinators are active and various other plants may be flowering.

Mitigation in maize

- ✓ The possible deposition of pesticide dusts during maize seeding on flowering plants adjacent to the field should be avoided.
- ✓ The use of good quality seed treatments, with high quality coatings and good working modern equipment should be used.

7.2. Deciduous, Citrus & Sub-Tropical Fruits, Tree Nuts

(Includes Citrus fruit, Grapefruit, Oranges, Lemons, Limes, Mandarins, Tree nuts (Almonds, Brazil nuts, Cashew nuts, Chestnuts, Coconuts, Hazelnuts, Macadamia, Pecans, Pine nuts, Pistachios, Walnuts) Pome fruit (Apples, Pears, Quinces, Medlar, Loquat), Stone fruit (Apricots, Cherries, Peaches, Nectarines, Plums) Berries & small fruit (Table and wine grapes, Strawberries, Cane fruit, Blackberries, Dewberries, Raspberries, Blueberries, Cranberries Gooseberries, Rose hips, Mulberries, Azarole, Elderberries, chokeberry), Dates, Figs, Table olives, Kumquats, Carambola, Persimmon, Kiwi, Litchi, Passion fruit, Prickly pear, Star apple, Avocados, Bananas, Mangoes, Papaya, Pomegranate, Cherimoya, Guava, Pineapples, Bread fruit, Durian, Soursop

Most deciduous and sub-tropical fruit crops are heavily or completely reliant on insect pollinators. However, the exposure of insect pollinators during the establishment of the crop does not usually involve high numbers. Most of these crops are planted as young trees and planting of new plants only takes place after an extended period as the plants have a relatively long life span, in some cases many years.

There is no doubt that foliar application of pesticide sprays around the time of crop flowering will present a risk to insect pollinators. This is a risk that can be addressed, at least in part, by appropriate label warnings and by increasing grower awareness of the value of insect pollinators to improved yields. The label warnings can take into consideration the timing of spraying in relation to pollinator activity in the crop. Treatments made to crops in flower or upwind of adjacent plants in flower that are likely to be visited by honey bees and other insect pollinators at the time of application, should not occur during the daytime if temperatures within an hour after the completion of spraying are expected to exceed 12^0C. In addition insect pollinators are generally active between 7:00 am and 4:00 pm, and spraying should occur outside these hours. It is recommended that orchard floors containing flowering plants be mown just prior to spraying. Beekeepers that are known to have hives in, or nearby, the area to be sprayed should be notified no less than 48 hours prior to the time of the planned application so that honey bees and other insect pollinators can be removed or otherwise protected prior to spraying. An application of any pesticide to a crop by chemigation using a dripper system will present a risk to insect pollinators, particularly if there are no other readily-available sources of water

Mitigation in deciduous fruit & sub-tropical fruit

- ✓ Notifying the apiarist when beehives are in the vicinity of crops to be sprayed to allow removal of the hives before spraying. Beekeepers require as much notice possible, preferably 48 hours, to move an apiary
- ✓ Where possible, choose pesticides less toxic to honey bees and other insect pollinators.
- ✓ Inform contract pesticide applicators operating on the property of the locations of apiaries
- ✓ Paying particular attention to wind speed and direction, air temperature and time of day before applying pesticides
- ✓ Using buffer zones as a mechanism to reduce the impact of spray drift or overspray; and
- ✓ Avoiding drift and contamination of surface waters where honey bees and other insect pollinators may drink

7.3. Sugarcane (*Saccharum* spp.)

In sugarcane, insect pollinators could be subjected to pesticides through all routes of exposure. However, sugarcane is vegetatively propagated for commercial cultivation through different kinds of planting materials; e.g. cane setts; settlings and bud chips. These materials can be treated with various fungicides and systemic pesticides. However there is no exposure to pesticide dusts from treated seeds, like in maize. Sugarcane is also not reliant on insect pollination for seed set or yield improvement. Sugarcane does not produce any brightly coloured flowers, nectar or scents that could be attractive to most insect pollinators.

Mitigation in sugar cane

- ✓ The possible contamination of surrounding vegetation by spray drift must be minimized, especially when using aerial application of pesticides in sugarcane.

7.4. Potatoes (*Solanum* spp.)

In potatoes, insect pollinators could be subjected to pesticides through some routes of exposure. However, potatoes are mostly vegetatively propagated for commercial cultivation through different kinds of planting materials; e.g. seed tubers, tubers. However, there is no exposure to pesticide dusts from treated seeds like is possible in maize. Most potatoes are also not reliant on insect pollination for

seed set or yield improvement. Potatoes produce many brightly coloured flowers, nectar or scents that could be attractive to insect pollinators, and therefore care should be exercised during this period.

Mitigation in potatoes

- ✓ The possible contamination of surrounding vegetation by spray drift must be minimized, especially when using aerial application of pesticides in potatoes.
- ✓ Apply pesticides less toxic to honey bees and other insect pollinators when the risk is high.

7.5. Wheat (*Triticum* spp.)

Wheat in South Africa is mostly used for human consumption with the remainder being used as animal feed. As with maize, wheat is wind pollinated and is not reliant on insect pollinators for seed set or yield improvement. Wheat pollen is assumed to have low protein quality, like most wind pollinated cereal-type crops. There is no nectar, colorful flower or scent production in wheat which may attract insect pollinators. Therefore, the direct exposure of insect pollinators to agricultural remedies applied to wheat is low. However, there is a risk associated with seed treatment of wheat seeds. However, in wheat, the risk associated with dust produced during the planting process may be less significant than with maize. This is because in South Africa, wheat is planted from April to July, or June to August and August to September depending on the cultivar and growing season of the crop. This corresponds to the autumn and winter seasons and a period when insect pollinators may not be at their most active and other nearby plants may not be in flower. A no-till planter can be used for seeding or a planter fitted with tines can be used for planting, which may not product as much dust as the vacuum seeders used for maize.

Mitigation in Wheat

- ✓ The possible deposition of pesticide dusts during wheat seeding on flowering plants adjacent to the field may need to be investigated.
- ✓ The use of good quality seed treatments, with high quality coatings and good working modern equipment must be investigated.

7.6. Viticulture (*Vitis* spp.)

The dependence of grapes on pollination by insects is none, i.e. there is no production increase with animal mediated pollination. Grape vines are usually planted as young plants and no seed treatments are involved. The planting of new plants only takes place after an extended period as the plants have a relatively long life span (many years).

Mitigation in viticulture

- ✓ The possible contamination of surrounding vegetation by spray drift must be minimized, especially when using aerial application of pesticides in viticulture.

7.7. Pasture grasses (and clover) and Lucerne

Erogrotis spp., ryegrass, finger-grasses etc. are some of the species that are grown as pasture or feed grasses in South Africa. These grasses are wind pollinated and are not reliant on insect pollinators for seed set or yield improvement. Grass pollen is assumed to have low protein quality. There is no nectar, colorful flower or scent production in grasses which may attract some insect pollinators. Therefore, as with maize and wheat, the direct exposure of insect pollinators to agricultural remedies applied to pasture or feed grass is low.

However, some of these pasture grasses are often grown in conjunction with a legume such as clover. A wide range of clovers are grown in South Africa. Pollination of these mostly self-incompatible species is necessary for seed set. Pollination has consistently been identified as a major limiting factor to higher, more reliable clover seed yields and improved seed quality. Planting of

pasture seed is by broadcasting (including aerial broadcasting) or shallow drilling. A similar scenario applies to Lucerne (*Medicago sativa*), a legume which is also attractive to pollinators.

Mitigation in pasture grasses mixed with flowering legume or Lucerne (*Medicago sativa*),

- ✓ Apply pesticides less toxic to honey bees and other insect pollinators during critical periods
- ✓ Notifying the apiarist when beehives are in the vicinity of crops to be sprayed to allow removal of the hives before spraying. Beekeepers require as much notice possible, preferably 48 hours, to move an apiary
- ✓ Inform contract pesticide applicators operating on the property of the locations of apiaries
- ✓ Paying particular attention to wind speed and direction, air temperature and time of day before applying pesticides
- ✓ Using buffer zones as a mechanism to reduce the impact of spray drift or overspray; and
- ✓ Avoiding drift and contamination of surface waters where honey bees and other insect pollinators may drink

7.8. Sunflower (*Helianthus annuus*)

Sunflower seed is a source of high quality oil used for cooking, salads, paints and industrial lubricants. Non-oil varieties are used for birdseed or roasted for cereals, snack bars etc.

Sunflower nectar is collected by honey bees and pollination by honey bees produces significantly greater seed set and seed weight than crops not pollinated by honey bees. But, the quality of sunflower pollen and the quantity of nectar is limited. Numerous experiments have found that a seed set as low as 10-20% results when insect pollinators are absent and plants self-pollinate, compared to up to 90% seed set in flower heads accessible to insect pollinators. It should be noted however, that different cultivars have different levels of self-fertility, and many modern sunflowers are fully self-fertile.

Sunflower is planted in November to January depending on the variety and planting area. The risk associated with seed treatment in sunflower relates to the planting mechanism. Sunflower planter are recommended to have press wheels, which compact the soil alongside the seed, good depth control and good contact between the seed and the soil. The amount of pesticide dust associated with this type of planting is unknown, and may warrant further investigation as there is possible deposition of pesticide dusts during seeding on flowering plants adjacent to the field.

7.9 Canola, Ornamentals and Vegetables

In South Africa canola and ornamentals present particular concerns with respect to bee feeding because they produce numerous flowers that are a source of attraction to honey bees and other insect pollinators and they rely on insect pollinators for good yields. In addition they produce abundant quantities of nectar and pollen with high protein content and thus are an important floral resource for beekeepers.

Insect pollinators working these crops could potentially be exposed to pesticides from (1) dust from seed coating arising during planting; (2) residues in nectar, pollen and guttation fluid arising from systemic absorption of the pesticide into the plant from the coated seed; and (3) direct exposure to foliar pesticide sprays applied around the time of canola flowering.

Mitigation measures

- ✓ The application of pesticides dusts arising during canola planting can be reduced by using low pressure air seeders which vent directly into the furrow and there is no generation of dust clouds.
- ✓ Avoid or restrict pesticides applications when the crop is in flower. Restrictions would be based on a risk assessment.

- ✓ Notify the apiarist when beehives are in the vicinity of crops to be sprayed to allow removal of the hives before spraying. Beekeepers require as much notice as possible, preferably 48 hours, to move an apiary
- ✓ Inform contract pesticide applicators operating on the property of the locations of apiaries
- ✓ Pay particular attention to wind speed and direction, air temperature and time of day before applying pesticides
- ✓ Using buffer zones as a mechanism to reduce the impact of spray drift or overspray; and
- ✓ Avoid drift and contamination of surface waters where honey bees and other insect pollinators may drink

8. Conclusions

According to the OECD, "regulatory authorities must balance the benefit of pesticides, and their contribution to meeting the increasing demand for safe and abundant food and fiber, with the potential risks that they may pose. If the risks from a pesticide become inconsistent with the goals of a regulatory agency (e.g., to protect human health and the environment), then regulatory authorities may explore options to mitigate the risk in order to bring the risks of that pesticide into balance with its benefits and into concert with the protection goals of the regulatory agency and societies they serve." This approach is in line with the provision of section 3 of Act 36 of 1947.

All labels in South Africa will be required to reflect the appropriate hazard classes and mitigation statements.

References and suggested further reading list

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