UV Blocking. Regular greenhouse films typically absorb UV radiation up to 350 nm. UV radiation from 350 to 380 nm is not blocked. Special UV blocking films have been developed which filter out UV radiation up to 380 nm. This will contribute to the control of certain fungus sporulation and pest control. Certain insects require this portion of light to navigate. UV blocking film should not be used when bees are being used for pollination.

Cooling Effect. The use of high diffusing films offers a moderate cooling effect. It is also possible to produce near infrared blocking films. These do not allow entry into the greenhouse of the near infrared radiation, which carries the sun's heat during the day. The additives required to perform this function are very expensive and it also has a negative effect on the usable light in the greenhouse.

CONCLUSION

Specialty plastic films produced with modern three-layer co-extrusion technology used in conjunction with naturally ventilated greenhouses will enable you to grow a high-value crop with a good return due to low running costs.

Environmentally Responsible Plant Production©

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INTRODUCTION

For many years the use of naturally produced organic pesticides have been debated against the use of synthetically produced organic and chemical agricultural remedies. Which direction is the right one to take? The use of organically certified products on the one hand resulted in produce that carries a high premium and affordable to the minority elite, where as the use of more economical chemical pesticides produce affordable produce for the masses. Technology at present is so advanced that today's chemical formulations available on the world market are in many cases less hazardous compared to many natural substances found in nature. At the same time many organic and biological pesticide formulations have become more affordable. Before selecting products for use in production one needs to do an assessment of risk.

Should pesticides be allowed that are isolated from nature (natural organic) or synthetically produced? Which of these pesticides should be made available for commercial use? To answer these questions one has to look where these pesticides fit in with the definitions of ecology, toxicology, toxicity, and hazard.

DEFINITIONS USED TO DETERMINE THE POSSIBLE RISK OF PESTICIDES

Ecology. This is the science of all levels of life in their relation to each other and to their environment. Man being at the top of the food chain is just as much part of the ecology as any other organisms and therefore must be recognized in the definition.

Toxicology. The science by which a qualitative and quantitative study is made to observe the alterations of structure and response in living systems caused by chemical and physical agents.

Toxicity. Toxicity is the ability of a chemical to produce injury once it reaches a susceptible site in or on the body (organism) and can be measured and expressed in mathematical terms.

Hazard. The probability that injury will be caused by the circumstances of use depends on many factors, such as the way it is used, formulation, environmental conditions, etc. (Guide to the treatment of poisoning by chemicals, Agriculture and Public Health, AVCASA publication).

By having an in-depth look at each of these definitions and the inter relationship between them one can make a decision on which product is most suitable for one's growing conditions. Further more, pesticide companies as well as the users of their products carry equal responsibilities when it comes to safeguarding the environment.

PESTICIDE COMPANIES

There are misperceptions that everything organically or naturally produced is nonhazardous and nontoxic and that everything chemically produced is toxic and hazardous. The time has come for companies to open up the real facts about the toxicity and the hazard of their products. A formulation's toxicity determines how hazardous a product might be to the user and the environment.

There are many pesticides that can cause serious harm when absorbed in even small quantities through the various routes of poisoning (mouth, nose, eyes, and skin). There are also pesticides that have been developed by companies with very low toxicity to humans, beneficial insects, and other life forms.

Growers that use various pesticide formulations should be provided with a complete material safety data sheet of the products. This should include information concerning environmental impact studies (possible poisoning or harm to beneficial insects, fish, bird life, and all the other life forms we need to safeguard, as well as possible health threats, etc.) (Table 1).

BASIC ANALYSIS OF ENVIRONMENTAL EFFECTS OF PESTICIDES

Pesticides that can cause poisoning through multiple routes are in general more hazardous than those with limited routes of poisoning. The most common routes of poisoning can occur through skin (dermal) and eye contact, inhalation through the mouth, nose, throat and lungs, and ingestion (oral intake). Acute poisoning is very unlikely for many pesticides. We forget that the effects of some poisons resemble those of natural illness, e.g., vomiting and diarrhea, or collapse. Individuals also react differently to poisons they were exposed to.

In general naturally prepared pesticides (referred to by many people as organic, biological, or botanical pesticides), are far less hazardous than most traditional chemically produced pesticides but not necessarily as different when it comes to the real toxicity of the substance. The main advantage of natural products is that most of them have one thing in common, no or very short residual action. No matter what the outcome of tests may be toxic effects must be weighed against the benefits offered by the compound. No substance is harmless, at some dosages all are fatal and the probability that the ecology may receive a harmful dose will depend, at least as much on how the material is used as on its inherent toxicity.

To summarize, the following should be considered when classifying a pesticide as more environmentally responsible, or rather more friendly compared to others.

1) How targeted is this product in controlling pests. Is it a selective or very broad-spectrum pesticide?
2) How friendly is this product to nontargeted organisms (birds, bees, fish, frogs, etc)?
3) What is the residual activity of the active ingredients in the formulation?
4) Is the product friendly to the user that has to apply it? What methods can be used to apply the product?
5) What are the oral and dermal toxicities of the actual active ingredients expressed in mg active ingredient per kg bodyweight, as well as the toxicity of the formulated product?
6) How persistent is this product in the environment (the actual time that it takes to break down) in the soil, water, and target pest? Persistency can be directly related to secondary poisoning.
7) What is the recommended dosage rate for effective control? The lower the dosage rate, the more "safe" a formulation becomes.

We must not just accept that all "natural" organic pesticides are safe or nontoxic. There are many substances in nature that are highly toxic. In these cases the product becomes friendlier purely because of the nonresidual properties in the environment, and not because of the actual toxicity.

PESTICIDE FORMULATIONS

There are many organic and biological products as well as synthetically produced chemicals available to growers. All these pesticides (naturally or synthetically produced) have to comply with the registration guidelines laid down by the Department of Agriculture, Act 36 of 1947 for the registration of agricultural remedies.

Most naturally produced organic pesticide formulations available differ quite drastically from chemical formulated pesticides when it comes to dosage and frequency of applications. Due to organic pesticide's none or short residual action (repelling and mainly contact), more applications are necessary to achieve the same results as with many residual chemical pesticides. The integration of organically formulated insecticides with a chemical spraying programme is vital especially in the case where pest resistance is evident against the chemicals. The use of organic formulations containing, for example, garlic juice extracts plus canola oil can play a very important role in producing high quality crops.

The following is a list of pesticides with an analysis of the impact they have on the environment (Table 1). This list is not exhaustive and it serves to demonstrate the information required to make an informed decision.

SUMMARY AND CONCLUSION

The route to be taken by growers is a well-balanced environmentally responsible one, including the use of naturally produced organic pesticides as well as synthetically produced chemicals. Products selected should carry no or a very low risk to the environment and inhabitants (including the human race). Select those products, organically or synthetically certified that has no or low impact on nontargeted organisms, relatively nonpoisonous or very low in toxicity, no or very short residual

activity in the environment as well as more pest-targeted formulations.

In the end, it is the user that has to select a product to solve problems the most effective, economical, and most friendly way, with the lowest risk of harm to the environment.

This can only happen if pesticide companies take the necessary environmental responsibility by giving detailed information through to users concerning all aspects of their products. At the same time, growers have to take the responsibility to select the more environmental friendly products from this information made available to them. It is of vital importance that products sold are registered under Act 36 of 1947, Department of Agriculture. This guarantees that the product has been approved for claims made on the label.

Table 1. List of pesticides with an analysis of the impact they have on the environment.

Product name	Unique environmental characteristics
Margaret Roberts biological caterpillar insecticide; Dipel DF Biological, natural insecticide Contains: *Bacillus thuringiensis* var. *kurstaki*	No harmful toxic residues. Targets destructive leaf-eating larvae of lepidopterous spp. No secondary poisoning. Harmless to bees, birds, fish, pets, wildlife, beneficial insects, and natural predators. Can cause possible harm to butterfly species. Very low dosage rates. No phytotoxicity of any kind observed on plants at recommended and double the dosage rates. Non persistent in the environment. Harvesting of edible crops direct after application.
Margaret Roberts organic insecticide; Kangar 931 Organic insecticide Contains: garlic juice extract and canola oil	Canola kills targeted small-bodied insects on contact by means of suffocation. Garlic keeps insects away from plants. Low impact on bigger bodied beneficial insects and natural predators. Harmless to fish, birds, wild life, pets, and humans. No harmful toxic residues. No secondary poisoning. Moderately high dosage rates. Formulations can be phytotoxic to sensitive plant varieties at the highest dosage rates. Nonpersistent in the environment. Harvesting of edible crops within 24 h.
Vegol; Naturen rape oil insecticide Organic insecticide Contains: canola oil	Kills targeted small bodied insects on contact by means of suffocation. Low impact on bigger bodied beneficial insects and natural predators. Harmless to fish, birds, wild life, pets, and humans. No harmful toxic residues. No secondary poisoning. Moderately high dosage rates. Formulations can be phytotoxic to sensitive plant varieties at the highest dosage rates. Non persistent in the environment.
Ludwig's Insect Spray; Pygar 932	Canola kills targeted small-bodied insects on contact by means of suffocation. Garlic keeps insects away from plants.

Product name	Unique environmental characteristics
Organic insecticide contains: garlic juice, canola oil, natural pyrethrum	Pyrethrum has a stomach poison activity of maximum 24 h. Can cause death of bigger bodied beneficial insects and natural predators on contact. Toxic to fish, moderately toxic to bees. Low toxicity towards mammals. Maximum of 24-h residual stomach poisoning activity. Secondary poisoning very unlikely. Moderately high dosage rates. Formulations can be phytotoxic to sensitive plant varieties at the highest and the double dosage rates. Nonpersistent in the environment. Harvest of edible crops 24 hours after last application.
Spruzit-Pyrol Organic insecticide Contains: canola oil, natural pyrethrum	Canola kills targeted small-bodied insects on contact by means of suffocation. Pyrethrum has a stomach poison activity of maximum 24 h. Can cause death of bigger bodied beneficial insects and natural predators on contact. Low toxicity towards mammals. Toxic to fish and moderately to bees. Maximum of 24 h residual stomach poisoning activity. Secondary poisoning very unlikely. Moderately high dosage rates. Formulations can be phytotoxic to sensitive plant varieties at the highest and double the dosage rates. Nonpersistent in the environment. Harvest of edible crops 24 h after last application.
Ludwig's Rose Spider Mite; Smite Chemically formulated insecticide (miticide) Contains: Etoxazole	Kills only mites. Very target specific. No harm to natural predators of mites or beneficials. Very low toxicity (four times less toxic than natural pyrethrum). Biodegrades, short to medium persistency in the environment. Nonphytotoxic to targeted host plants. No secondary poisoning, or very unlikely. One of the safest miticide chemical formulations. No, or very low toxicity to birds, fish, wild life, pets. Acute poisoning very unlikely. Registered on tomatoes (3-day withholding period), apples, pears, and roses. Can be used on ornamentals and flowers.
Spider mite spray; Hunter Chemically formulated insecticide (miticide) Contains: Chlorphenapyr	Kills only mites. Very target specific. Toxic to bees, fish, and invertebrates. Moderately toxic to humans, almost five times more toxic than Rose Spider Mite. Biodegrades, short to medium persistency in the environment. Nonphytotoxic to targeted host plants. Secondary poisoning unlikely. Acute poisoning very unlikely. Registered on roses and ornamentals.

Product name	Unique environmental characteristics
Rot'n Spot; Sumislex Synthetically produced organic fungicide Contains: Procymidone	Broad spectrum fungicide registered for use on fruit , lawns, and vegetables. Can be used on roses and ornamentals. Withholding periods average 7 days. Toxic to fish. Harmless to bees, birds, beneficial insects, wild life, pets. Very low toxicity towards humans. Acute poisoning not possible. No secondary poisoning. Low dosage rates. Short to medium residual activity. Nonphytotoxic to targeted host plants.
Bravo 500 A chemically formulated contact fungicide Contains: Chlorothalonil	Broad-spectrum fungicide registered for use on fruit, vegetables ornamentals, roses, and lawns. Withholding periods average 7 days. Harmless to bees, birds, beneficial insects, wild life, pets. Very low toxicity towards humans. Acute poisoning not possible. No secondary poisoning. Low to medium dosage rates (dosage rates double of those of Rot'n Spot). Short to medium residual activity. Nonphytotoxic to targeted host plants.
Neudosan Organic insecticide Contains: fatty acids	Fatty acids kills targeted small-bodied insects on contact by means of destruction of their cell membranes. Nontoxic to humans, fish, birds, wildlife, pets. No residual activity. No secondary poisoning. Moderately high dosage rates. Formulations can be phytotoxic to sensitive plant types at the highest and the double dosage rates. Nonpersistent in the environment. Harvest of edible crops 24 h after last application.
Natural insecticide Organic insecticide Contains: fatty acids, natural pyrethrum	Fatty acids kills targeted small-bodied insects on contact by means of destruction of their cell membranes. Pyrethrum has a stomach poison activity of maximum 24 h. Can cause death of bigger bodied beneficial insects and natural predators on contact. Toxic to fish. Low toxicity towards mammals. Maximum of 24-h residual stomach poisoning activity. Secondary poisoning very unlikely. High dosage rates. Formulations can be phytotoxic to sensitive plant varieties at the highest and double the dosage rates. Nonpersistent in the environment. Harvest of edible crops 24 h after last application.