PRINCIPLES OF WEED, PEST AND DISEASE MANAGEMENT

INTRODUCTION

The under-lying principle in any pest control programme is that the crop must be protected, while interfering as little as possible with factors which affect the long-term maintenance of the production system. The cheapest and most reliable way to deal with pest and weed problems is to anticipate and avoid them, if possible. When pesticides are needed, choose materials and application methods that are effective without adversely affecting other organisms or the natural environment. The cost aspect is also important; where two registered chemicals are equally effective for specific control, it is logical to use the less expensive one.

Many normal cultural practices can be manipulated to minimise pest damage. Making such adjustments is often the most economic and reliable long-term defence against pests. A strong, well-grown crop is often less prone to attack by various pests and diseases, as well as being better able to withstand such attacks, than physiologically weak plants. Cultivar selection, field selection, land preparation, planting methods, time of planting, fertilizer application, irrigation and cropping sequence (rotations), are all points which have an impact on pest problems.

The following brief outline of production methods is intended to aid in anticipating problems, and in choosing among alternative methods, depending upon local conditions.

Cultivar Selection

Select a cultivar that produces a high-quality product, with a good potential yield under local growing conditions. For example, the heat tolerance of various lettuce and cabbage cultivars varies appreciably, so proper selection for the planting time envisaged can be critical. Bolting resistance and the ability to germinate under hot conditions might be important for summer lettuce. Resistance to bolting is very important for carrots, beetroot or cole crops planted under colder conditions. Some cultivars are more sensitive to herbicides than others; this was probably the major reason for the withdrawal of registration of the herbicide, “Linuron”, on green beans.

In selecting a cultivar, resistance, or perhaps acceptable tolerance, to likely pathogens, nematodes or other pests that might occur, should be considered. Adaptation of the cultivar to local growing conditions is important, because vigorous, healthy plants can better tolerate damage by insects and pathogens, as well as the competition from weeds, than weak, unthrifty plants. Always seek up-to-date information on pest and disease resistance or tolerance in available cultivars.

Field Selection

Pest control is cheaper and easier on land that is well suited for the crop. Ideally the soil should have sufficient depth; ridges or raised beds may be advisable should soils be shallow. The soil should have a uniform texture; sandy patches or other irregularities may interfere with irrigation, or require different rates of fertilizer or herbicides, thus complicating management, affecting plant growth and making plants less able to withstand pest attacks.
Rootknot nematodes are more likely to be present and to cause economic damage on sandy soils than on heavier soils. However, fumigation for nematodes and other soil-inhabiting pests is easier on light soils. Light soils do not store as much water as medium to heavy soils, and are less suitable for crops with a high moisture requirement, such as broccoli and cauliflower.

Clay soils require careful water management, and root development may be adversely

affected in fields with shallow hardpans, compacted layers, or high water tables.

Check the soil and irrigation water for salinity, or potentially harmful minerals. Have the soil analysed for nutrient deficiencies and correct them before planting. Adjust soil pH and acid saturation levels to the range suited to the intended crop. If the soil has a history of club-root and a pH below 6,5, add lime before planting cole crops. Most forms of common scab of potato are favoured by a pH above 5,5: unfortunately, acid - tolerant strains of the scab organism are present in some soils.

Ensure that the planting time and climate are suitable for growing the crop.

Consider previous herbicide use for possible harmful herbicide residues.

Avoid fields heavily infested with weeds, especially those weeds that are hard to control with herbicides registered for use on that particular crop. Refer back to records of previous years, for these and adjacent lands, for notes on problems with weeds, pests or diseases, and choose suitable management practices to counter them.

Land Preparation

Well prepared fields and seedbeds tend to encourage better plant growth. Compacted soil layers should be broken up by subsoiling while the soil is still dry. Avoid working soil that is too wet; this can cause smearing or compaction. Raised beds or ridges will provide better drainage, and will offer protection against diseases favoured by over-moist soils; however, they tend to dry out more quickly. The soil surface should be fairly level; high spots tend to be dry, and low spots often too wet.

Deep ploughing, to a depth of 400 mm, with complete inversion of the soil, should be considered on lands heavily infested with *Sclerotinia*, as the sclerotia (fruiting bodies) cannot emerge from such a depth, and are often destroyed by natural soil micro-organisms. Such deep ploughing will also destroy seeds of various weeds, such as sowthistle and portulaca, which are not long-lived, and which cannot germinate from a great depth. Even ploughing to a depth of only 200 mm may be successful with such weeds, provided that the soil is well inverted.

Time of planting

Some weeds, insects and diseases are more troublesome at certain times of the year, when conditions favour their development. Selection of planting times can be used to avoid them, or at least to reduce the pest incidence. However, the planting time selected must be such as to allow the crop to develop during climatic conditions which are optimal for the crop.
Problems may arise when crops are established in less than ideal climatic conditions in order to grow them to maturity during optimal conditions. Summer potatoes may be established in cold soils and some post-emergence herbicides can severely damage the young developing haulms under low temperature conditions.

Planting Methods

Certain crops, such as carrot, green bean, pumpkin and sweet-corn, do not transplant easily, and are seeded directly into their permanent position on the land. Generally an attempt is made to plant a well-spaced stand, but thinning out a few weeks after emergence sometimes has to be resorted to when stands are too dense.

Some crops, like baby marrow, which also do not transplant easily from bare-rooted plants, may be grown in special multi-cell trays (“Speedling” or equivalent system), and are then transplanted successfully. This method is often used in order to produce an early crop after winter. The seedlings develop in an area protected from inclement conditions before being established in the field.

Several crops, such as tomato, capsicums, cole crops and lettuce, transplant fairly easily, and seedlings of these are generally produced in seedbeds, or in speedtrays, for transplanting into the land. The use of seedtrays, especially for high-priced seeds, is very popular with many commercial nurseries supplying such transplants. Most such nurserymen produce good healthy seedlings, but there is a risk of introducing new pests or diseases onto the farm. It is possible for a few seeds to be infected by inoculum of a pathogen, and the bacteria or fungi to multiply and spread rapidly under the frequently misted conditions which are present in the nursery beds. Ideally, the grower could check the nursery, as well as the plants supplied, to ensure that such problems are not encountered.

Before sowing, be sure that soil and air temperatures are sufficiently warm to encourage moderately rapid emergence. Slowly emerging seedlings are more likely to suffer setbacks from insects, diseases and weed competition. Very hot conditions may also adversely affect germination. Lettuce seed, for example, may enter a heat-induced dormancy when exposed to temperatures above about 26°C. To avoid this problem, plant into dry soil - dry seeds are not affected in this way - and irrigate in the late afternoon after temperatures have dropped. By the time temperatures rise to their peak the next day, seeds should have started germinating and will be past the heat-sensitive stage.

Planting depth is also important. If very shallow planting is adopted, the soil in which the seed is placed may dry out too rapidly, particularly on sandy soils, giving rise to poor and uneven germination. If planted too deep, the plants may not emerge, or may use up too much of their energy in emerging. This may also result in poor stands, often of weaker plants less able to withstand an attack by pests. Deep planting is more critical on the heavier soil types.

Fertilizing

A well-balanced fertilizer programme will contribute to vigorous, healthy growth, and high yields of good quality. Imbalances of plant nutrients can cause poorer growth and more pest problems. Excess nitrogen, for example, may lead to over-lush growth, and the plants may be more susceptible to foliar diseases.

Because of variations in soil fertility, it is generally advisable to have the soil analysed, so that high soil acidity levels, or nutrient deficiencies or imbalances, may be corrected before planting.

Irrigation

Correct decisions regarding amounts of irrigation to be applied are essential. Too little water can result in small plants, slower and poorer growth, lower yields and quality, premature bolting and lower resistance to pest attacks. Excessive irrigation, or poor soil drainage, may contribute to poor root development, poor growth and a higher disease incidence.

Good soil preparation can contribute to even distribution of water by reducing the number of dry high-spots, or over-wet low-spots. Breaking up of compacted soil layers, and reducing clod size, will increase water penetration, and result in more even wetting of the soil.

A good procedure in many situations is to irrigate with sprinklers from planting through the seedling stage, and then to switch to furrow irrigation until harvest. When using sprinklers, especially for germination, do not apply water faster than it can infiltrate the soil. Application should be at a rate that avoids runoff or surface puddling, but the sprinklers should run for sufficient time to apply the required amount of water. Sprinkle irrigation on windy days, when it is impossible to apply water uniformly, should be avoided. Wait until the wind has died down in the evening, and then irrigate. The use of solid set sprinkler irrigation is best for germination, because all the seeds in the field are wet at the same time, so germination and

maturity will be more uniform. It also assists in keeping the soil aggregated, and is less conducive to damping-off of seedlings. Sprinklers can also be used for the incorporation of some herbicides.

Unfortunately, in older plants, sprinkler irrigation can increase many disease problems and can promote germination of weeds. Splashing of sprinkler irrigation can dirty the leaves of crops such as lettuce, and also favour the spread of diseases. For these reasons, the use of furrow irrigation between raised beds, or even ridges, may be a better practice on older crops. While soil crusting and compaction occurs in the furrows, the tops of the beds remain looser, which promotes soil aeration, and drier, which reduces weed germination and disease pressure.

Drip irrigation, although costly to install, has proven to be a good option for several crops, such as tomatoes. It has the advantage of keeping the foliage and much of the soil surface dry, which reduces the incidence of foliar diseases, as well as weeds. There is also a saving in water usage. Various nutrients may also be applied through the irrigation system.

The cost of irrigation equipment invariably renders it impossible for a grower to be able to irrigate only under ideal conditions and times. Irrigation is often applied at times when plants remain wet for prolonged periods, creating conditions which favour infection by many plant disease organisms. Awareness of the danger of known disease outbreaks could enable a possible re-arrangement of the irrigation cycle.

Pesticides

Properly used, pesticides can provide convenient, economical protection from pests that would otherwise cause significant losses. Often they are the only feasible means of control. However, careless or excessive use can result in poor control, crop damage, and hazards to human health and the environment. Nationally and internationally, government organisations now routinely sample produce for the presence of chemical residues.

Pesticides should be used with circumspection, and only when needed. Try to establish thresholds below which damage is minimal, and so limit chemical application that is not really needed, taking into account the specific crop and its growth stage. Loopers or bollworms may, for example, cause relatively minor economic damage to large broccoli plants before head emergence, because they feed mainly on leaves which are not marketed, but would need to be adequately controlled far earlier on lettuce or cabbage, where the heads consist of leaves. Eliminating unnecessary treatments can reduce costs and potential hazards.

More than one chemical may be registered for control of a particular pest on a specific crop. The choice made depends on the toxicity and efficiency of the chemical, the degree of control necessary, the effect on other pests, natural enemies and the environment, and on economic factors. Over-use of specific pesticides, through repeated applications, is one of the causes of the presence of pesticide-resistant strains of a pest. Once resistance has developed, other pesticides, or higher dosages, may be needed for adequate control, often substantially increasing pest control costs. Relying on a number of different control methods, and avoiding repeated applications of the same material, may slow the development of resistance.

Agricultural chemicals may be used on plants only if registered for such purpose. Guides which list and detail the use of registered chemicals (pesticides, fungicides, herbicides, and plant growth regulants, defoliants and desiccants) are published every year or so. They are obtainable from:

The Director
Directorate of Communication
Private Bag X144
Pretoria
0001
Telephone: (012) 3197141

Note, however, that such chemicals may be used only on the crops listed and for the purposes designated on the label and directions for use supplied by the manufacturer / distributor of the product. Application rates, possible precautions, including safety aspects and incompatibility with other chemicals, are important points which appear on the container labels and growers should meticulously follow the directions provided.

Biological Control

Certain predators, parasites and pathogens can attack and kill some pests in vegetable crops. The use of such biological measures is limited, because of the relatively short life of most vegetable crops, the demand from consumers for high cosmetic standards, and the low tolerance for insect contamination. However, they do play a role, and are likely to play an increasingly important role as more restrictions are placed on the presence of traceable amounts of agricultural chemicals on produce. To gain maximum benefit from biological control, the use of pesticides has to be monitored and restricted, particularly those with a broad spectrum. The insecticides used, their rates, and times and methods of applications, should be as least harmful as possible to the activities of natural enemies of the plant pests.

Sanitation

Sanitation is generally thought of as the avoidance or elimination of insect pests or disease organisms which are harboured on crop residues or weed hosts. The disposal of residual plant material, **as soon as possible** after harvest, is vitally important. This may be carried out by chopping plants and deep ploughing the residues, especially if soils are not cold. It might also mean removal of plant material from the field to a dump-site, or burning the plant residues. This would be especially important if disease pathogens are not readily antagonised and destroyed by natural soil organisms.

Adequate control of annual weeds, especially before seeding, will reduce weed pressure, and may reduce crop pests and diseases that shelter in, or feed on them.
Preventing the introduction of pests is an equally important aspect of sanitation. Weeds, pests and diseases on land verges and adjacent lands are potential sources of new outbreaks, and may need control. One should be conscious of the possibility of introducing contaminated soil on equipment, transplants, manure or run-off water. Ensure that transplants, manure and water used for irrigation are free of weed seeds, pests and diseases. Use only disease-free seed for planting.

Rotation

The population of certain pests and diseases can be limited by planting lands with crops that will not support them. The different cultural practices required for different crops may play a role in limiting populations of harmful organisms. Most pathogens cannot survive for long periods in soil in the absence of their natural hosts. Depending upon their ability to remain viable, they and specific plant pests may die out without a host, within a year, or it may take a number of seasons.

Rotating crops also provides the opportunity for using a wider range of herbicides, perhaps effective against a different range of weeds, which might otherwise be more difficult to control with the limited herbicides registered for use on a specific crop.

CONCLUSION

The production costs of most vegetable crops have escalated in the past few years at a faster rate than the prices obtained when marketed. It is absolutely vital for the grower to maintain a “hands-on” management approach in production. He must be aware of problems as soon as, or even before, they occur. Weeds may be shaded out by the developing crop, and pests and diseases may be present, but reduced to such a low level that the manager could decide to tolerate the problem without taking active measures for control. However, awareness is needed before the action decision is taken, and routine visits to the field must be made frequently.