BEST MANAGEMENT PRACTICES FOR VEGETABLE PRODUCTION AT SCOTT RIVER

Background

These Best Management Practices describe management practices that is appropriate to vegetable production (principally processing potatoes, carrots, onions and sweet corn(?)) at Scott River and will advise new as well as help established growers on viable, environmentally sustainable management practices. They provide guidelines for irrigation, fertiliser, and pesticide applications and they address aspects of environmental and social responsibilities.

Best management practices are written by growers in conjunction with agencies that have responsibilities for managing and protecting natural resources as well as the environment. They deal with all aspects of horticulture that have environmental and social impact or consequence and they are regularly updated.

Best management practices set out what needs to be achieved by growers management practices, rather than how management needs to be practiced. This approach is important because it allows growers to develop practices that suit their situation and circumstances.

It is proposed that in future, these best practices will also indicate how components of best vegetable production practices can address environmental, ecological and community issues that will be considered in the proposed horticultural developments approval process.

Establishment/Expansion Considerations

Property Management Planning

Property and or site selection for horticultural development needs to make best use of natural resources and to minimise the impact of these developments on the natural environment, including soil and water as well as wildlife and natural vegetation.

The main resource considerations include:

- Soil type which together with which depth to ground water, influences the risk for nutrient/pesticide loss from the property, in either ground water or by soil particle loss in surface water;

- Movement of surface water both onto and off the development site which will also contribute to nutrient/pesticide loss from horticultural sites;
- Clearing of natural vegetation including 12 month and older regrowth, is subject to the Soil and Land Conservation Act which is managed by Agriculture Western Australia;
- Distances from national parks and conservation areas.

Farm plans

Farm plans can be needed to show how consideration of drainage, soil types, and proximity to sensitive environments such as wetlands and areas containing important flora and fauna are being considered in planning the horticultural development.

The management of surface water movement and possible internal property drainage, requires a contour map with contour intervals as close as one to two meters on flat properties to enable earthworks to be designed and costed.

Property maps will also identify and show the location and approximate extent of natural vegetation, as well as drainage lines, waterways, streams and rivers. They should indicate significant drainage lines within horticultural production areas that need to be retain in permanent grasses.

General considerations

The following factors need to be considered

Soil Types

A characteristic of most properties within the Scott River Coastal Plain region is that they have a number of different and highly inter-mingled soils.

The Scott River Plain comprises low lying sands that frequently overlay a clay, coffee rock or iron rich sub-soils at depths of one metre or more. These soils have shallow water tables and are periodically inundated between May and November. These sands can be highly variable ranging from red/brown loamy sands to grey, peaty silticous sands. Many of the grey sands can have reasonable ability to hold phosphorus, largely because of there naturally high organic matter contents. Minimise cultivation, and maximising periods of permanent pasture within the crop rotation cycles will help to maintain these organic matter levels.

Dunal sands along the coast to the south of Scott River consist of coarse often quite deep siltaceous sands over yellow calcareous sands.

Soils in the north east of the Scott River Coastal Plain are generally loamy sands over clay or higher phosphorus fixing layer and have a greater depth to ground water.

Soils to the west are characterised by deep sands which can vary to yellow sandy loams.

The coloured sandy soils and the sub-soil clays have considerable phosphorus holding ability, as do the layers of coffee rock present in some soil types.

Water Licenses

Water licenses must be obtained from the Water and Rivers Commission (at Bunbury) before any horticultural development is commenced.
Although the process of water license approval is undergoing considerable development, you should allow for a 12 month delay between the application and final approval you.

At this time all water license applications within the Scott River Coastal Plain are referred to the Department of Environmental Protection and licenses will be issued subject to conditions. Depending on your location, these conditions will be determined informally, in which case approval will be relatively quick, or it will be subjected to a more intensive public process such as a Consultative Environmental Review (CER) which will take much longer.

Clearing (Note, Jim Dixon, will provide wording and include drainage if appropriate. There is also a farmnote on clearing and this will be referenced at the end of this document)

To clear more than a total of one hectare of natural vegetation, including regrowth on any one property approval must be obtained from Agriculture Western Australia under the terms of the Soil and Land Conservation Act. Under the same act, approval is also required to install new or modify existing drainage.

Property/site development

Property/site development considerations will be determined by natural resource protection issues identified in the property management planning section and they will be unique to each property. These development considerations will include combinations of the following.

Earthworks and drainage.

Soil amendment.

Cover cropping and tree planting.

Vegetation protection.

Wetland rehabilitation and nutrient stripping.

Earthworks and drainage

Earthworks needs to be well designed and constructed to minimise risks of increasing soil erosion and therefore nutrient loss.

Typically drains that move water away from sites, need to be wide, shallow battered and permanently grassed. Drains within horticultural sites are not to be planted to crop, cultivated or otherwise disturbed.

Earth works to divert of site surface water away from and around horticultural developments and to control surface water movement of these sites will be needed on many properties. This may also include localised drainage to lower water tables within development areas, provided drainage water can be retained within the property boundary. Earthworks will also direct potentially nutrient rich surface water into retention areas or modified wetland areas.

Short duration water retention within development sites will minimise nutrient loss associated with soil particles by enabling some settling and by slowing water movement away from the site to maximising nutrient stripping associated with grassed waterways and other devices.

Soil amendment
Physical particle characteristics of sandy soils and the phosphorus retention of a development site can be improved by the application of at least 100 tonnes per hectare of clay or clay loam. These materials can also be used to line surface water retention areas and to further reduce the loss of phosphorus from the property.

**Vegetation protection**

Cleared land should not exceed 80% of the total land area. Fringing vegetation along streams and major drainage lines as well as around wetland areas and permanent grassed swards within drainage lines need to be protected by fencing if practical, stock control and by avoiding disturbance associated with harvesting and other site as well as property management practices.

**Wetland rehabilitation, nutrient stripping and drainage water retention**

Wide low gradient shallow drains that are permanently grassed effectively strip soil particles suspended within surface drainage water and hence prevent the loss of attached phosphorus. Nutrient stripping areas have limited long term benefit unless vegetative material is regularly removed or harvested.

Wetland areas can also be modified to increase surface water retention and to increase soil particle sedimentation.

**Cover cropping, tree planting and windbreaks**

To minimise soil particle loss from annual horticultural cropping sites, cover crops are established as soon as harvesting is complete.

Natural vegetation or tree plantings should be utilised as wind breaks as well as to lower ground water tables and remove nutrients from the ground water. However it needs to be recognised that most trees including Eucalyptus Species mainly store nutrients such as phosphorus, nitrogen and potassium in their foliage. Consequently, as tree plantings reaches maturity, nutrient removal declines significantly and when the trees are harvested, there is potential for the stored nutrients to be largely left behind.

Tree planting needs to enable sequential tree harvesting inorder to maintain their effect as wind breaks and to minimise the potential for a period of nutrient loss following commercial harvest.

**Buffer distances**

In many farm situations, buffer requirements that have the potentially to take up to 100 to 200 metres of the cleared, productive land when development are adjacent to a national park, have significant implications for the viability of the proposed development and the farms as a whole.

It is proposed that the buffer requirement between the farm and the adjacent reserve could shared. This could result in the landholder planting a standard windbreak comprising a minimum of ($y$) rows of *Blue Gum or acceptable equivalent tree variety* to a width of ($x$) metres as a contribution to protecting the national park or area of significant environmental, ecological or social value.

Management practices

**Fertiliser management**

The information provided in Table 1 is based on fertiliser programs that were specifically developed for the region and that have been modified in response to crop performance tissue analysis.
Agriculture Western Australia research information on crop phosphorus requirements in relation to soil test results are used to generate recommendations on high phosphate fixing soils.

Fertiliser rates for potato production are increasingly based on commercial experience at Scott River, however the rates provided for the other crops are based on trial work and experience from other parts of the state. They are therefore ‘best bet recommendations and as experience is gained and specific trial work is carried out, they will be modified to become “best practice” rates.

Fertiliser programs need to be continually monitored and developed with the aid of soil testing and tissue analysis. Over time as sites are re-planted to successive horticultural crops, it will also become increasingly important to take account of the cropping history.

Table 1. Fertilizer Application rates for vegetable crops at Scott River (1995/96 recommendations for phosphorus on grey sand sites in parenthesis)

<table>
<thead>
<tr>
<th>Soil</th>
<th>Nutrient</th>
<th>Crop fertiliser rate (kg/ha)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Potatoes</td>
<td>Carrots</td>
</tr>
<tr>
<td>Orange-brown sand</td>
<td>Phosphorus*</td>
<td>200 - 250</td>
<td>200</td>
</tr>
<tr>
<td>Grey sand</td>
<td></td>
<td>90 - 100</td>
<td>100</td>
</tr>
<tr>
<td>Orange-brown sand</td>
<td>Nitrogen</td>
<td>320</td>
<td>250</td>
</tr>
<tr>
<td>Grey sand</td>
<td></td>
<td>360</td>
<td>250</td>
</tr>
<tr>
<td>Orange-brown sand</td>
<td>Potassium</td>
<td>300</td>
<td>250</td>
</tr>
<tr>
<td>Grey sand</td>
<td></td>
<td>350</td>
<td>300</td>
</tr>
</tbody>
</table>

* These phosphorus rates assume low soil test levels. As available phosphorus levels increase, application rates will fall to crop replacement levels which are in the order of 30 to 40 kg/ha.

Phosphorus application strategies

As indicated above, phosphorus applications strategies are based on soil type. Actual application rates need to be based on soil test levels that determine available phosphorus and Phosphorus Retention Index (PRI) values. Determining the “Virgin PRI” value for each of the main cropping soil types, assists with determining phosphorus fertiliser requirements in conjunction with PRI values and available phosphorus levels for each soil type within the cropping area.

Virgin PRI is determined from soils of the same type that have had no phosphorus application (such as under natural vegetation), or if not accessible, an indication will be obtained by testing these soils under pasture that has received minimal phosphorus application, at least in recent years.
These three measurements combined are needed to determine phosphorus application, in terms of both quantity and best application strategy.

As a guide, when virgin soil PRI values are less than 2.0 to 3.0, phosphorus is best broadcast in two and preferably in three applications. To accommodate progressive development of the crops root system, the total amount should be applied as follows

- 15 to 25% of the total application at planting. Apply the higher proportion when only two applications will be made. This application should be applied over the planting row
- 30 to 40% of the total application, three to four weeks later and when three applications will be made.
- Balance half way through the crops expected life or as late as is practicable in terms of minimising crop damage, such as with potatoes.

When virgin PRI values exceed 15 to 20 and when available phosphorus soil test levels are low, the total phosphorus application should be banded at planting.

**Note of caution.** Current recommendations for processing potatoes indicate that on grey, low PRI sands, 50 to 60% of the total phosphorus application can be banded at planting. However recent potato research by Agriculture Western Australia (Dr. Ian McPharlin and others) indicates that banding phosphorus at more that 20 to 30 kg/ha in these soils, results in root damage and significantly reduced yields. These results have been obtained for Delaware potatoes grown on Karrakatta sand that have PRI values less than 5.0.

**Potatoes**

**On grey sands** with PRI values less than 2.0 to 3.0, band no more than 20 to 30 kg/ha of phosphorus at planting.

The remainder should be broadcast in one or two application up to the time of final hilling/mounding, 8 to 10 weeks later.

On high phosphorus fixing sands that have PRI’s greater than 15 to 20, and low available phosphorus levels, the total phosphorus application should be banded at planting.

**Carrots, Onions and Sweet Corn:** On grey sands, apply phosphorus in three applications. The fist pre-plant or planting application should be confined to the planting row and be followed by two broadcast applications, three to four and six to nine weeks after planting. See previous information for the recommended proportions of the total amount to be applied at each application.

On high phosphorus fixing sands with PRI’s greater than 15 to 20, and low available phosphorus, the total phosphorus application should be banded at planting.

Note that in all cases, the actual phosphorus application rate is determined for soil test results.

Future options may be to fertigate phosphorus through the center pivot irrigators, as is currently practiced with most of the nitrogen and potassium that is applied, however rain events during the early season when most phosphorus applications are required, make this approach less attractive.

**Nitrogen and Potassium application strategies**
Once the crops water requirements are being provided by irrigation, both nitrogen and potassium are applied through the irrigation systems in regular applications that are at least weekly for Nitrogen and at least fortnightly for potassium.

**Potatoes**: For processing potatoes, around 40% is applied prior to planting followed by two to three post plant applications of 50 kg/ha up to 50 mm tuber size and weekly applications of 20, dropping to 10 kg/ha/wk to maintain leaf petiole nitrate levels above 8000 ppm. Nitrogen rates for seed potatoes can be further reduced.

**Other vegetable crops**: On all soils, apply nitrogen weekly. Rates for the first four weeks are 30% less than subsequent applications and these are maintained until a week before harvest.

**Soil pH management**

The acidic Grey sands at Scott River need applications of lime to adjust soil pH, measured in Calcium Chloride, to between 5.0 and 5.5. Applications of lime should be applied at the break of season (May/June) prior to planting to maximise opportunity for it to impact on the soils pH.

**Nutrient monitoring - Soil Testing**

Pre-plant soil test are taken for each of the soil types using a sampling tool that enables the top 15 cm of soil to be tested. Each soil test should include at least a Phosphorus Retention Index (PRI), which indicates the soils ability to hold phosphorus, total and available Phosphorus, Potassium, pH, and Organic Carbon. To ensure representative results, a minimum of 30 sub-samples per soil type is required.

At or just prior to harvest, a further soil test should be taken to guide pasture/cover crop establishment once harvesting is completed.

**Nutrient monitoring - Plant Tissue Testing**

Most vegetable crops have specific tissue testing requirements in terms of tissue sampled and timing in relation to crop development.

**Potatoes**: Petiole testing is the most reliable check on a potatoes nutrient level and should be carried out at least four times during the season. It is very important that the first test is taken when developing tubers reach 10 mm in length because our standards are based on this stage of potato plant development. To accurately judge this, begin checking tuber size at least weekly, five weeks from planting. Repeat petiole sampling at least four times, ideally every two weeks.

**Carrots and Onions**: Sample youngest mature leaf during the mid crop growth period.

**Corn**: At tasselling, sample the ear leaves.
Irrigation

Center pivot irrigation is capable of uniform water application.

Experience at Scott River indicates that potatoes require around 5000 to 6,000 kilolitres of irrigation per hectare per crop. Other crops, including potato varieties that have shorter growing seasons are likely to require proportionally less water.

As a guide irrigation is applied once a day at around 5 mm per application. However on hot days, up to 10 mm per day is required to avoid moisture stress. Installing high speed motors on centre pivot irrigators will enable two applications per day to be made which in warmest periods and on the poorer grey sands will:

- enable higher moisture levels to be maintained and
- improve soil wetting.

Note: that over irrigation is a major contributor to over fertilising because it leaches the more soluble plant nutrients and especially nitrogen, below the crops root zone.

Soil moisture monitoring

Monitor soil moisture with Environscan capacitance probes or tensiometers placed at three depths, namely 10-15, 25-30 and 65-70 cm depth. The advantage of environscans is their continuous recording. If tensiometers are used record readings at a fixed/consistent interval before and after each irrigation.

It is important to place tensiometers or Environscan tubes in representative soil types and to include the poorest quality soils such as coarse grey sandy ridges because these areas will run out of plant available moisture first. The soils with poorer water holding ability therefore need to guide the irrigation program.

Pesticides

Pesticides include fungicide, insecticides, soil fumigants, herbicides and growth regulators. An important principal in using all pesticides is to use different types to reduce the development of resistant pests, diseases and weeds.

Correct application

Pesticides such as fungicide and insecticide can be applied through the irrigation. Although this potentially reduces the need for fungicide applications because physical crop damage associated with tractor mounted boom spraying is reduced, pesticide efficacy can be reduced if insufficient active ingredient is retained where it is most needed. It is therefore important to note label comments on application methods.

An alternative may be to apply pesticides by aircraft and if these applications can be coordinated, at least for neighboring properties, re-infection rates and therefore applications can be reduced.

Major pests and disease concerns for potatoes at Scott River are aphids and Early Blight. Comments and typical application requirements are indicated in table 2. As the area continues to grow potatoes, the incidence and levels of spraying required can be expected to increase marginally.
For the other crops under consideration at Scott River, the incidence of pest and disease problems will need to be determined by commercial experience. For this reason, no information has been included, but some indications of anticipated problems will be provided by appropriate agronomists in the next of these best practices.
Table 2: Main pests and diseases problems encountered at Scott River and pesticide applications applied

<table>
<thead>
<tr>
<th>Problem</th>
<th>Pesticide type</th>
<th>Number of applications</th>
<th>Comments (Always read the label)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Spot</td>
<td>Fungicide</td>
<td>6 to 8</td>
<td>Fungicides generally need good coverage</td>
</tr>
<tr>
<td>Aphids</td>
<td>Aphicide</td>
<td>1 to 2</td>
<td>Timing and uniform coverage important. Coordinated application across farms can reduce need to re-apply pesticides</td>
</tr>
<tr>
<td>Tuber Moth</td>
<td>Insecticide</td>
<td>1 to 2</td>
<td>Not a problem as long as potato tubers remain covered with soil</td>
</tr>
<tr>
<td>weeds</td>
<td>herbicides</td>
<td>1</td>
<td>Seek advise on best herbicides to control your range of weeds.</td>
</tr>
</tbody>
</table>

Requirements for other vegetable crops have yet to be determined. A different range of chemicals will be required for these crops however, it is unlikely that the number of pesticide applications will exceed those of potatoes

Correct usage of pesticides

Pesticides including insecticides, fungicides, herbicides and plant growth regulators need to be applied correctly in order to prevent or minimise:

- contamination of surface and ground water;
- contamination of food;
- operator poisoning.

Always read pesticide labels carefully and follow the instructions fully. A failure to do so in validates any claim against the manufacturer and may render you liable to prosecution.

When applying pesticides:

- calibrate application equipment to ensure uniformity of application and correct application rates are achieved, refer to manufacturers specifications;
- apply only to crop for which its application is registered;
- apply only at recommended rates, frequencies and harvest only once the withholding period has passed;
- keep good records of their purchase and use;
- avoid application in strong winds.
Storage and Disposal

- Store pesticides in dedicated lockable store and away from fertilisers, animal feeds etc.;
- store pesticides in original containers with labels intact;

When disposing of containers observe label comments, do not burn and:

- contact your local shire about disposal methods;
- Rinse empty containers into spray tank three times, then puncture and flatten if they cannot be recycled.

Wash Down Areas

- Ensure that wash down areas are not located within or near to drains or waterways;
- use bleach or ammonia to create alkaline solutions which aid breakdown of most pesticides.

Safe Use of Pesticides

- Users should undertake approved pesticide application courses such as those run by the National Farm Chemical Users Training Program.
- users should under go annual medical checks;
- appropriate protective clothing should be worn at all times, refer to labels for information;
- mix chemicals only in well ventilated areas;
- Wash before eating, drinking or smoking;
- keep first aid kit handy at all times;
- avoid contact with skin and particularly around the eyes.

Procedures for Finalising and in Future Upgrading these Best Practices

It is suggested that this best practice document could be developed and in future updated by a horticultural sub-group that is part of or affiliated with the Lower Blackwood Landcare District so that they form part of a broader document - "Best Agricultural Practice for the Scott Coastal Plain"