Soil, Water, and Nutrient Management 2

(updated September 2008)

This chapter covers the basic principles of soil, water, and nutrient management for field-grown floriculture crops. Information specific to the production of container crops is presented in Chapter 3. Other useful resources on general soil management include two Ministry publications titled *Soil Management Handbook for the Lower Fraser Valley* and *Soil Management Handbook for the Okanagan and Similkameen Valleys* that are available from the Abbotsford Soil Conservation Association. Other useful information can be obtained through local BC Ministry of Agriculture and Lands offices.

Recommendations in all manuals, including this production guide, are general guidelines only. Qualified consultants are available on a fee-for-service basis to give recommendations specific to each farm. Growers planning to plant a new parcel of land should consult with a professional for recommendations on soil suitability, and for advice on nutrient management, irrigation and drainage.

Soil Management

Good soil management begins before planting. Assess the soil conditions of each field and understand the potential problems as a first step to planting a floriculture crop. Land may be inadequately drained, have shallow topsoil, have impermeable subsoil or be too steeply sloped for successful cropping. Soil management problems are generally related to soil texture, soil structure, drainage, and erosion.

Soil Texture

The mineral components of soils are simply small fragments of rock or mineral materials derived from rock that were altered by water and chemical reactions in the soil. Soil particles are grouped into four particle sizes: gravel, sand, silt and clay. In describing soil, “texture” refers to the relative percentages of sand, silt and clay sized particles in the soil. Soil texture is a permanent characteristic. Texture will not change unless a large quantity of soil of another texture is added to it, such as might occur during land clearing or very deep plowing into subsoil of a different texture.

Problems related to soil texture are common. Stony soils can interfere with tillage and digging operations, and will reduce the overall nutrient and water storage capacity when they cover greater than 50% of the surface area or make up more than 75% of the soil volume. Coarse, sandy soils will require careful nutrient and water management.

Soil Structure

In soil, individual sand, silt and clay particles become more closely packed and bonded together to form larger particles called aggregates. “Soil structure” refers to the type and arrangement of aggregates found in soils. Aggregates occur in almost all soils, but their strengths, sizes and shapes vary considerably among soil types. Some of these aggregates are in stable forms that are not easily broken down by water or physical forces. In addition to the soil texture, the organic matter content can play a significant role in the development of good soil structure.

The formation of soil structure results from many different processes, including the growth of plant roots, activities of soil organisms, wetting and drying, freezing and thawing, and tillage. Plant roots excrete sugars and resins that bind aggregates and, upon their death, leave behind pores in the soil. Soil organisms also bind aggregates with “glues” or, as in the case of earthworms, create channels that improve drainage and aeration.

Soil structure also affects the internal drainage of the soil, water holding capacity, temperature and the growth of plant roots. In soils under cultivation, most aggregates at the surface tend to break down under the forces of rainfall, irrigation, tillage and traffic. When soils are left exposed to rainfall or are excessively cultivated under less than ideal moisture conditions, the result is the degradation of soil structure. Structure degradation leads to crusting or puddling of the soil surface, or compaction deeper within or below the root zone. This can lead to poor crop growth, poor drainage and soil erosion.

Maintaining Soil Structure

Soil structure is the most important soil characteristic to consider when managing soils as it is most affected by farming practices. It also is one of the most important factors in crop growth, along with water and nutrients. The main objective in soil management is to promote and maintain good soil structure that will be favorable to crop growth.

Soil structure degradation can be reversed by carefully using these cultural practices:

- add organic matter from manure or compost,
- use appropriate and timely tillage, and
- protect the soil surface by using cover crops.

Adding Organic Matter. Managing soil organic matter is integral to sound soil management and is a key to long-term productive field operations, particularly where significant quantities of topsoil are removed over time. Organic matter provides structure to soil, increases water holding capacity and is a major source of phosphorus, sulphur and the primary source of nitrogen. Numerous, readily available soil amendments (e.g. manure and compost) can be applied to the land to improve soil fertility and/or structure. The nutrient content of these amendments must be the first consideration for their use. Nutrients added from the amendment must match the crop's nutritional requirements.

Animal manures are abundant; however, they can be major sources of ground and surface-water pollution if not properly managed. Rates and times of manure application must be considered, as well as the nutrient requirement of the crop, soil characteristics (e.g. drainage and slope of land) and the presence of surface and ground waters. Manure should, in most cases, not be applied to bare land, due to leaching and/or volatilization potential. Generally, a late summer (July/August) manure application is recommended, followed (after approximately 1 week) by seeding a winter cover crop, which will act to 'catch' the nutrients. When manure is used, fertilization rates should be reduced.

Compost application is another option to add humus to the soil. Composts are generally low in available nutrients but should be tested for nutrient content prior to use. Non-composted materials should not be used, as they will cause nutrient tie-ups. As an example, straw and woodwaste can be beneficial to soil, however, when added directly to the soil, nitrogen can be 'tied-up'. In order to avoid this, urea or an ammonium salt should be added at the same time at a rate of 20-40 kg/ha. Woodwaste should only be applied in the top 10 cm of the soil.

Growing and tilling-in cover crops can also increase organic matter levels.

Appropriate and Timely Tillage. Tillage is used to prepare a suitable planting bed, to bury or incorporate crop residues, fertilizers, lime, manure or other soil amendments, to kill weeds, and to form raised planting beds. There are two groups of tillage implements. **Primary tillage** implements, such as plows, discs, subsoilers and rotary spaders, are used to break soil, reverse compaction and incorporate residues. **Secondary tillage** implements such as cultivators, harrows and rotovators are used to prepare planting beds and incorporate soil amendments. Secondary implements can have a large impact on soil structure by breaking soil aggregates.

Caution is advised when tilling soil because improper tillage can degrade soil structure. Repeated plowing to the same depth may form a compacted layer that can impede water and root penetration. Many growers rely on the conventional rototiller for residue incorporation or for weed control between rows. Too much cultivation with a rototiller or rotovator will pulverize the soil and compact the subsoil over time. Avoid slow tractor speeds that result in excessive pulverizing of the soil. An alternative tillage implement that is not as damaging to soil structure is the spading machine. Medium to fine textured soils are the most susceptible to structural damage. The soil moisture content also does influence the degree of soil degradation that occurs during tillage.

When a tillage operation is carried out, ask the following questions:

- What is the purpose of the tillage operation?
- Is the timing of the tillage operation best for the soil moisture and weather conditions?
- Is the tillage implement the best for the intended purpose?

Using Cover Crops. Cover crops have many benefits in addition to improving soil structure. Refer to the section on cover crops below.

Problem Soils

Most floriculture crops require moderately to well-drained soils with at least 0.5 m unrestricted rooting depth in order to obtain top yields. Most lowland soils in the South Coastal area have poor natural drainage with a high water table in the fall, winter and spring. These soils are not well suited to crop production without the use of a tile drainage system to remove excess water from the rooting zone.

Many upland soils in the Coastal region have a hardpan subsoil within 0.5 m of the surface. In most cases, this hardpan will not allow the soils to drain during the fall, winter and spring. Such soils require a tile drainage system to remove excess water from the rooting zone.

In the Coastal region, all soils are susceptible to water erosion when cultivated and left bare over the winter. Many upland soils have slopes from 5-10% or more, and have a serious problem with water erosion. Valuable topsoil is removed from the upper slopes and may be deposited deep enough to bury plants on the lower slopes. Where water erosion occurs, the soils require drainage and other special management practices such as cover cropping.

Erosion Control

Where water or wind erosion is a problem, erosion control practices should be used to reduce soil loss. Water erosion damage is most severe on long or steep slopes where the crop rows run up and down the slope, or where cropping practices leave the soil surface exposed to rainfall impact. In South Coastal areas, water erosion will occur on any site where the soil becomes saturated and is left exposed.

Where possible, use the following practices to minimize the loss of soil by water or wind erosion. Although any of the listed practices will help control erosion, the best control is achieved by using as many of the practices together that are appropriate.

Water erosion:

- install a drainage system,
- use contour planting (plant across the slope),
- maintain a protective layer of crop residues or a winter cover crop on the soil, and
- establish a permanent cover crop on field roads, field margins and water runs.

Wind erosion (these practices slow the wind speed at the crop or soil surface):

- establish windbreaks (e.g. tree rows, snow fences or hedges), and
- maintain a protective layer of crop residues (the residue should be anchored to the soil) or a winter cover crop on the soil.

Cover Crops

As mentioned above, cover crops will protect soils against erosion by wind and water. Cover crops are also used to improve soil structure, trafficability and soil fertility, to suppress some insect pests and weeds, and to promote some beneficial insects. They are not usually grown for harvest or forage. They are planted when portions of the field, or the entire field, is left bare. Cover crops are also called green manure, living or dead mulches, plow down, companion, relay, double or catch crops depending on their specific use.

Before planting a cover crop, it is important to know the soil problem that needs to be addressed. Is the cover crop for erosion-control, organic matter addition and/or trafficability? For example, cover crops will not prevent flooding, but if a field is drained they can help to improve the movement of rainwater into the soil and the drains without staying on the soil surface.

Choosing a Cover Crop

Once the purpose is established, planting date and subsequent management are important factors. Spring cereals sown in the fall are usually winter-killed leaving a protective mat on the soil. Winter cereals will usually grow slowly over the winter, producing the majority of their growth in the spring. Winter cereals require a spring management program. Grasses or white clover are recommended for permanent covers. Some varieties of cover crops have been reported to suppress pests or increase the population of beneficial insects. Others may be useful for specialized conditions such as organic production or specific soil management concerns. Table 2.1 lists the best types, seeding rates and planting dates for cover crops.

If a winter-killed cover crop is desired, then a late August or early September seeding date is desirable. Beyond this time, cover crop growth tends to be slower and winter-kill may not occur. If, however, overwintering cover crops are preferable, seeding can be delayed until mid-October, although earlier seeding will ensure maximum ground cover. Winter-hardy cover crops must be controlled either by mechanical or chemical methods in the spring. Permanent cover crops such as perennial ryegrass mixes and turfgrass species (e.g. fescues), are another consideration for long-term floriculture crops and can be planted in late summer, early fall or early spring.

Spring Management of Cover Crops

For spring cereal crops, crop residues can be disced, or disced and plowed, depending on the amount of residue. Chop heavy residues first to prevent the formation of a mat of under-decomposed residue.

Winter cereal crops or cover crops that survive the winter should be mowed or killed with a nonselective herbicide before plowing down. If large amounts of plant material are to be turned under, apply a light application of manure or 20-30 kg/ha of fertilizer nitrogen to speed decomposition. Chop and incorporate the crop residue with a disc prior to plowing. Rotovating or plowing alone is not recommended.

Table 2.1: Recommended Cover Crop Seeding Rate and Planting Dates

Types	Seeding Rate	Recommended Seeding Dates
Spring cereals (barley or oats)	80 - 150 kg/ha (30 - 60 kg/acre)	• before September 10
Winter cereals (winter wheat or fall rye)	80 - 150 kg/ha (30 - 60 kg/acre)	• after August 15 and before September 30 • fall rye better for late seeding
Winter legumes (hairy vetch or winter pea)	15 - 30 kg/ha (6 - 12 kg/acre)	• before September 15 • best seeded in mix with winter cereals
Legumes (crimson / white clover)	10 - 20 kg/ha (4 - 8 kg/acre)	• September 10 (later plantings will fail) • needs drained conditions
Brassicas (forage rape or kale)	10 - 15 kg/ha (4 - 6 kg/acre)	• after August 15 and before September 30 • watch for ‘green bridging’ of insect and disease pests
Annual grasses (annual ryegrass)	20 - 40 kg/ha (8 - 16 kg/acre)	• up to September 15 • can be seeded as in-season cover
Grass mixes (containing creeping red fescue, sheep’s fescue, hard fescue or perennial ryegrass)	20 - 40 kg/ha (8 - 16 kg/acre)	• generally recommended for spring seeding or when soil moisture is available in late summer (can be hydro-seeded for better catch) • can be used as a permanent cover on roads and paths

Note: If seeding late in the seeding window, use the highest seeding rate.

Water Management

Water

Water management is an essential part of crop production. Too little or too much water can result in crop losses since natural conditions rarely satisfy crop needs. In some cases, water is also required for pest control or nutrient application. Water quality must also be considered, as unsuitable water can impact crop growth and quality.

Drainage

Removing excess water in spring, fall and winter is usually necessary in South Coastal British Columbia and, to a lesser degree, in some Interior areas. In the Interior, drainage is frequently required for reclamation and to control soil salinity and alkalinity. Many coastal floodplain areas can also benefit from drainage to reduce or remove saline salts. The benefits that can be realized by installing a drainage system on agricultural land are:

- increased trafficability,
- extended crop season,
- increased crop yields due to improved nutrient uptake,
- improved aeration of the root zone,
- warmer soil temperatures,
- crop protection from “drown-out”,
- control of water erosion, and
- increased land values.

Drainage systems usually have a surface and a subsurface component. Both components must be well planned, installed and maintained to be effective. Subsurface drainage with a functioning outlet is the best way to control water on most soils. Lightweight, continuous, flexible, perforated plastic drainpipe is used. On sloping land, porous surface or blind inlets may be needed to lead water to the subsurface drains in order to reduce overland flow and erosion. On sandy soils, geotextile filters are needed around the perforated pipe to prevent sand from clogging the drain tube. Filters should not be used on organic soils.

Drainage contractors using specialized equipment quickly install plastic drainpipe. Installation depth and spacing differs with fields and is mainly based on the climatic conditions and soil type. Pumps are sometimes needed in low-lying areas that lack gravity outlets.

Drainage systems must be maintained. This includes periodic cleaning of drainpipes, outlets and ditches, and careful in-field soil management. Soil conservation and best management practices should be followed to reduce the need for ditch cleaning and avoid damage to soil tilth. Agricultural ditches are often connected to channels and streams that contain fish and provide good fish habitat. When conducting channel maintenance, producers must follow the *Drainage Management Guide*. The guide also provides information on how to prepare a drainage management plan and on the operation of drainage systems.

Soil loosening may be a consideration where soils are poorly drained as a result of a plow pan or compacted subsoil. Soil loosening, however, may not be economically viable unless problems with compaction have led to obvious yield declines. For more information on tillage refer to either the *Soil Management Handbook for the Lower Fraser Valley* or the *Soil Management Handbook for the Okanagan and Similkameen Valleys.*

The *British Columbia Agricultural Drainage Manual*, and Ministry of Agriculture and Lands factsheets provide more information and details on installing a subsurface drainage system.

Irrigation

In almost all parts of the province, natural rainfall is insufficient to replace water lost from the soil due to evaporation or crop usage, for at least part of the growing season. At these times, irrigation can result in higher yields and, in some cases, prevent crop failure. Irrigation is especially necessary for recently transplanted stock, since it will have a small and shallow root system.

Irrigation systems include drainage systems used for subirrigation, trickle and drip systems, and various forms of sprinkler irrigation. Each system has merits. The systems must be properly designed, installed, operated, and maintained to be effective. Efficient delivery and distribution systems conserve water and save on power and fertilizers. Applying too much water or having leaky pipes may lead to soil erosion, reduced production and higher operating costs. Over-application of water will also result in leaching of nutrients such as nitrogen and boron. Check pipes, pumps and sprinklers on a regular basis, and repair or replace them if necessary. The Irrigation Industry Association of BC (IIABC) offers certification courses for designers to become Certified Irrigation Designers (CID). CIDs can provide design plans and products that are cost-effective and efficient based on the standards and guidelines set out by the IIABC. The Association has recently developed courses for installers to become Certified Irrigation Technicians (CIT Level 1 and 2) to ensure proper system installation and to develop irrigation schedules that match up with the systems and field conditions. The Association can be contacted at 604 859-8222 for further information.

A water license is required to use irrigation water from surface water sources under the *Water Act*. Licenses can be obtained from the BC Ministry of Environment. Groundwater is not licensed at the present time; however, the peak withdrawal rate taken from a well should be similar to what is authorized under a surface water licence. Therefore, should groundwater licensing be implemented in the future, the well, pump size, and irrigation system peak flow rate established will be close to the licensing requirement. For more information on irrigation system design, operation and maintenance, refer to the *B.C. Irrigation Management Guide*, the *BC Trickle Irrigation Manual* and the *BC Sprinkler Irrigation Manual* that are available from the Irrigation Industry Association of BC, or irrigation factsheets available online and from BCMAL offices.

Irrigation Scheduling

Irrigation scheduling is a systematic method by which a producer can decide when to irrigate, how much water to apply, and how often to irrigate. The goal of an effective scheduling program is to supply the plants with sufficient water while minimizing losses to deep percolation or run-off. Irrigation scheduling depends on soil, crop, climate, irrigation system type, and operational factors. The goal of irrigation scheduling, like other water conservation strategies, is to help in securing current and future agricultural water needs, planning for water allocation within the agricultural sector, and achieving sustainability for agriculture.

Proper irrigation scheduling requires a sound basis for making irrigation decisions. The level of sophistication ranges from personal experience to techniques based on expensive computer aided instruments that can assess soil, water and atmospheric parameters. Irrigation scheduling techniques can be based on soil water measurement, meteorological data or monitoring plant stress. Conventional scheduling methods are used to measure soil water content or to calculate or measure evapotranspiration rates. However, research in plant physiology has led to methods that use leaf turgor pressure, trunk diameter and sap flow. For more information on irrigation scheduling, refer to the factsheet *Irrigation Scheduling Techniques*, the three British Columbia irrigation manuals mentioned above, or the Farmwest website.

Farmwest is an agricultural website that provides real-time climate information at close to 100 locations across the Province for local farmers. The climate tab contains links to a number of options for irrigation scheduling purposes, e.g., cumulative and daily reference ET, precipitation, and moisture deficit. Values can be obtained for any chosen time period up to the previous day. The ET on Farmwest is calculated based on a reference grass crop of 10 to 15 cm tall. This ET can be adjusted for a specific crop by using a crop coefficient. Having real-time climate data from the immediate area can assist producers to increase crop production and conserve water. Climate data can help decide: when and how much to irrigate; when to plant; when to apply fertilizers; and how to manage a pest.

Chemigation

Chemigation refers to the injection and application of pesticides or fertilizers (fertigation) through an irrigation system. Growers who have solid set sprinkler or trickle irrigation systems may use chemigation as a method of applying nutrients. However, pesticides must be registered for application through an irrigation system. Check the label to make sure this method can be used to apply a specific pesticide. Prior to injecting fertilizers or other chemicals into an irrigation system, proper safety procedures must be followed. The booklet *Chemigation Guidelines for British Columbia*, which is available from the Irrigation Industry Association of BC, provides information on injection rate calculations and safety considerations.

Water Quality for Irrigation

Irrigation water comes from surface or groundwater sources. In many areas, ditch water is used for irrigation. Ditch water may contain high levels of micro-organisms, salts, metals or organic compounds that can affect the performance or quality of crops. Some groundwater sources may also contain high levels of ions or nutrients that may impact crop performance.

Table 2.2: Desirable Ranges for Specific Elements in Irrigation Water

Characteristic	Quantity
Set 1 (the minimum set of analyses to be done regularly)**:**	
pH	5-7
Soluble salts	0-1.5 mmhos/cm
Phosphorus (P)	0.005-5 mg/L
Calcium (Ca)	40-120 mg/L
Sulphate (SO_4)	24-240 mg/L
Alkalinity	0-100 mg/L as $CaCO_3$
Sodium (Na)	0-50 mg/L
Boron (B)	0.2-0.8 mg/L
Fluoride (F)	0-1.0 mg/L
Magnesium (Mg)	6-24 mg/L
Chloride (Cl)	0-140 mg/L
Set 2 (desirable analyses, but not absolutely necessary)**:**	
Nitrate (NO_3)	0-5 mg/L
Potassium (K)	0.5-10 mg/L
Zinc (Zn)	1-5 mg/L
Molybdenum (Mo)	0-0.02 mg/L
Iron (Fe)	2-5 mg/L
Copper (Cu)	0-0.2 mg/L
Aluminum (Al)	0-5 mg/L
Sodium Absorption Ratio (SAR)[a]	0-4

[a] SAR quantifies the sodium level in relation to the calcium and magnesium levels.
From: *Water Quality Reference Guide for Horticulture*, Aquatrols Corporation of America

Water quality should be checked at a laboratory before planting a crop. If the crop is established, check the water before using for crop production. Refer to your local Yellow Pages™ under "Laboratories - Analytical", for a listing of laboratories that conduct water testing. Appendix F also includes a list of laboratories that conduct soil, tissue, and water analysis services. Water tests should assess salt levels (both electrical conductivity and sodium adsorption ratio), pH, metals, nutrients, possible toxic elements and coliforms (see Table 2.2). Also check the levels of bicarbonate (HCO_3), calcium, and magnesium. High levels will cause precipitates to form on the crop or possibly plug a drip irrigation system. The *British Columbia Sprinkler Irrigation Manual* and the *British Columbia Trickle Irrigation Manual* provide further information on irrigation water quality guidelines. Table 2.2 shows the acceptable levels of some chemical aspects of water.

The presence of plant-available nutrients in the greenhouse water supply does not usually present a problem, unless they exceed the amounts normally fed to plants. However, they must be taken into account when formulating nutrient solutions. Certain fertilizer materials, such as phosphoric acid, will react at high concentrations with dissolved calcium and magnesium to form insoluble precipitates. The precipitates may clog drippers. Water supplies high in calcium and magnesium may not be suitable for use in mist systems due to the accumulation of unsightly mineral residues on plant surfaces.

More information on greenhouse water quality is provided in Chapter 3 and in the factsheet *Irrigation Water Quality for BC Greenhouses* available from the Ministry of Agriculture and Lands.

Protecting Water Quality

Waste products generated during the planting, maintenance, and harvesting of floriculture crops may negatively impact water. Growers who operate at the highest environmental standards will be better able to protect themselves from possible challenges to their operations. Proper use and storage of pesticides, fertilizers, manure, and woodwaste will help to protect water quality. Growers are reminded to use best soil management practices.

Nutrient Management

Soil Testing

A soil analysis is the most accurate guide to fertilizer and lime requirements. It is especially important to determine soil fertility and pH levels before planting a crop, so that the necessary lime and fertilizer can be applied to the soil. Soil and tissue testing are useful for determining fertilizer requirements in established crops. Soil and tissue sampling must be done accurately and carefully to be representative of soil and crop conditions. Refer to the Ministry of Agriculture and Lands factsheet *Soil Sampling* for proper methods of collecting and handling a soil sample. For more information, see the section on tissue analysis in Chapter 3.

Soil and tissue testing are provided by several commercial laboratories in British Columbia (see Appendix F). It is recommended that you use the local laboratories as they have the knowledge and experience of local conditions to conduct the appropriate analyses and give correct recommendations. Once a lab is chosen, it should be used each year in order to obtain consistent interpretations and recommendations.

Fertilizer Application

Nitrogen should be surface applied each spring. The quantity applied will depend on the amount available in the soil, the soil environment, the plant type and size, and the objective of the grower. A rate of 150 kg N/ha is suggested but can be modified with experience. Higher rates are used in areas of intensive production. The total amount of nitrogen should be divided into 2-3 applications. Apply the first and largest amount in early spring, either before new growth begins or just after planting. Spread the remaining smaller application(s) over the next 3-4 months. Do not apply nitrogen after August 15 on the Coast and July 15 in the Interior, as the late growth induced may suffer winter injury. Slow release forms of nitrogen fertilizer can be used.

Application of fertilizer can be broadcast, banded along each side of the row or dropped around each plant by hand. Broadcast application is not recommended for most field stock because of the wasted fertilizer applied between rows. Fertilizer can also lodge in the foliage and cause chemical burn. Banding or hand dropping the fertilizer ensures application to the root zone of the plant. The placement should be 15-30 cm (6-12 in) away from the main stem to prevent chemical burn to the bark.

Table 2.3: Suggested Soil Fertility Standards for Woody Plants					
		Available (kg/ha)[a]		**Exchangeable (meq/100 g)[b]**	
Group	**CEC [c]**	**P**	**K**	**Ca**	**Mg**
Silt loam to loam	12-16	39-79	169-225	5-10	2
Sandy loam	5-10	28-39	113-169	2.5-4.0	1
Loamy sand to sand	2-4	17-28	68-113	1.5-2.0	0.5

[a] P X 2.3 = P_2O_5; K X 1.2 = K_2O.

[b] 1 meq/100 g Ca = 450 kg/ha; 1 meq/100 g Mg = 270 kg/ha.

[c] CEC = cation exchange capacity, which is a measure of the soils ability to hold certain nutrients.

Adapted from: Davidson, Mecklenburg and Peterson (1988)

Potassium should be applied in split applications over the season. More nitrogen and potassium will be required in sandy soils than in clay soils.

Phosphorus is relatively immobile in the soil and is not subject to leaching. After the initial incorporated broadcast application prior to planting, phosphorus applications should be banded. An entire year's phosphorus supply may be applied with one early spring application.

With the exception of nitrogen, soil analysis is the only method to indicate the type and amount of nutrients required to prevent deficiencies from affecting growth. Use of a standard fertilizer formulation every year will not necessarily increase growth to the extent expected, if another nutrient is deficient or in excess.

Methods of Fertilizer Application

Broadcasting and incorporation refers to spreading fertilizer on a soil surface before the crop has been planted, then incorporating the fertilizer into the soil by tillage.

Top-dressing refers to spreading fertilizer on a field when a crop is growing. It is not incorporated, but sprinkler irrigation will wash fertilizer off the leaves and a few centimetres into the soil.

Banding refers to the application of fertilizer at the time of planting in continuous bands 2.5 cm or more to the side of the plant and 5 cm or more deep, depending on the crop.

Side-dressing refers to the banding of fertilizer after plants are established. Care should be taken not to disturb the roots of the plants.

Fertigation refers to the application of fertilizer in irrigation water.

Deep-banding refers to banding fertilizer at a depth of 5 cm or more prior to planting. There is scientific evidence indicating that this results in greater fertilizer efficiency than surface broadcasting for deep-rooted row crops.

Calculation of Fertilizer Rates

Fertilizers are labelled by percentage according to their guaranteed minimum analysis in terms of nitrogen (N), phosphate (P_2O_5), potash (K_2O), and other nutrients when these are present. Five 20 kg bags (100 kg) of 12-51-0 contain 12% nitrogen (12 kg N), 51% phosphate (51 kg P_2O_5), and no potash (0 kg K_2O). The rest of the material in the five bags is other elements (oxygen and hydrogen) that are part of the fertilizer compounds carrying the nitrogen, phosphate, and potash. See Table 2.4 for sample fertilizer calculations.

Starter Solutions

High analysis, readily soluble or liquid concentrate starter solution fertilizers are available for use with seedlings and transplants to help get them off to a quick start. Often, during warm, dry weather, the addition of water by itself is of benefit. Starter solutions are particularly helpful in cool planting weather, since the dissolved nutrients are immediately available to immature root systems. Most starter solutions are high in available phosphorus. Some typical fertilizers include 0-52-0, 20-20-20, 10-50-10, 10-52-17 and 21-53-0. Fertilizers containing about 50% P_2O_5 should be dissolved at a rate of 0.8-1.0 kilogram per 100 litres of water. If a highly soluble type of fertilizer is used, such as 20-20-20, it should be dissolved at 0.2-0.3 kilograms per 100 litres.

Table 2.4: Fertilizer Calculations for Field Grown Crops

A. The ***amount of fertilizer*** required = (recommended rate x 100) ÷ fertilizer analysis

Example:

Recommended rate potash = 135 kg/ha
Fertilizer analysis = 0-0-60

Amount of fertilizer required = (135 kg/ha X 100) ÷ 60 = 225 kg of 0-0-60 per ha

B. The ***amount of nutrient*** applied by a fertilizer = (fertilizer applied X the fertilizer analysis) ÷ 100

Example:

Amount of fertilizer applied = 225 kg/ha

Fertilizer analysis = 13-16-10

Amount of N supplied = (225 kg/ha X 13) ÷ 100 = 29 kg of N/ha

Amount of P_2O_5 supplied = (225 kg/ha X 16) ÷ 100 = 36 kg of P_2O_5/ha

Amount of K_2O supplied = (225 kg/ha X 10) ÷ 100 = 22.5 kg of K_2O/ha

Fertilizer Reactions in Soils

Fertilizers added to the soil may become more or less available depending on the type of fertilizer, the soil moisture, the pH conditions, the nature of the soil and the amount of organic matter, rainfall and temperature. Some nutrient elements may be completely lost; others may be 'tied-up'.

Plants often display characteristic symptoms of nutrient imbalance (e.g. chlorotic, necrotic, abnormal, stunted, or cracked growth). Table 3.5, *Generalized Plant Nutrient Deficiency Symptoms*, is useful when diagnosing crop disorders that are suspected to be caused by a nutrient deficiency.

Fertilizers

Nitrogen

The most common forms of fertilizer nitrogen are nitrate (NO_3^-), ammonium (NH_4^+) and urea ($CO[NH_2]_2$). All three forms are highly soluble in water. Urea is converted to the ammonium form by enzymes in the soil. Ammonium nitrogen is adsorbed (chemically bound) to clay minerals and organic matter and is, therefore, not easily lost from the soil. Some ammonium and urea nitrogen may be converted to ammonia gas, which escapes into the atmosphere. This usually occurs in dry soil with surface-applied fertilizer. Ammonia losses are reduced or eliminated by ensuring that the fertilizer is well covered with moist soil. Losses are minimized by banding, immediate incorporation after broadcasting, irrigation following application or broadcasting onto moist soil in cool weather.

Nitrate nitrogen is not held by the soil and can be lost by leaching with water. Leaching losses are greatest in sandy soils and in areas with high rainfall. Some nitrate nitrogen may be converted to gases, which escape into the atmosphere. This frequently occurs in wet soils during fall, winter and spring.

Phosphorus

All phosphorus fertilizers are phosphate salts. They are water soluble, but tend to form insoluble compounds when incorporated into the soil. Unlike nitrogen and potassium, phosphorus does not readily move in the soil and very little leaching occurs. Phosphorus tends to remain where it is placed. Therefore, it is important to place phosphorus fertilizer in the rooting zone of the crop before the crop is established, or to band it next to the roots in established crops. Surface application without incorporation is the least efficient way to use phosphorus fertilizer. In some soils, phosphorus becomes "tied-up" if the pH is below 6.0 or above 7.5.

Potassium

Potassium fertilizers are all simple potassium salts, such as potassium chloride, potassium sulphate, potassium-magnesium sulphate or potassium nitrate. All are readily water-soluble. Potassium is adsorbed to some extent to organic matter and clay minerals.

However, it is subject to leaching, especially in sandy soils.

Secondary Nutrients

Magnesium and sulphur levels in the soil may be inadequate for good crop growth. Soil and tissue testing are the only accurate ways to determine if they are lacking. Since calcium is applied as lime it is rarely deficient in soils. Many common fertilizers contain calcium. Sulphur and magnesium fertilizers are also available.

Micronutrients

The soil levels of iron (Fe), manganese (Mn), copper (Cu), zinc (Zn) and boron (B) are sometimes inadequate for optimum crop production. Micronutrients are required in very small amounts and it is important to ensure that micronutrient fertilizers are applied at the correct rate. High levels of micronutrients, especially boron and manganese, are toxic to plants. Soil and/or tissue testing are the only accurate ways to determine if these elements are lacking. If they are needed, micronutrients can be added to blended fertilizers and applied along with the routine fertilizer program. If necessary, micronutrients can be applied in irrigation water or with a crop sprayer.

Boron

Boron deficiency may cause a wide variety of abnormalities in crops. Fertilizers that include boron can be obtained in most areas. **Caution:** Do not exceed the recommended amount of boron per hectare as it may cause plant injury. If boron-deficiency symptoms occur during the growing season, boron can be applied as a foliar spray. Apply Borospray, Solubor or Borax at manufacturers' directions.

In the Interior, boron should be applied in the fall. At the Coast, it should be applied in the spring where a need for it has been shown.

Managing Soil pH

pH is a measure of the acidity or alkalinity of the soil. Soil pH is very important because it affects the availability of nutrients to the plant. Most floriculture crops do not respond to fertilization when the pH is very low (extremely acid soils, pH less than 5.0) or very high (extremely alkaline soils, pH above 7.5).

Calcium, phosphorus, magnesium, and molybdenum are the nutrients that are most likely to be deficient under acid soil conditions. Test the soil to determine pH before planting and every 2-3 years to monitor changes. Soil pH can usually be modified to obtain a suitable pH.

Raising Soil pH

Soils in South Coastal British Columbia are typically acidic and, therefore, many acid-loving crops do not require modification of soil pH. Lime application to raise soil pH is usually required for species that are not acid-loving. When the soil pH is not known, a soil test should be performed.

On extremely acidic soils, most crops will not respond to fertilization or other management factors. Agricultural grade limestone (calcium carbonate or $CaCO_3$) is generally recommended to correct soil acidity. For the Fraser Valley, the general application rate is 1-2 tonnes/ha/yr (400-800 kg/acre) for pH sensitive crops. Rates higher than 2-4 tonnes (800-1,600 kg/acre) are not recommended due to soil reactivity and the difficulty of incorporation. Lime should not be applied within 1 week of applying nitrogen fertilizer or manure. The high soil pH that occurs shortly after liming will increase the loss of ammonia.

Lime does not move through the soil, it must be incorporated.

Some soils limed heavily over a period of years may not require further applications. Some light-textured soils that have an adequate pH occasionally test very low in calcium, and therefore require lime. If calcium levels are low, gypsum or fertilizers such as calcium nitrate may also be used to supply calcium, rather than using lime. Gypsum ($CaSO_4$) is not a liming agent. It will not increase soil pH, and under certain conditions it is used to lower soil pH. The use of some dolomitic limestone is recommended since it contains a significant quantity of magnesium, an essential and often deficient plant nutrient.

The positive effects of lime application include:

- reduce soil acidity,
- improve the physical condition of the soil,
- provide calcium and magnesium (if dolomitic limestone is used),
- favour bacterial action and, thereby, hasten the decomposition of organic matter and the release of nitrogen,

- improve conditions for availability of other nutrients, notably phosphorus and some minor elements, and
- reduce the toxicity of some elements such as manganese and aluminium.

Growers need to be careful when applying lime. If applied at too high a rate (above 5 tonnes per ha), lime may tie up some micronutrients (e.g. boron) or cause nutrient imbalances. Lime application may aggravate magnesium deficiencies, especially in sandy soil. Where this is a problem, some dolomitic lime should be used. Liming can also increase the rate of organic matter depletion and encourage the germination of some weeds. Lime should always be used in conjunction with a planned soil testing and fertilizer program.

Forms of Lime Used

Calcium oxide: quicklime, caustic lime, burnt lime. Not recommended for use on agricultural land.

Calcium hydroxide: hydrate or slaked lime. Should only be used as a spring application for rapid results. "Agricultural Lime" refers to this form but the use of this term is not recommended. It is the quicker acting form of agricultural lime. It will correct soil acidity quickly, but is usually two or more times as expensive. Excessive rates above 1,100 kg/ha (450 kg/acre) may be quite caustic and "burn out" organic matter.

Ground limestone: calcium carbonate. The most convenient form to handle. May be applied at any time of the year. It dissolves slowly and lasts longer in the soil. (Usually grey lime material sold in bulk in South Coastal BC.)

Ground dolomite: calcium-magnesium carbonate. May be substituted for ordinary limestone. It contains magnesium in addition to calcium.

Note: Fineness of grind is very important. Fine grinds (100 mesh and above) react in soil much quicker than coarse grinds (10-100 mesh). Very coarse limestone (less than 10 mesh) is not recommended. Some coarse material is desirable to facilitate lime handling. Excessively fine material will not flow readily and is subject to wind drift during spreading.

Lowering Soil pH

Sometimes it is advantageous to lower or acidify the soil pH. In Interior areas, alkaline mineral soils may need to be acidified for crop production.

The principal materials used to lower soil pH are elemental sulphur, sulphuric acid, aluminum sulphate and iron sulphate (ferrous sulphate). Ammonium sulphate, ammonium phosphate and other ammonium containing fertilizers are also quite effective when the soil receives sufficient water, though they are primarily sources of plant nutrients.

For large areas, elemental sulphur is probably the most economical product to use. The finer ground the sulphur, the more quickly it will react in the soil to lower the pH. Flower sulphur is very fine (powder) and reacts relatively quickly. Solid sulphur prills (granules) are less finely ground and therefore react more slowly and are more convenient to apply. Finely ground sulphur is sometimes available in prills that contain a mixture of flower sulphur and bentonite clay that improves the handling, stability, and safety of the material.

Soil test laboratories can, by request, determine total soil acidity and calculate the sulphur required to attain a desired pH. As a general recommendation apply the equivalent of 2 tonnes/ha (800 kg/acre) in a band where the planting beds will be formed. For more information refer to the Ministry's factsheet, *Acidifying Soils*.

Soluble Salts in Soil

Elevated salt levels in soil will interfere with water uptake and eventually plant growth. The effects range from delayed or non-germination of seed to death of new transplants and serious reduction in growth of new or established plants (see Table 2.5). Most soils in BC are low in soluble salts. However, there are regions where salts can accumulate, such as lowland areas adjacent to ocean dykes, areas where salt-water intrusion may affect irrigation water, alkali seep areas in the Interior, and areas where road salts or fertilizer salts have accumulated. The problem with soluble salts is most severe when soil moisture is low and salt concentration is high.

Table 2.5: Soil Conductivity Readings (derived from field soil samples using a 2:1 water and soil paste mixture)		
Conductivity Reading (milliSiemens/cm)	**Rating**	**Plant Response**
0-0.25	Low	Suitable for most plants when using recommended amounts of fertilizer.
0.26-0.45	Medium	
0.46-0.70	High	May prevent emergence and cause slight to severe damage to most plants.
0.71-1.00	Excessive	
1.00	Excessive	Expected to severely damage most plants.
Source: OMAFRA Nursery & Landscape Plant Production, Publication 383		

Manure and Woodwaste Management

Code of Agricultural Practice for Waste Management

The use of livestock manure and agricultural vegetation wastes is covered by the *Code of Agricultural Practice for Waste Management*. This Code is part of the *Agriculture Waste Control Regulation* under the *Environmental Management Act*. The Code describes general practices for the use, storage, and management of agricultural waste in an environmentally sound manner. Also refer to the *BC Environmental Farm Plan Reference Guide*. The guide describes in general terms many of British Columbia's diverse farm practices. It also refers the reader to existing government legislation, industry guidelines, and other sources of information related to farm practices in BC.

Storage

The Code requires that agricultural waste, particularly manures, be kept in a storage facility or covered if not used immediately. The storage must prevent escape of manure to the environment that could cause pollution. Manure may be stored uncovered in the field for up to 2 weeks prior to use. Manure may be stored in the field for up to 9 months if it is kept in a temporary storage facility that prevents the escape of nutrients to the environment (e.g. securely covered with a tarp on a dry site). In the Lower Fraser Valley and Vancouver Island regions, stored manure must be covered from October 1 to April 30. The field storage facility must be 30 meters from a watercourse or a water source used for domestic purposes.

Nutrient Value

Manures supply plant food over a period of time. Table 2.6 shows the typical amount of nutrients supplied in various types of livestock manure. The moisture and nutrient content varies as a result of storage method, litter content, and manure age.

The nitrogen values given in Table 2.6 are for total nitrogen. For all types of manure, the amount of nitrogen that is available to the crop after it is applied may vary from the value listed in the table. Incorporate all manures (solid or liquid) within 12-24 hours of spreading to reduce ammonia volatilization and to achieve the greatest benefit from the manure nutrients. If the manure is incorporated soon after spreading, 20% of the nitrogen may be lost. However, as much as 50% of the nitrogen can be lost if the manure is left on the soil surface after being spread.

Test the nutrient content of the manure after it is delivered to the farm. The nutrient content will not change significantly if the manure is kept covered. If a manure test is unavailable, the table values can be used but they may require adjustment for the moisture content of the manure. Nutrient applications from all sources, including manure and commercial fertilizer, should be balanced to meet the crop requirements. The release of nutrients from manure is not consistent. Therefore, in any year manure should only be used to supply up to 75% of the crop’s nitrogen requirement. About 50% of the phosphorus in manure is readily available in the year it is applied. Where manure has been used repeatedly, phosphorus is assumed to be 100% available. All potassium from manure is available in the year of application.

Using Compost

The nutrient content of composted manure is slightly higher than fresh manure. However, the availability of the nutrients is lower as they are held in a more stable form by the organic matter of the compost. Note that use of compost or composted manure may be expensive for large-scale field production. The benefits of using composted manure include reduced nitrogen leaching and, its usefulness as a supplement or replacement for other organic matter in plant production. Compost increases the soil's organic matter content and moisture-holding capacity. Compost improves soil porosity and helps to control soil erosion. It also enhances plant growth, helping to develop a sound root structure, and has been reported to suppress or control soil-borne diseases.

It is very important to know the nutrient availability and salt content of compost, whether the compost is derived from animal manure or plant wastes. Nutrients will be released slowly from compost, but there is often a flush of readily available nutrients and salts from compost that has not been fully cured or slightly weathered prior to use. It is critical to check salt content prior to use as a medium for seedling or transplant production. Generally less than 50% of the growing medium by volume should be made up from compost, and this may be even lower for composted manure.

Soil Conditioner

Manure can be used as a soil conditioner if its nutrient content is known and no more is applied than the crop requires. Using manure together with cover crops can improve soil structure. The decomposition of the manure in the presence of cover crop roots stimulates biological activity, and increases aeration, permeability and water-holding capacity of the soil. Do not apply manure in the fall to bare ground, or in the winter (mid-September to March 1). Manure may be applied in January and February to fields that have a well established and actively growing cover crop.

Table 2.6: Typical Nutrient Content of Various Types of Manure

		Nutrient Content[a] kg/tonne (kg/m^3)		
Type of Manure	**Moisture %**	**Total Nitrogen**	**P_2O_5**	**K_2O**
Beef (solid)	68	4.2 (2.1)	4.8 (2.4)	8.2 (4.1)
Dairy (solid)	77	3.9 (2.0)	3.4 (1.7)	9.0 (4.5)
Dairy (liquid)	91	2.9 (2.9)	2.1 (2.1)	4.5 (4.5)
Swine (covered pit)	93	6.3 (6.3)	3.3 (3.3)	3.9 (3.9)
Swine (uncovered pit)	98	3.5 (3.5)	1.5 (1.5)	1.7 (1.7)
Horse (with shavings)	72	2.4 (1.2)	1.7 (0.8)	3.2 (1.6)
Spent mushroom compost	70	5.8 (2.9)	2.5 (1.2)	8.5 (4.2)
Poultry (broiler)	25	31.6 (15.8)	22.8 (11.4)	12.2 (6.1)
Poultry (layer)	50	22.8 (11.4)	29.2 (14.6)	11.2 (5.6)

[a] Nutrient values for manure assume proper storage, handling, and application to minimize losses.

Conversions:

1 tonne of liquid manure = approximately 1,000 litres = 1 m^3 = 220 Imp. gallons
1 m^3 = 1.25 yd^3 = 28 bushels
1 tonne of solid manure = approximately 2 m^3 = 2.5 yd^3
To convert kg/tonne to lb./ton, multiply by 2.0
To convert kg/m^3 to lb./yd^3, multiply by 1.7

Applying Manure

Under the Code, manure can only be applied to land as a fertilizer or soil conditioner.

In South Coastal British Columbia, apply manure to field crops between mid-March and early July. Be sure that the amount of manure applied is no more than what is needed to fertilize the crop. Manure can be applied to a cover crop or permanent grass crop between July and October if, based on a soil test, the application rate matches the crop's nutrient requirements. Manure should not be applied to bare land after July. No manure should be applied between October and March.

In the Interior of British Columbia, spread manure only when the risk of run-off is near zero. Manure should not be applied to frozen or snow-covered ground. Manure may be applied in the fall if the application rate is equivalent to the crop's nutrient requirements, and if there is a cover crop in place and no run-off will occur.

Additional Precautions

Concerns have been raised recently over the potential contamination of watercourses with constituents of manure. Floriculture growers are encouraged to use best management practices to avoid direct discharge or run-off losses of manure into watercourses. This concern applies not only to the nutrient and solid fractions, but also to the potential pathogens that may exist in animal manure.

Water in ditches is often used for irrigation and crop washing, so its quality is important. Growers are encouraged to avoid direct contact between the harvestable portions of plants and any manure applied to the crop as a fertilizer. Growers may wish to follow the *British Columbia Certified Organic Production Operations Policies and Farm Management Standards* that state the use of raw manure is allowed only prior to seeding a cover crop or a green manure crop. Crop production standards of organic certification organizations may recommend the use of composted manure or the incorporation of manure prior to planting a cover crop. In either case, it places sufficient time between the application of manure and the growth of the crop to allow the soil to effectively assimilate nutrients and for the pathogen risk to be eliminated.

The levels of pathogenic micro-organisms in manure, such as *Salmonella* and fecal coliform, are reduced by 99% in about 18 days when soil temperatures are at 15°C. It may take as long as 45 days to reduce the numbers when the soil is about 5°C.

Non-Agricultural Wastes (Biosolids, Whey, Yard Waste, Pulp Sludge, Fish Waste, Etc.)

Caution: Many wastes generated off-farm are being offered, or sold to farmers for use as soil conditioners or fertilizers. The use of all agricultural wastes is covered by the *Environmental Management Act* in BC. Use of these materials may be allowed under Regulation or an authorization under the Act. Many of these materials can provide benefits to the soil or crop. However, they come with characteristics or contaminants that can be undesirable to growers. Refer to the Ministry's factsheet, *Use Caution When Bringing Non-Agricultural Waste or Products on to Your Farm.*

Determining the Amount of Manure to Spread on the Field

To spread manure as a fertilizer the following must be known:

- the nitrogen content of the manure,
- the amount of nitrogen supplied by the manure to the crop,
- the amount of manure the spreader can hold (its capacity),
- the nitrogen needs of the crop, and
- the number of spreader loads of manure per area in the field.

Table 2.7 outlines the steps to follow to calculate the amount of manure to spread based on crop requirements.

Environmental Considerations

- Application of fertilizer around each plant, but not touching the stems or foliage, will ensure efficient application to the root zone. This reduces weed growth between rows and nutrient loss to the environment through leaching or run-off.
- Irrigating in the early morning will prevent or reduce the incidence of foliar diseases and reduce the need for fungicides.
- Weed control around each plant will improve plant quality, while reducing damage by rodents and insects.

Table 2.7: Calculating the Quantity of Manure to Apply

Step 1. Determine the nitrogen content of the manure.

Refer to Table 3.8 for typical total nitrogen contents of various types of livestock manure. Use these values if a laboratory or quick test value is not available. Nitrogen comes in several forms in manure. The amount of nitrogen in manure also varies and is subject to many management and environmental conditions that can result in nitrogen losses.

Step 2. Calculate the approximate amount of nitrogen supplied by the manure (kg N/yd^3).

Losses of nitrogen upon application of manure can range from a low of 20% if manure is incorporated within 24 hours, to as much as 50% by volatilization if the manure is left on the soil surface.

$$\frac{\text{N supplied by manure (kg/m}^3\text{) (see Table 3.8) X initial application loss factor*}}{1.31\ \text{m}^3/\text{yd}^3}$$

*Initial application loss factor = 100% - % nitrogen lost

Step 3. Determine the capacity of the manure spreader (yd^3).

$$\frac{\text{Box length (ft) X width (ft) X average depth of manure in spreader (ft)}}{27\ \text{ft}^3/\text{yd}^3}$$

Step 4. Determine the nitrogen needs of the crop (kg/ha).

Refer to specific crop recommendations in the results of a soil test.

Step 5. Calculate the number of spreader loads of manure per area in the field (loads/ha).

$$\frac{\text{Crop N requirements (kg N/ha)} \div \text{spreader capacity (yd}^3\text{/load)}}{\text{N supplied by the manure (kg N/yd}^3\text{)}}$$

Example:

A spreader has a box that is 7.5 feet long and 4 feet wide. It is filled with solid poultry (broiler) manure to an average depth of 2.25 feet. The manure will be spread prior to planting a crop that, based on soil testing, requires about 80 kg/ha (32 kg/acre) of nitrogen. The manure is to be broadcast over the entire area using a conventional spreader. How many loads are needed to supply the crop's nitrogen requirements?

Step 1. Determine the nitrogen content of manure.

From Table 3.8, poultry manure contains 15.8 kg N/m^3

Step 2. Calculate the approximate amount of nitrogen supplied by the manure (kg N/yd^3).

$$= \frac{\text{15.8 kg N/m}^3\text{ (from Table 3.8) X 0.80}}{1.31\ \text{m}^3/\text{yd}^3} = 9.6\ \text{kg N/ yd}^3$$

Step 3. Determine the capacity of the manure spreader (yd^3).

$$= \frac{\text{7.5 ft long X 4 ft wide X 2.25 ft deep}}{27\ \text{ft}^3/\text{yd}^3} = 2.5\ \text{yd}^3\text{/load}$$

Step 4. Determine the nitrogen needs of the crop (kg/ha).

80 kg N/ha (32 kg N/ac) (based on soil testing)

Step 5. Calculate the number of spreader loads of manure per area in the field (loads/ha).

$$= \frac{\text{80 kg N/ha} \div \text{2.5 yd}^3\text{/load}}{9.6\ \text{kg N/yd}^3} = \text{3.3 loads/ha } (\div 2.47 = \text{1.3 loads/acre})$$

BC Environmental Farm Plan Program

The long-term prosperity of British Columbia's agricultural sector is linked to its environmental sustainability. With increasing agricultural production intensity and expanding knowledge of our biological and physical environment, the need for improving farm practices has been recognized. The goal of Environmental Farm Planning is to raise awareness amongst producers and enhance environmental farm stewardship. This can be accomplished through the establishment and implementation of Environmental Farm Plans. Environmental Farm Planning (EFP) is normally seen as a voluntary, confidential, producer-driven planning exercise that uses specifically designed resource materials and technical assistance. In British Columbia, both the senior governments and the agriculture industry recognize the value of EFPs, and programming is available in all agricultural regions. Between 2003 and 2008, recognized planning advisors working under the Canada-British Columbia Environmental Farm Planning Program provided Planning Workbook and Reference Guide materials to participating farmers. These materials are used to develop a farm plan that identifies on-farm environmental risks and subsequently establishes a priority sequence of action items for addressing those risks.

The EFP concept has been around for over two decades. The first in North America was the Farm-A-Syst program in Michigan. This was adapted by the Ontario Farm Environment Coalition for use by Ontario farmers. The Ontario program has been in place for well over 10 years. Since 2004, all Canadian provinces have had an EFP program in place. EFPs are voluntary. There are no government laws or regulations that require a farmer or rancher to prepare a plan. However, institutions such as banks, insurance companies, and food processors and buyers are paying increasing attention to the impact of agriculture on the environment and are requesting some form of environmental risk assessment from their customers. Farmers may find their environmental farm plan to be a very useful tool when dealing with these other organizations.

What is an EFP?

An EFP is an agriculture-environment risk identification process. It is conducted through a comprehensive review of activities and facilities that exist on the farm or ranch with respect to their impact on the environment. The review also looks at the impact of the environment on the farm, for example impacts from wildlife or flooding. The review considers current environmental regulation requirements and beneficial management practices that should be in place on farm. It looks at the risk of the operation to the environment as well as the risk of the environment to the farm or ranch operation.

Why Do an EFP?

- To determine the standing with respect to environmental rules and regulations and the environmental risk of management practices.
- To sustain the resources used and affected by farming practices for long-term production.
- To increase public confidence that BC farmers are "doing it right" with respect to the environment.
- To improve farm/ranch profitability. Some potential economic benefits include making fertilizer dollars go further through nutrient management planning, reducing tillage costs by converting to conservation tillage practices, and minimizing cost of pesticides by using integrated pest management techniques.
- To differentiate your product(s) in the market-place and thereby maintain or enhance marketing opportunities.
- To help plan for unforeseen contingencies such as floods, spills or fires.
- To demonstrate due diligence on the part of the producer.
- To reduce potential for new legislation or regulation.
- To improve relationships with regulatory agencies and to reduce the need for further regulation.

More information on the program is available on the Ministry of Agriculture and Lands website. Contact Hedy Dyck at the BC Landscape and Nursery Association (604 574-7772) for information on the status of the program.