Yukon Garden Handbook

A Collection of Helpful Techniques

Yukon
Renewable Resources

YUKON GARDEN HANDBOOK

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INTRODUCTION AND ACKNOWLEDGEMENTS

This handbook was developed by selecting information from various sources. The following are the main sources utilized:

- *various gardeners throughout Yukon*
- *the agricultural and forestry experimental station at the University of Alaska at Fairbanks, Alaska*
- *various Agriculture Canada Publications*
- *Manitoba Agriculture's Vegetable Production Guide*
- *gardening material from Saskatchewan, Alberta and British Columbia departments of Agriculture*
- *the Director and staff of Agriculture Canada Research Station in Beaverlodge, Alberta*

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Paul and Josie Fletcher - Lake Laberge Area
Art Hutchison and Linda Eckert - Fox Lake
John Schuffels and Yvonne Fradsham - Carcross Junction Area
The Wilcox's - Lubbock Valley Greenhouses

The information in this publication is an attempt to tailor various sources of information more closely to Yukon vegetable crop growing conditions. The conditions of heat, light, moisture, and fertility available to plants in various locations in Yukon are considered. There are still many unknowns to be researched in Yukon gardening. In the meantime, the process of trying different kinds and varieties of crops on any particular location is fundamental to the success of home and commercial gardening in Yukon.

The information in this publication is intended to be of assistance to the commercial as well as the home gardener.

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1. YUKON CLIMATE

1.1 Growing Periods

To suggest that the climate in Yukon varies depending on location is a clear understatement of fact. Table 1 provides some indication of the variability of growing periods at specific locations in Yukon. It is extracted from "Farming Potential in the Canadian Northwest", Agriculture Canada Publication #1466.

TABLE 1

KILLING FROST-FREE PERIOD, VEGETATIVE PERIOD,
AND NUMBER OF DEGREE-DAYS
AT 6 LOCATIONS IN YUKON

	Killing Frost-Free Period, 28°F						Vegetative Period, 42°F			Degree-Days (42°F)	
					Average Date of Frost						
Station	No. of Years	Longest In Days	Shortest In Days	Average In Days	Last	First	Number of Years	Average Number Days	Average Date Started	Average Date Ended	Number of Years	Number of Degree-Days
Dawson	29	142	63	119	May 17	Sept 12	10	136	May 5	Sept 18	29	1,636
Mile 1019	29	86	16	52	June 21	Aug 14	21	122	May 19	Sept 19	20	605
Mayo Landing	30	121	32	96	May 25	Aug 28	10	138	May 6	Sept 21	30	1,349
Teslin	20	126	74	94	June 2	Sept 3	10	138	May 9	Sept 24	20	1,159
Watson Lake	28	145	76	118	May 19	Sept 13	10	144	May 6	Sept 27	28	1,574
Whitehorse	20	143	94	118	May 19	Sept 13	10	143	May 6	Sept 26	20	1,437

1.2 Site

Factors which should be considered when selecting a garden site are:

Elevation - the higher the elevation the cooler the climate. Dawson City at an elevation of 1065 ft (323 m) is considerably warmer during the growing season than Whitehorse at over 2000 ft (600 m).

Slope - the slope should be in a southerly direction in order to make full use of the heat from the sun.

Air Drainage - the lower side of the garden area should be open to permit cold air to settle down and away from the garden.

Natural Protection - trees or natural land barriers are useful to protect gardens from wind. Protection should be developed against prevailing winds.

Proximity to Water - no area in southern Yukon has sufficient rainfall for optimum crop growth on an average year. It is necessary to have an adequate water supply nearby. The water should be near neutral in pH and should be low in undesirable salts such as sulfates and chlorides. Remember, 22,651 imperial gallons of water are required for one inch of water on one acre.

Soil - the pH of soil should be between 6.5 and 7.5 for general gardening. The soil texture should be a friable sand-silt loam. Mixing peat, working in green manure crops and/or working animal manure into the soil will improve the moisture holding capacity and create a more acceptable medium for plant root development.

Local Experience - study the success of gardeners in nearby similar locations.

Proximity to Markets - this factor is particularly important to the commercial gardener. The time required to get fresh vegetables from the garden to the market is essential for freshness and appearance.

To summarize the climatic requirements for successful gardening:

1. *A period of 80 days free of killing frost.*
2. *A vegetative period of over 100 days.*
3. *An accumulation of 1000 growing degree days. The basic temperature for cool season crops is 42°F (5.6°C). This temperature is subtracted from the average daily temperature to determine degree-days (average temperature of 50°F (10°C) would yield 8 degree days.*
4. *Adequate moisture during the growing season.*

I.3 Precipitation and Frost-Free Periods

*Precipitation is insufficient and frost-free periods short in most Yukon communities. The following information (**Table 2**) provides an indication of precipitation and frost-free periods for some locations. The table is an extract of "Farming in the Canadian Northwest", Agriculture Canada publication #1466.*

TABLE 2

PRECIPITATION AND FROST-FREE PERIODS FOR SPECIFIC LOCATIONS IN YUKON

STATION	Elevation In Feet	Precipitation May - Sept. 65 - 69	No. of Years	Longest In Days	Shortest In Days	Average In Days	Average Date of Frost Last	Average Date of Frost First
Dawson	1,062	7.10	30	126	28	83	June 1	Aug 24
Mile 1019	2,000	6.00	22	38	4	21	July 11	July 31
Mayo Landing	1,625	6.74	30	107	20	62	June 9	Aug 11
Teslin	2,300	6.19	17	96	43	69	June 16	Aug 25
Watson Lake	2,248	8.38	22	127	46	96	May 29	Sept 2
Whitehorse	2,289	5.77	26	127	26	87	June 5	Aug 31

1.4 Minimum Moisture Requirements

Most vegetables require the following minimum moisture supply during the growing season in Yukon:

May	*1.5 inches (35 mm)*
June	*3.5 inches (90 mm)*
July	*3.5 inches (90 mm)*
August	*3.0 inches (75 mm)*
September	*0 inches (except for overwintering crops)*
Total =	*11.5 inches (290 mm)*

The moisture deficit in Yukon is particularly evident in May, June and July in most communities. The driest areas generally are the Carcross Valley and the Whitehorse and Takhini Valley areas.

II. HOME GARDENING

II.1 Garden Site

a) *Slope - if possible, select a site sloping towards the afternoon sun.*

b) *Soil - should be a loam mixture. Heavy clay or peat soils are cold soils and need to be altered for gardening purposes. A loam soil is a mixture of sand, silt and clay.*

c) *Shelter - the garden should be sheltered from prevailing winds but the garden should not be shaded by shelterbelts. Shelterbelts should be broken on the downslope from the garden to permit air drainage. If no trees are available, slotted fences can provide shelter from wind.*

d) *Site location should be close to the home for easy daily access.*

e) *Garden Layout - plant rows north and south to maximize sunlight.*

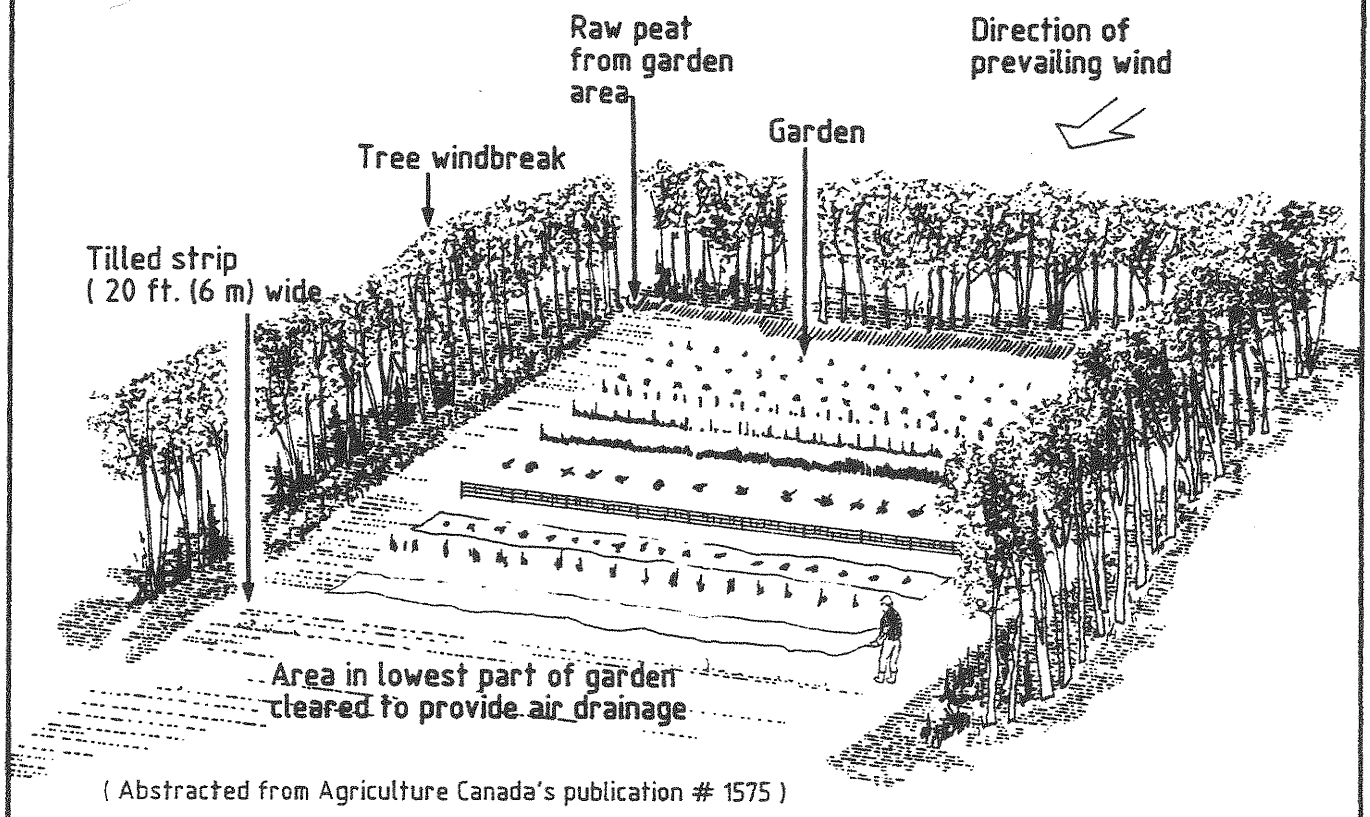
Figure 1, taken from Agriculture Canada publication #1575, indicates some of the virtues of a good site location.

Place perennial vegetables or fruit in an area of the garden where they will not interfere with cultivation.

II.2 Size of Garden

The garden should be large enough to permit 50% of the garden to be grown to a cover crop and worked into the soil annually. This practice will help to improve the soil and assist in crop rotation.

Fig. 1 : Suggested Site Location



(Abstracted from Agriculture Canada's publication # 1575)

Suggestion for garden layout :

- plant rows north and south to maximize sunlight

II.3 Crop Rotation

Most garden crops require a 3 to 5 year crop rotation for purposes of controlling soil-borne diseases and insect pests. This also permits part of the garden to be treated with manure and compost annually.

II.4 Garden Layout

You should consider grouping crops according to growth habits and time of maturity. This practice can facilitate increased production and encourage growth conditions for early vegetables and their subsequent storage.

*The following layout (**Table 3**) is abstracted from Agriculture Canada Publication #1059E.*

TABLE 3
TYPICAL GARDEN LAYOUT

		Strawberries
		Main Crop Vegetables
		Early Vegetables
	Tall	*Vine Crops*
North	*Plants*	*Early Vegetables*
		Main Crop Vegetables
		Perennial Vegetables
		and Bush Plants
		West

II.5 Spacing Requirements

Follow the suggested spacing for each crop as indicated in the general production recommendations section.

III. PLANTING BASICS

III.1 Depth of Planting (follow the recommendations for each crop)

Commercial fertilizer should be sidebanded preferably. This applies to all garden crops. Care should be taken to avoid contact of fertilizer with the seed.

III.2 Plant Growth Habits

The growing habit of each crop should be known and considered before planting. Table 4, abstracted from Manitoba Agriculture, summarizes the compatibility of plants including height, root system, shade or light tolerance, water and plant food requirement.

TABLE 4

A VEGETABLE COMPATIBILITY GUIDE

	Maximum Height cm (in)	Root System (Depth)	Root System (Breadth)	Tolerates Partial Shade	Water Requirement	Need for Nitrogen	Maturity Date
Bean, Bush	25.5-35 (10-14)	Medium	Spreading	No	Moderate	Legume	Early
Beet	15-20 (6-8)	Deep	Narrow	Yes	Moderate	Heavy	Early
Broccoli	30 (12)	Medium	Spreading	Yes	Moderate	Heavy	Midseason
Cabbage	25.5 (10)	Medium	Spreading	Yes	Moderate	Heavy	Midseason
Cantaloupe	15 (6)	Shallow	Spreading	No	Heavy	Heavy	Late
Carrot	15-20 (6-8)	Deep	Narrow	Yes	Moderate	Light	Early-Mid.
Cauliflower	25.5-30 (10-12)	Medium	Spreading	Yes	Moderate	Heavy	Midseason
Celery	30-35 (12-14)	Shallow	Narrow	Yes	Heavy	Heavy	Midseason
Corn	122-183 (48-72)	Medium	Narrow	No	Heavy	Heavy	Mid.-Late
Cucumber	15 (6)	Shallow	Spreading	No	Heavy	Heavy	Mid.-Late
Eggplant	30 (12)	Medium	Spreading	No	Heavy	Heavy	Late
Kohlrabi	20-35 (8-10)	Medium	Spreading	Yes	Moderate	Heavy	Early
Leet	25.5-30 (10-12)	Medium	Narrow	Yes	Moderate	Light	Late
Lettuce, Leaf	15-35 (6-10)	Shallow	Narrow	Yes	Moderate	Heavy	Early
Onion (mature)	35 (10)	Shallow	Narrow	No	Moderate	Light	Mid.-Late
Parsnip	20-35 (8-10)	Deep	Narrow	Yes	Moderate	Light	Late
Pea	76-152 (18-60)	Shallow	Spreading	Yes	Heavy	Legume	Early
Pepper	30 (12)	Medium	Spreading	No	Moderate	Light	Mid.-Late
Radish	10-15 (4-6)	Medium	Narrow	Yes	Moderate	Heavy	Early
Spinach	15 (6)	Shallow	Narrow	Yes	Moderate	Heavy	Early
Squash	15 (6)	Shallow	Spreading	No	Heavy	Heavy	Late
Tomato	60-152 (24-60)	Med.Deep	Spreading	No	Heavy	Heavy	Mid.-Late

III.3 Soil Temperature

Plants respond to warm soil even more than warm air temperature. It is therefore generally more efficient, for energy conservation and growth stimulation, to heat the soil for plants rather than the air surrounding the top of the plants. In view of this growth factor, some measures which may be useful are:

- *the use of electric heating cables in greenhouses*
- *the use of hot water lines to warm soils in enclosures*
- *the use of warm water for watering soils*
- *the use of hot frames for starting plants*
- *the use of south facing slopes*
- *clear plastic mulches (N.B. all other types of mulches keep soil cooler than clear mulch in summer)*

III.4 Depth of Seeding

The smaller the seed, the shallower the seed should be planted. In outdoor conditions, the soils surface is warmest and most conducive to plant growth. Small seeds such as carrots and lettuce should be planted in the top 1/2 inch (12 mm) of soil. Larger seeds such as beans and peas may be planted to a depth of 2 inches (50 mm). Do not plant crops deeper than recommended except in cases where it is necessary to meet moisture. In the case of moisture deficit, practices such as ridging are used to reach moisture without increased depths of soil covering seeds. Potato tubers should be planted at a depth of 2-3 inches (50-75 mm) for early emergence and earlier maturity. Don't forget - northern soils are cool soils.

III.5 Basic Procedures

- *wait until soil temperature is 42°F (5°C)*
- *seed early vegetables in shallow trenches*
- *seed correct depth for each vegetable - pack soil firmly around seed or transplant*
- *sidebanding fertilizer application results in more effective use and protects the seedling from fertilizer burn. The fertilizer should be placed 2 - 3 inches (5 - 8 cm.) below the seed and 2 - 3 inches (5 - 8 cm.) to one side.*

IV. SOIL FERTILITY

IV.1 Yukon Soils and their Fertility

a) Natural Soil Conditions

The natural soils of the Yukon have formed under a cold and generally semi-arid climate. The development of soils differs in each region of the territory. The northern Yukon was glaciated some 10,000 years ago (similar to the rest of Canada) and because of climatic conditions, soils have weathered only slightly since that time. Soils range from gravelly to clayey and are often calcareous (free lime in the soil just beneath the surface) and alkaline (soils are basic rather than acidic). On fine textured materials (the silts of major valleys in the southern lakes area) soils are sometimes saline (concentrations of salts high enough to affect the growth of sensitive plants). In the central Yukon, particularly the Klondike, some landscapes are much older. Here, a longer history of weathering and greater annual precipitation have produced soils of a different character. These tend to be non-calcareous (without free lime), neutral to slightly acid and non-saline. These soils tend to be higher in humus than those of the drier regions of the southwest Yukon. In the Watson Lake region, warm moist summers produce moderately weathered soils which tend to be slightly acid.

Another important natural soil condition that the home gardener should be aware of is soil temperature. Mean summer soil temperature in the Whitehorse area at the 6 inch (20 cm) depth is only $50^{o}F$ ($10^{o}C$). Temperatures further north are colder and in many areas permafrost at 2 - 3 ft (1 m) depth may be encountered. Natural soil temperatures restrict vegetables which generally require at least $42^{o}F$ ($5^{o}C$) before much growth occurs. Cold soil temperatures reduce the

microbial activity that converts humus materials into available plant food. Increasing soil temperature can indirectly increase soil fertility.

Natural Yukon soils are cold and generally low in plant nutrients. Soil management should concentrate on overcoming these two obstacles to vegetation and/or flower growth. The key to soil productivity is increasing the soil humus (organic matter) content and improving the soil temperature regime of your garden plot.

b) Fertility

Maintaining adequate levels of soil humus will aid in providing good soil moisture holding capacity, aeration and provide a storehouse for plant nutrients. With rare exception, soils in Yukon are low in available nitrogen and phosphorus and a high percentage of the potential agricultural soils are also low in available potassium. Sulphur is usually in adequate supply. These elements are the major fertility components required for all plant growth. In addition, some trace elements may be deficient. Most important of these is boron. The fertility requirements may vary considerably with different plants. It is necessary to know, with accuracy, the fertility requirements of the crop you intend to grow.

IV.2 Soil Salinity

Salinity refers to the soil condition where a build-up of water soluble salts (usually Na_2SO_4, or NaCl) occurs in the soil. Salts get into the soil through irrigation water, excessive addition of manure, or may be inherited in the soil material itself. Salinity is seldom a problem in outdoor gardens, but is common in greenhouses where there is a tendency to apply water in frequent, light applications. Evaporation from the soil tends to concentrate the soluble water-borne elements which remain behind and build-up as white precipitate on the surface.

There are three methods of reducing the impact of salts on plant growth. These are:

1) *diluting the soil by adding peat moss or other organic fiber (not manure),*
2) *leaching the soil - washing the salts out of the root zone by heavy continuous application of water,*
3) *removing the salt affected soil and replacing it with non-saline material.*

The size of the affected area and the type of garden will dictate which method to use to alleviate salt problems. There is no chemical treatment to reduce the effects of salt.

IV.3 Nutrient Requirements and Soil Testing

This publication suggests the fertility requirements under the general production recommendation for each vegetable group. If you plan a large garden, greenhouse or commercial vegetable project, a representative soil sample should be submitted to a reputable soil testing laboratory to determine the nutrient availability of the soils and to determine if trace elements (also known as micronutrients), specifically boron, are deficient.

IV.4 Organic Amendments

The fertility level of a soil may be improved mostly by the use of:

- *animal manure*
- *compost material*
- *green manure crops, commercial fertilizer or a combination of these*

The nutrient content of animal waste varies considerably with the type of livestock manure, the degree of dilution and the time it is exposed to air prior to incorporation with the soil. Manure and

compost materials should be incorporated as soon as they are spread on the soil to avoid unnecessary loss of nitrogen.

***Table** 5 details the components of some animal manures along with other organic amendments. This table is abstracted from the Manitoba Commercial Farming manual.*

Table 5
Animal Manures and their Components
lbs/ton (kg/tonne)

Animal	Nitrogen (N)	Phosphorus (P)	Potassium (K)
Cattle	10(5)	4(2)	10(5)
Goat	10(5)	6(3)	20(10)
Horse	14(7)	6(3)	10(5)
Swine	14(7)	12(6)	14(7)
Sheep	28(14)	14(7)	30(15)
Poultry	30(15)	20(10)	10(5)
Other Organic Materials and their Contents			
Bonemeal	40(20)	440(220)	0
Dried Blood	260(130)	20(10)	0
Compost (depending on materials used)	43(6)	27(14)	27(14)
Fish Meal	200(100)	100(50)	0
Wood Ashes	0	20(10)	100(50)
Sawdust	-4(2)	20(10)	4(2)

Manures also contain Boron, Calcium, Copper, Iron, Magnesium, Manganese, Sulphur, and Zinc in varying amounts.

Be careful to avoid the error of adding too much manure. This can result in an excessive buildup of nitrogen and sometimes salt in the soil. The effects of manure are generally long-term therefore manure every second year or keep annual addition to light applications.

IV.5 Inorganic Amendments

Commercial fertilizers are available in a variety of forms and composition. These plant nutrients are more concentrated than composts and manures, and the materials are usually easier to handle and apply mechanically. They do not, however, have the same soil-building properties or generally contain as many micro nutrients. Table 6 is a comparative example of the major nutrient components of commercial fertilizer. Compare the plant nutrient availability with those of the previous organic materials in pounds of nutrients per ton (kgs/tonnes) of material.

TABLE 6

NUTRIENT COMPONENTS OF COMMERCIAL FERTILIZER

FERTILIZER MATERIAL	NITROGEN (N) lbs/ton (kgs/tonne)	PHOSPHORUS (P)	POTASSIUM (K)	SULPHER (S)
Urea (46-0-0)	920 (460)	0	0	0
Ammonium Sulfate (21-0-0)	420 (210)	0	0	480 (240)
Mono-Ammonium Phosphate (11-48-0)	220 (110)	960 (480)	0	50 (25)
Muriate of Potash (0-0-60)	0	0	1200 (600)	0
Blend (8-24-24)	160 (80)	480 (240)	480 (240)	20 (10)

Manures and composts are generally too low in phosphorus for many vegetable crops. A combination manure and commercial fertilizer may be used to produce the balanced fertility level required. Commercial fertilizers may be blended to any required ratio.

V. SOIL PREPARATION

Soil tests should be carried out to determine the presence of N, P, K and S as well as minor elements such as boron, zinc and manganese.

V.1 Soil Sterilization

A perennial problem with many gardeners is the damping-off of seedlings in flats in the greenhouse. As the damping-off organism is soil borne, sterilization of the soil will decrease its numbers and therefore reduce losses associated with this disease. Small amounts of soil to be used for the production of seedlings for transplanting may be heated in an oven at 350°F (185°C) for 45 minutes. For information on soil sterilization for commercial operations, contact the Yukon Agriculture Branch in Whitehorse.

V.2 Tillage

Mechanical tillage equipment for commercial vegetable production varies considerably from plows, discs, cultivators or rotovators. Rotovators appear to be the most commonly used in Yukon. Soils should be thoroughly worked between the time of harvest and the time of planting the following year, particularly for root and tuber crops. Soils to be planted to carrots, turnips, parsnips and rutabagas should be worked to a depth of about 8 inches (20 cm). Soils for beets and potatoes may be worked 6 inches (15 cm) whereas soils for other crops may be worked 4 to 5 inches (12 to 12 cm) in depth.

It is suggested that deep tillage (4 to 8 inches) be done in the fall and only a shallow tillage operation (2 inches) be done in the spring. This will reduce soil moisture loss and result in a firmer seedbed.

V.3 Depth of Cultivation

The depth of cultivation is related to the depth of tuber or root development. The soil should be packed firmly around seed or transplants at the time of planting. This improves contact with roots and improves the transmission of heat and water.

VI. POST-ESTABLISHMENT PROCEDURES

VI.1 Post-emergence Cultivation

(a) Soil cultivation between rows in a garden helps to warm the soil and provide weed control.

(b) Depth of cultivation should not be more than 1/2 inch (1 cm) close to plants to avoid damage to the root system. In our cool northern soils, roots have a tendency towards shallow development.

(c) Avoid working in the garden when plants are wet to prevent soil compaction and reduce disease spread.

VI.2 Chemical Control of Weed, Diseases and Insects

FOR INFORMATION ON (CHEMICAL TOXICITY) PROTECTIVE CLOTHING AND EQUIPMENT, OBTAIN A BULLETIN FROM THE AGRICULTURAL BRANCH, BOX 2703, WHITEHORSE, YUKON, Y1A 2C6. PHONE: 667-5838

(a) Label directions - make sure you read the label carefully. If you are uncertain of the meaning of the directions indicated, contact the Agricultural Branch for advice.
Follow the directions carefully.

(b) Pesticide precautions - If a person suspects poisoning from exposure to a pesticide by swallowing, skin contact, inhalation or contact with the eyes, carry out the first aid treatment suggested on the container label. Immediately after first aid treatment the patient

should be taken to the nearest medical aid centre taking the pesticide label with you. Pesticides include all chemicals used for the control of weeds, insects and diseases of crops. Precautions which should be taken before using any pesticide:

1) *Read the label before opening a pesticide container and follow the directions precisely.*

2) *Do not smoke, chew tobacco, or eat while handling or applying pesticides. Do not carry food items in clothing used for applying pesticides.*

3) *Avoid spilling pesticides on skin or clothing. Remove clothing which has come in contact with a chemical spill immediately. Skin should be washed with soap and water immediately.*

4) *Always wash clothing and skin after applying or handling pesticides.*

5) *Avoid inhaling pesticides. Wear a mask recommended for the pesticide being applied.*

6) *Clean up pesticide spills immediately. Dry soil may be used to absorb liquid material in the case of small spills.*

7) *If symptoms of illness occur during or shortly after handling or applying pesticides, seek medical aid immediately.*

8) *Avoid contamination of water in wells, ponds, streams.*

9) *Disposal of pesticide containers and contaminated material should be carried out according to Yukon Territorial Government regulations for proper disposal.*

10) *Caution: it is an offense under the Federal Pest Control Products Act to use a control product under unsafe conditions, or for a use not included on the label.*

11) *Information on container labels which should be observed carefully:*

- *rate of application*
- *methods of application*
- *concentrations recommended when mixing*
- *preharvest waiting periods*
- *frequency of application*
  DO NOT EXCEED RECOMMENDATIONS ON LABELS
- *storage temperature recommended for the chemical*
- *incompatibility of mixing procedures or other chemical mixes*
- *antidote and emergency recommendations*
- *precautionary measures for safe use of the chemical*
- *residue problem which may arise from the use of the chemical.*

(c) *Diseases - **Table** 7, extracted from the Manitoba and Alberta Vegetable Production Guides, provides some hints for the control of garden diseases:*

TABLE 7

SOME COMMON GARDEN DISEASES AND METHODS FOR THEIR CONTROL

CROP	COMMON DISEASES	CONTROL
Asparagus	asparagus rust	Do not plant new asparagus in soil that previouly has asparagus.
Bean	sclerotinia White Mold	Plant beans in an area of the garden that has good air circulation; do not walk in garden when leaves are wet with dew or rain as diseases are spread easily in this manner.
Cabbage, cauliflower, broccoli, brussel sprouts	black rot, bacterial leaf spot	Use seed that has been hot-water treated and dusted with products.
	yellows	Plant resistant cultivars.
	clubroot	New cultivars are being developed that are resistant.
	black leaf spot	Chemical fungicide.
	downy mildew	Chemical fungicide.
Carrot	aster Yellows	Control the leafhopper insects that spread this disease.
	leaf spots, blight	Chemical fungicide.
Celery	early blight, late blight	Chemical fungicide.
	celery mosaic	Eliminate weeds which harbor the aphids that spread the disease.
Corn (sweet)	seed decay	Treat seed with an appropriate fungicide or plant when soil is warm.
	leaf blights, stalk rot	Plant in soil that has not had corn grown in it for 2 - 3 years.
Cucumber, melon, squash	bacterial wilt	Control cucumber beetles which spread this desease.
	angular leaf spot, cucumber mosaic virus, scab, anthracnose, powdery mildew.	Plant tolerant cultivars when possible.
Eggplant	verticillium wilt	Plant tolerant cultivars.
Lettuce	aster Yellows	Control leafhoppers
Onion	downy mildew, botrytis leaf spot	Chemical fungicide
	smut	Treat seed with appropriate fungicide
	soft rot, botrytis neck rot	Cure and dry onions properly before storing, store mature onions only.
	white rot	Long-term rotation
Pea	root rot, wilt	Use tolerant cultivars and rotation
Peppers	viruses, verticillium wilt	Control aphids, rotate, do not plant in ground that has had other solanaceous crop grown in it, e.g., tomatoes, eggplant, and potatoes.
Potato	early blight, late blight	Chemical fungicide
	leaf roll virous, leaf rolling mosaic	Control aphids
	seed-piece decay	Treat seed pieces with fungicide before planting or plant whole small tubers
Rutabaga	turnip mosaic virus	Control aphids
Spinach	downy mildew, mosaic virus	Use resistant cultivars
Tomato	early blight, late blight	Chemical fungicide
	virus diseases	Control aphids

Plant Disease Reminders

The prevention of plant diseases is probably among the most important measures that you might take in gardening. Some useful measures are as follows:

- *use fertile well-drained soil*
- *plant crops suited to the soil and local climate*
- *control weeds and grass which may provide protection for insects*
- *use disease-free seed*
- *use treated seed*
- *purchase healthy plants - free of root swellings, leaf spots, etc.*
- *plant disease-resistant varieties if possible*
- *remove plant refuse from fields annually and compost it*
- *stay out of the garden when it is wet as it leads to soil compaction and spread of disease*
- *avoid over-use of insecticides which may kill beneficial insects*
- *rotate crops and follow the general production recommendations*
- *remove individual diseased plants*

(d) *Insects*

If you wish to minimize the use of insecticides, there are several methods which may be helpful. Some of these are as follows:

- *destroy plant material in the fall which may harbor insect eggs, larvae or adults*
- *rotate crops*
- *use natural repellants*
- *avoid killing natural predators and encourage their development*

V1.3 Natural Control of Pests

Some gardeners prefer to minimize the use of chemicals. Table 8, taken from Manitoba Agriculture, may be of interest.

TABLE 8

NATURAL REPELLENTS and the PESTS THEY REPEL

VEGETABLE	NATURAL REPELLENT HERB	PEST REPELLED
Cabbage	Mint, Rosemary, Sage	Cabbage maggot
	Tansy, Thyme	Cabbage Worm
	Rosemary, Wormwood, Sage	Carrot Fly
	Wormwood, Mint	Black Flea Beetle
	Horseradish	Potato Bug
	Mint	Ants
	Santolina	Moths
	Tansy	Flies, Ants, Moths
	White Savory, Tansy, Sage	Most Insects
	Coriander, Marjoram, Wormwood	

VEGETABLE	NATURAL REPELLENT FLOWER	PEST REPELLED
Strawberry	Chrysanthemums	Most insects
Most Crops	Marigolds	Nematodes, white fly, most insects
Most Crops	Asters	Most insects
Most Crops	Chrysanthemums	Most insects
Most Crops	Calendula	Most insects
Most Crops	Geranium	Most insects

VEGETABLE	NATURAL REPELLENT VEGETABLE	PEST REPELLED
Asparagus	Tomato	Asparagus Beetle
Beans	Eggplant	Colorado Potato Beetle
Beets	Onion Family	Most Pests
Carrots	Onion Family	Carrot Fly
Carrots	Salsify	Carrot Fly
Cabbage	Tomato	Cabbage Maggot
Tomato	Garlic	Blight
Potato	Garlic	Blight
Most Crops	Onion Family	Most weeds

VI.4 The Law Weeder

Bert Law of Whitehorse has designed a light hoeing tool which can be effectively used for hoeing and "thinning". The implement consists of any regular mop style handle attached to a loop made of 3/4" to 1" (2 to 2.5 cm) light steel strap. The loop is attached to both sides of one end of the handle with light bolts or rivets. Both sides of the basal part of the strap are filed or ground to a sharp edge. This light strap hoe is particularly useful when weeds are in the seedling stage.

VII. COLD CLIMATE GARDENING TECHNIQUES

Focus on techniques of expanding the growing season to increase the number of crops that can be grown. Start with the simplest means and move into more complex methods. If you are contemplating commercial production, you will have to carefully weigh the costs and benefits of each approach.

VII.1 Site Selection

- *select a site of suitable soil with a southern sloping exposure*
- *the site should have air drainage (see section 1.2)*

VII.2 Ridging or Terracing

These practices increase soil temperature by as much as $4^{o}F$ ($2^{o}C$). Crops such as potatoes, carrots and rutabagas are most responsive. The soil may be formed into raised beds which are usually broad and flat on top. The resulting depression or ditches in between beds may be used to sub-irrigate the beds -- this method is called terracing. Ridging is sometimes used as a method of reaching moisture in dry soils. The soil is ridged and the seeds are planted in the bottom of the resulting furrow. This enables the gardener to reach moisture in dry soils. It also provides a depression to trap water in the vicinity of the seed placement.

VII.3 Mulches

Mulches are essentially different types of ground covers. They may be used to warm or cool soils as well as conserve moisture and discourage weed growth.

Black polyethylene - will smother weeds and conserve moisture, but will not appreciably increase soil temperature.

Clear polyethylene - will not smother weeds but will conserve moisture and can dramatically increase soil temperatures. 1 1/2 or 2 ml plastic offers good results at reasonable cost. Do Not use straw, manure, sawdust, or peat mulches in cold soils. These insulate the soil against the sun and reduce soil temperatures.

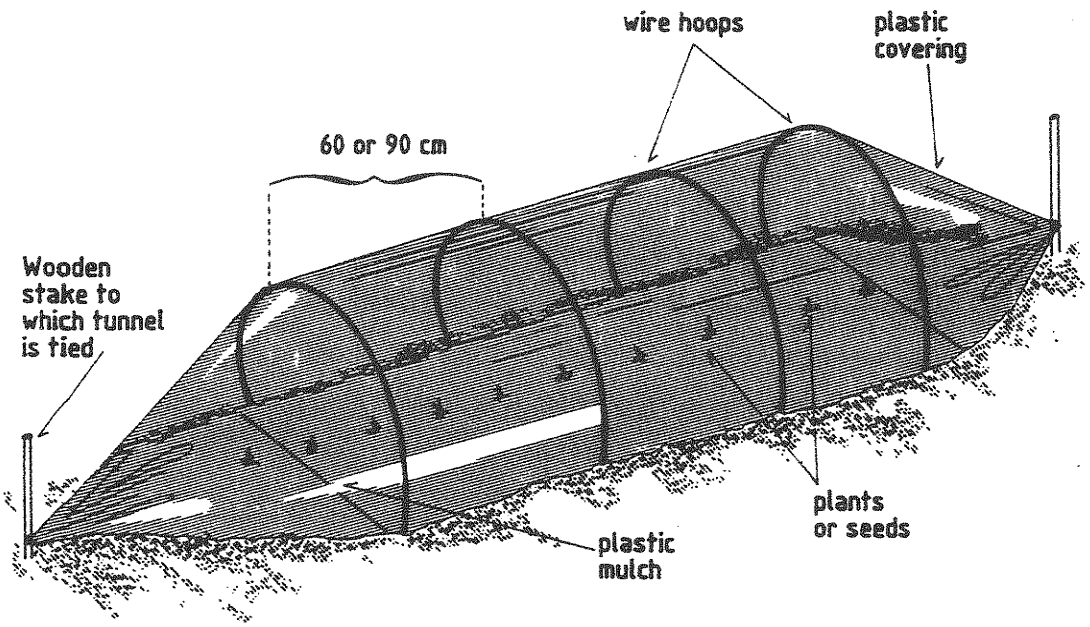
VII.4 Hot Caps

Transparent caps reinforced with wire act as small greenhouses allowing plants to be placed outside much earlier. If you use hotcaps, water plants and soil prior to covering. When the danger of frost is over, the caps should be removed.

VII.5 Row Coverings

These are most commonly constructed by the use of clear plastic over wire hoops. There is an increase in soil temperature by using a clear plastic mulch under a clear plastic tunnel. Do not forget that warm soil is more conducive to plant growth than warm air surrounding the top of the plant. Figure 2, extracted from the Alberta Vegetable Production Guide, provides some direction to assist in the construction of row covering.

Fig. 2 : Construction of Row Covering



Exerpt from Don Dinkel, Wassila, *Alaska and Alberta Vegetable Production Guide*

Suggestions in the construction and use of row coverings:

- *use clear plastic*
- *level the soil equivalent to the width of the plastic*
- *dig a trench along the edge and bury the plastic edges*
- *the plastic mulch should be firm and flat on the ground surface*

Suggestions in the construction and use of row coverings:

- *use clear plastic*
- *level the soil equivalent to the width of the plastic*
- *dig a trench along the edge and bury the edges. The plastic mulch should be firm and flat on the surface. 2 to 3 inch cuts in the centre of plastic are made to permit seeding or transplanting*

- *row covers should be built the same day as planting takes place*
- *wire hoops are placed in the ground about 30 inches (75 cm) apart.*
- *plastic strips should be cut about 1 foot (30 cm) wider than the cover section to permit about 6 inches (5 cm) on either side to be covered with soil*
- *make air holes with a hot iron (knife cuts have more tendency to tear with wind)*

Alternative method:

- *cut plastic mulch wide enough to cover 2 rows of plants with enough width to fold back over wire hoops. The plastic can be arranged with clothespins on the wire hoops to provide full or partial cover depending on weather conditions.*

Row coverings offer about $2^{o}F$ ($1^{o}C$) of frost protection. Their main uses are to warm soils and conserve moisture.

VII.6 Hot Beds

These may be useful in Yukon as:

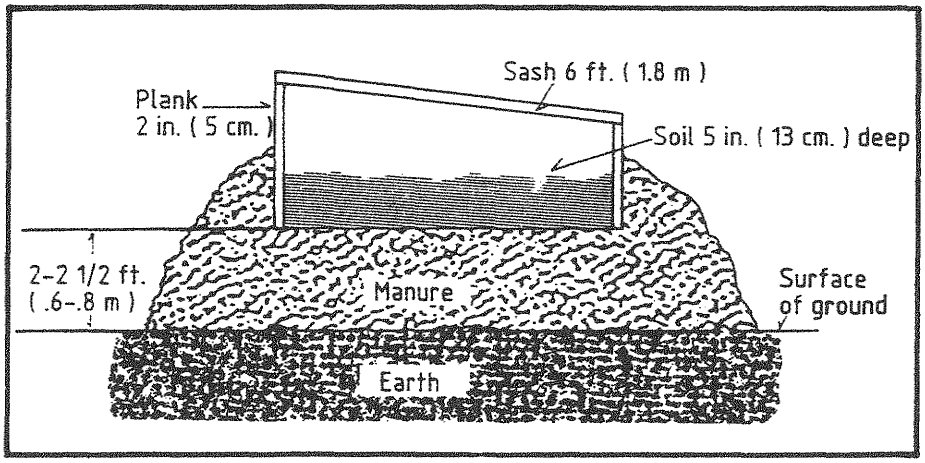
- *an intermediary step between the greenhouse and garden*
- *a method of extending the growing season and the supply of fresh vegetables.*

***Figure** 3, abstracted from Agriculture Canada's publication #1575, illustrates this practice.*

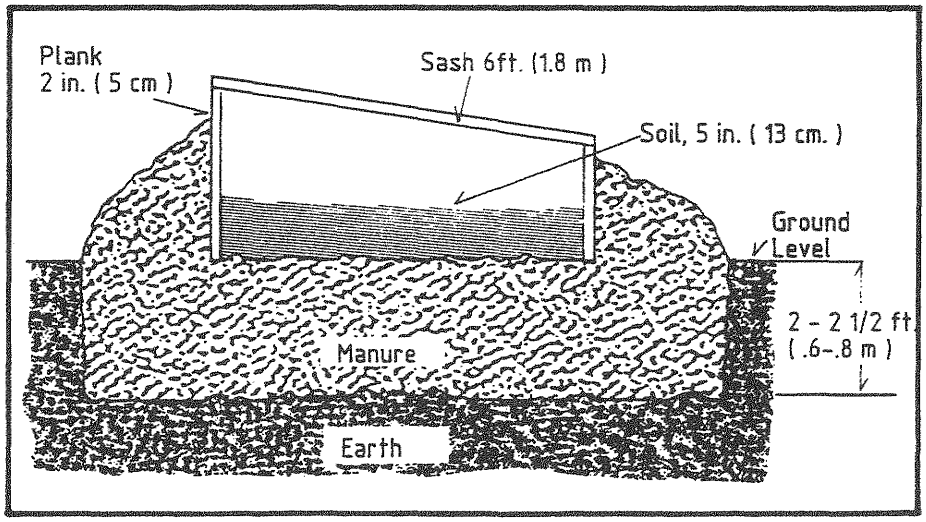
There are ways of extending the growing season through shelters, hutches and greenhouses. These may be built in a number of ways as evidenced throughout Yukon and Alaska. For information on the

construction of these shelters, contact the Yukon Territorial Agriculture Branch in Whitehorse.

Fig. 3 : Hotbed Construction



A surface hotbed in cross section.



A pit hotbed in cross section.

VIII. WATER

Different crops use varying amounts of moisture. Adequate moisture for the germination, development, yield and quality of a plant is essential. The moisture availability for crop use varies with soil texture. The moisture holding capacity is dependent on the size of the soil components and the level of organic matter in the soil.

It is important to follow proper irrigation practice. Generally, it is better to irrigate less frequently but more thoroughly so that soils are wetted throughout the root zone when water is applied. Frequent, light watering, particularly within a greenhouse may lead to a build up of salts on the soil surface with a resultant decline in production. Using well water high in alkalinity or sodium for irrigation purposes can accelerate this process of salinization. If you suspect poor water quality, have a water sample tested. The Agriculture Branch can advise you of its suitability for irrigation use.

Once crops are germinated, moisture stress should be avoided from flowering through seed formation and during head, bulb, root or tuber development.

The amount of moisture depletion should not be allowed to drop to less than 25% of the saturated moisture content in the case of surface, bulb or tuber crops and 50% in the case of root crops. Onions effectively draw moisture from 2 feet (60 cm) and carrots from 3 feet (90 cm). Onions require more frequent irrigation with less water per application. If the soil is kept moist at the time of tuber formation, an increase in number of tubers should result. There will also be a decrease in the size of tubers. Different crops use varying amounts of water at various phases of plant development. ***Table 9****, abstracted from the Alberta Vegetable Production Guide, indicates the irrigation requirements and moisture sensitivity of some vegetables.*

TABLE 9

IRRIGATION REQUIREMENTS OF VEGETABLES

Crop	Rooting Depth Metres (ft)	Allowable Depletion of Available Moisture* (%)	Comments
Beans (fresh market)	0.9 (3)	40	Beans are sensitive to moisture stress during the period of flowering to seed formation. A water-logged soil during flowering or pod formation stages will reduce seed yields and encourage the development of diseases.
Beans	0.9 (3)	50	
Beets	0.9 (3)	50	
Broccoli	0.6 (2)	30	Broccoli and cabbage are sensitive to moisture stress at all stages but most sensitive at the time of head formation and enlargement.
Carrots	0.9 (3)	40	Several small applications of water near the time of emergence will aid in obtaining a uniform stand. Carrots are sensitive to moisture stress during the root enlargement period. In fall, an excessively wet soil will encourage the development of soft rots.
Corn (sweet)	1.0 (3.2)	40	Corn is sensitive to moisture stress from tassel to seed formation stages.
Cucumbers	0.6 (2)	50	Available soil moisture should be kept above 60% after flowering begins.
Lettuce	0.9 (2)	25	Lettuce is sensitive to moisture during head formation. Excessive moisture in the seedling stage may cause seedlings to die off.
Onions	0.6 (2)	35	Irrigation water (light applications) may be needed early in the spring to aid the emergence of onions. Moisture stress during the bulb formation period will reduce the yield and the dry matter content. Not watering after the third week of August allows time for ripening of bulbs.
Parsnips	1.0 (3.2)	40	
Peas	0.6 (2)	30	Peas are most sensitive to moisture stress from the beginning of flowering through pod formation. Peas are sensitive to waterlogged soil.
Peppers	0.9 (3)	30	Moisture stress during flowering and fruit development will reduce yields of peppers.
Potatoes	0.8 (2.5)	30	Potatoes are sensitive to moisture stress from tuber formation until ripening of the vines begin. If the soil is kept moist at the time of tuber formation, this increases the number of tubers formed but reduces the average size of tubers. Late potatoes which do not suffer moisture stress will have a higher dry matter content. Potatoes grown for commercial purposes have a slightly higher allowable depletion level.
Tomatoes	0.9 (3)	40	Tomatoes are sensitive to moisture stress from the time of flowering through to full enlargement of the fruit.

* A crop that has an allowable depletion of 25% of the available moisture will require twice as frequent irrigation twice as often as a crop that has an allowable depletion of 50%, if they have the same depth of rooting and daily water use. Available moisture is the moisture that is held in the root zone between field capacity and wilting point.

1.1 Methods of Irrigating

a) Trickle - consists of supplying water at low pressure through porous tubing or multi-chambered tubing with closely spaced outlets.

Advantages:

- makes best use of available water
- minimizes evaporation
- places water where plants can make best use of it in a continuous supply
- operates on low pressure (5 - 15 psi)

Disadvantages:

- costly
- limited life of tubing (high annual cost)
- cannot be used for frost prevention
- labor intensive (only applicable to high value crops)

b) Sprinkler

Advantages:

- adaptable to most soils
- can apply large or small amounts of water as desired
- can be used for frost abatement

Disadvantages:

- *subject to effect of winds resulting in varied amounts of water being applied over a given area*
- *subject to air evaporation*
- *requires higher pressures to operate which increases power requirements and operating costs*
- *high initial cost of equipment*
- *increases foliage diseases*

Sprinkler systems vary in design:

(i) *Hand move systems using portable plastic or aluminum tubing are best suited to gardens, market gardens and small crops. These systems are most commonly used but are labor intensive.*

(ii) *Wheel Roll - suitable for vegetable production on larger acreages. Works well on rectangular fields - reduced labor requirements.*

(iii) *Volume Guns - suitable for use on oddly shaped fields but require high pressure and high energy costs to operate. The pattern can be severely affected by wind.*

(iv) *Centre Pivots - for large acreages of usually 160 acres or more. The main advantage is a reduction in required labour - provide automatic control of water application by varying the speed of movement of the system. This type of system will have limited use in Yukon because square fields and electric power are necessary for the efficient operation of these systems.*

VIII.2 Irrigation Design Considerations

a) Water Supply - 22,651 imperial gallons of water are required to apply one inch of water on one acre. For example: in order to pump 1 inch of water on 1 acre in 1 hour would require a pumping rate of 377 imperial gallons per minute. A water supply permit is required to use water for irrigation purposes.

b) Quality of Water - salts in water usually result in detrimental salt build-up in soil. The source of water intended for irrigation use should be tested for pH and salt content.

c) Size of Area, Crops to be Irrigated and Rainfall - these factors should be used to determine the size and type of equipment and the water supply requirements.

d) Shape of the Area to be Irrigated - will determine the design configuration.

e) Frequency of Irrigation - will depend on kinds of crops grown, rate of evaporation, soil type, and rainfall patterns for a specific area.

f) Power Sources Available - electricity, natural gas, diesel, water power.

g) Other Intended Uses - frost abatement; off-season applications.

h) Topography - undulating land may exclude Wheel Rolls while a relatively level field could be ditch or flood irrigated

i) Distance from Source - lift, operating pressure should be considered.

j) Costs in Relation to Value of Production

IX. VARIETY RECOMMENDATIONS

The recommendations are based on the suggestions submitted by Yukon gardeners and experimental results from the State of Alaska. Alaskan varieties will be highlighted by an asterisk. Those underlined, are varieties recommended by Yukoners. The remainder are varieties considered acceptable by some Alaska trials as well as some Yukon gardeners.

ASPARAGUS - Mary Washington, Viking 2k (Manitoba and Alberta)

BEANS (green) - Striker, Contender*, Scarlet Runner Provider*, Top Crop, Green Crop, (Wax) Jumbo Bush Wax, Improved Golden Wax*, Cherokee Wax.*

BEETS - Detroit Dark Red, Formanova, Ruby Queen, Firechief, Royal Burgundy.*

BROCCOLI - Green Comet, Green Valiant, Shogun*, Emperor*, Cleopatra, DiCicco, Bravo, Hybrid Green Duke, Premium Crop.*

BRUSSEL SPROUTS - Jade Cross E, Early Jade*, Early Crop*, Long Island Improved.*

CABBAGE - Green Acre, Hinova, Casio*, Winterkeeper*, Custodian*, Emerald Cross, Golden Acre, Early Jersey Wakefield, Emerald Acre, Quick Green Storage, Copenhagen, Stonehead, Red-Meteor, Rubyball*, Ruby Perfection*.*

CARROTS - Hinova, (Nantes Types), Touches Deluxe, Fedora, Kuroda Chantenay*, Royal Chantenay, Royal Danvers*, Scarlet Nantes Coreless, Little Fingers, Klondike Nantes, Orange Sherbert, Special Nantes 616, Chantenay Supreme, Canuck, Early Cross Hybrid.*

CAULIFLOWER - Snowball, Whiterock, Whitetop*, Andes*, White Summer, Stokes Extra Early Snowball, Snow Crown*, Snowball x and y, Early Abundance, Dominant*.*

CELERY - Golden Plume, Green Giant, Utah Green, Selfblanching, Snowball x and y*

CHARD - White King Chard.*

CORN - Polarvee, Early Vee*, Yukon Chief*.*

CUCUMBER - Sweet Slice, Dublin, Straight 8, China Long English, Farbiola, English Telegraph, Sweet Success, Euro-American*.*

GREEN PEPPER - Early Prolific, Hybrid Bell Box, California Wonder.

KALE - Dwarf Green Curled.

KOHLRABI - Early Purple Vienna, Grand Duke*, Azurstar*, Early White.*

LEEKS - Kilema, Leader, King Richard*.*

LETTUCE: *(Head) - Ithaca*, Seagreen*, Vanmore* (late, Great Lakes 659* (late), Minilake (early), Salad Bowl Ruby (red).*

(Leaf) - New York 12 (late), Black Seeded Simpson, Grand Rapids (early).

(Romaine) - Valmaine Cos (early), Parris Island**

ONIONS- *(Sets) - Yellow Dutch Danvers*
(Pickling) - Crystal Wax, Auiv, Perla Prima, Perennials Bunching*
(Green Onions) - Evergreen White, Hardy White*, Heshiko*.*

PARSLEY - Champion, Curlina, Bravour.*

PARSNIP - Hollow Crown, White Gem, All American*.*

PEAS - Sugarsnap, Homestead, Novela, Green Arrow, Grey Sugar Pea, Peter Pan, Lincoln (late)*, Improved Laxton's Progress (early), Extra Early Alaska.*

POTATOES - Norland, Gemseg, Norgold Russet*, Kennebec*, Purple Survivor, Yukon Gold, Viking, Superior(1).*

RADISH - Cherry Bell, White Icicle, Champion*.*

RUTABAGA/TURNIP - Laurentian, Altasweet, American Purple Top*.*

SPINACH - Longstanding Bloomsdale, King of Denmark, Melody, Popeye's Choice*, Skookum*.*

SQUASH - Trial.

TOMATOES - Earliest and Best Better Boy, Champion, Early Girl, Sub-Arctic Maxi, Tiny Tim, (1) Basket King*, (2) Pixie*, Toyboy*.*

ZUCCHINI - Select, Aristocrat, Gold Rush.

X. PRODUCTION RECOMMENDATIONS

X.I Asparagus:

a) Seedling Production

Plant seed 1 to 1 1/2 inches deep (2 - 4 cm) and 3 to 4 inches (7 - 10 cm) apart in rows 24 inches apart in May. The following year, select plants which have produced at least 10 roots for transplanting, dig a furrow 6 to 8 inches (15 - 20 cm) deep and space plants 12 to 18 inches (30 - 45 cm) apart in rows 4 to 5 feet (1 - 2 m) apart. Spread roots and cover with 2 inches (5 cm) of soil. As the plants grow gradually fill in furrows until they are level with the rest of the garden.

b) Fertilizer

Soil testing is critical to determine your fertilizer requirements. Apply a liberal application of horse or cow manure if available. A rate of 30 tons per acre (125 - 150 lbs per 100 square feet). If poultry manure is used, reduce the rate of application to 10 tons per acre (40 - 50 lbs per 100 square feet). If no manure is available use commercial fertilizer at the rate of 100 lbs nitrogen, 100 lbs phosphorus and 100 lbs potassium per acre. (example: apply a rate of 600 lbs of 17-17-17 per acre or 1.5 lbs per 100 square foot).

c) *Irrigation*

Asparagus should receive 1 inch (2.5 cm) of water or rain every 10 days during the harvest period. In addition, the plants should receive 2 inches (5 cm) of water after harvest and another inch (2.5 cm) of water at the end of the growing season.

d) *Harvest and Storage*

Usually no harvest should be taken until the third year. The spears are cut 1/2 inch below the soil surface with a sharp knife when they are 5 to 8 inches (15 - 20 cm) long. Fresh cut spears should be refrigerated or consumed as quickly as possible after cutting. A well-tended asparagus bed should produce for many years.

e) *Other Recommendations*

Retain asparagus fern through the winter as a snow trap. Dispose of fern early in spring by cutting by hand or mowing.

IX.2 *Beans (Green or Wax):*

a) *Seedling Production*

Plant seeds 1 1/2 to 2 inches (4 to 5 cm) apart and in rows 2 to 3 feet (.5 - 1 m) apart.

b) *Fertilizer*

Beans are legumes and are therefore associated with nitrifying bacteria. These convert nitrogen from the soil air into forms which the plant can use. These bacteria are available as inoculants from garden centres and seed houses. The specific bacterial inoculant should be utilized. Heavy applications of manure will have a tendency to delay maturity of pods. If you intend to use commercial fertilizer, use 8-24-24 at 200 to 300 pounds per acre (1 1/2 pounds per 100 feet of row) sidebanded.

c) *Disease Control*

Use a 3-year crop rotation, rotating with non-susceptible crops such as beets, onions and cereals. Do not work in the garden when it is wet. Diseases - anthracnose, bacterial blights, white mold, gray mold, and other soil-borne root rots.

d) *Irrigation*

Moisture requirements are critical from the bud stage to harvest. One inch of water per week during this period would probably be required in most areas of Yukon.

X.3 *Cabbage, Cauliflower, Broccoli, Brussel Sprouts:*

a) *Seedling Production*

If necessary treat seed with Thiram or Captan and plant about 3/4 inch (2 cm) deep. Transplanting should be done in rows 36 inches (91 cm) apart.

Spacing between plants within the row is as follows: Cabbage 18 inches (45 cm), Cauliflower 18 - 24 inches (45 - 60 cm), Brussel Sprouts 20 - 24 inches (50 - 60 cm) Broccoli 6 inches (15 cm).

b) *Fertilizer*

Use horse or cattle manure at 30 tons per acre or poultry manure at 10 tons per acre (150 lbs/100 square foot and 50 lbs/100 square foot respectively). Commercial fertilizer may be applied at a rate of 100 lbs of N, P and K per acre. Example: 600 lbs of 17-17-17 would provide 102N-102P-102K lbs per acre (or 1.2 pounds per 100 square foot). Plants of the cabbage family respond well to nitrogen and phosphorus. Fertilizer may be applied through the season rather than as one application at planting time. Example: at transplanting time use a starter solution of 1 lb of 17-17-17 or 20-20-20 per 10 gallons of water and apply to 160 transplants. Additional nitrogen may be applied between the rows about one month after transplanting (100 lbs of 34-0-0/acre or 1/4 lb of 34-0-0 per 100 square foot).

c) *Disease Control*

i) *Treat seed with Captan or Thiram before planting in flats of sterilized soil warmed to 60^{o} F (16^{o} C). Do not water seedlings in latter part of the day. This practice may reduce the incidence of damping-off, wirestem, downy mildew, blackleg and black rot.*

ii) *Avoid injury to plants in cultivation and harvest. This will increase the storage life of the vegetable*

and reduce the incidence of diseases such as soft rots.

iii) Rotate with unrelated crops on a 3-year rotation pattern.

d) Insect Control

Root maggots - These are particularly obnoxious insects. Other insects which can cause damage to plants of the cabbage family are:

- *cabbage loopers*
- *cutworms*
- *aphids*
- *flea beetles*

Methods of pest control:

i) Cultural and mechanical
ii) The use of natural repellants. The interspersing of rows of garlic, onions, asters, marigolds, mint, sage, etc., has a repelling effect on many insects as does ash (see Table 9).

e) Harvest and Storage

Some tips for extending the storage life of these vegetables:

- *reduce field heat of vegetables as quickly as possible - this applies to any vegetables. This is necessary to maintain quality and color.*

- *cabbage and brussel sprouts should be stored at a temperature near 32°F (0°C) and humidity should be maintained near 100%.*

- *cauliflower should be harvested before heads begin to separate and "rice". Tie up leaves to maintain a white curd.*

- *broccoli heads should be harvested before yellow flowers appear on the bud clusters (the terminal bud is the largest and forms first, followed by lateral bud formation).*

f) *Other Recommendations*

- *Head splitting - is caused mainly by lack of proper watering.*

- *Cauliflower buttoning - is the formation of a small head before the plant is mature enough to support it. The causes may be:*

  - *unbalanced soil fertility*
  - *low moisture supply*
  - *extreme temperature changes and cold and moist climate 39 - 50°F (4° - 10°C) for periods of 10 days or more.*

X.4 Carrots

a) *Seedling Production*

A deep seed bed is required for the uniform development of root vegetables. For carrots, soil should be worked to a depth of 8 to 10 inches

(20 -35 cm) preferably in the fall of the previous year.

i) Spacing - 1/2 - 2 feet (45 - 60 cm) between rows with 10 to 15 plants per foot (30 cm) of row. Banks of rows planted closer together may also be effectively used providing you maintain sufficient moisture and fertility.

ii) Depth of Seeding - 1/2 to 1 inch (1.5 - 2.5 cm) is usually sufficient.

b) Fertilizer

Carrots respond well to phosphorus. An application of 250 lbs per acre of 8-24-24 (1 1/2 lb per 100 ft. of row) sidebanded near the row should stimulate growth.

c) Weed Control

Hand pulling of weeds in the row should be done when the soil is moist to avoid disturbing the root system of young carrots.

d) Diseases

Aster Yellows - a virus infection transmitted by leaf hoppers - no chemical control

e) Irrigation

Carrots do not tolerate drought well. They need steady and large amounts of water for optimum growth. In the seedling stage carrots are sensitive to high temperatures and to soil crusting at the time of emergence.

f) *Harvesting and Storage*

- *harvest under cool conditions*
- *prevent drying from field to storage*
- *cool carrots as rapidly as possible after harvesting*
- *maintain storage temperature at ($32^{0}F$) $0^{0}C$ and humidity at 100%*

g) *Special Problems*

Greening - hilling should be done to avoid exposure of the shoulder of the carrots to sunlight.

Off-Shape Carrots - may be caused by:

- *lack of uniformity of stand*
- *improperly prepared seed bed*
- *excess moisture at certain periods*
- *excess packing of soil*

Crop Rotation - At least 2 years between successive carrot crops. You may rotate with onions, beets, cereals. Avoid rotating with beans, lettuce, parsnip or crops of the cabbage family, peas, cucumber or celery as all of these crops are susceptible to similar mold infestations.

X.5 *Celery:*

a) *Seeding Production*

Use treated seed. If the seed has not been treated, treat with a fungicide such as Thiram before planting in flats. The germination of celery is slow and may take up to 20 days from seeding. Plant flats 10 to 12 weeks before expected transplanting to field or

garden. Prolonged cool periods can result in "bolting" of celery plants. In order to develop sturdier celery plants, the tops of the plants may be clipped once or twice while they are in the flats.

b) *Fertilizer*

Celery responds to high rates of nitrogen. Use 10 tons of poultry manure per acre (50 lbs per 100 feet of row) chemical fertilizers - use 200N-100P-100 per acre - suggestion - mix 2 parts of 17-17-17 with 1 part of 34-0-0 and apply as a sideband application at 100 lbs per acre (2 lbs per 100 ft of row) - plant rows 2 feet apart. Boron deficiency will usually cause crooked shanks. Borax at 10 lbs per acre will rectify this.

c) *Diseases*

Diseases such as early and late blights, black heart and aster yellows may infect celery. Aster yellows infection is transmitted by leafhoppers.

d) *Harvest and Storage*

Cut celery 1 to 2 inches (2.5 to 5 cm) below the crown, trim the outer coarser leaves and reduce field heat as quickly as possible. Celery may be stored for up to 2 months at 32°F (0°C) and 95% humidity.

X.6 *Corn*

This is a crop which requires special treatment to grow in the home garden. It is doubtful that sweet corn can be grown economically on a commercial scale at this time.

Anyone who is interested in growing corn might contact the Agricultural Branch of the Yukon Territorial Government in Whitehorse.

X.7 Lettuce

This is a cool-weather crop which produces best at temperatures of 60 - 64°F (15 - 18°C). It will also withstand freezing temperatures as low as 21°F (-6°C). Transplants should be started about 8 weeks before transplanting to garden or field.

a) Seedling Production

Head and Butterhead lettuce should be planted about 10 inches (25 cm) apart in rows 1 foot (30 cm) apart. Head lettuce should be transplanted in rows 18 inches (45 cm) apart with 18 inches (45 cm) between plants in the row.

i) *Direct Seeding - Thin lettuce about two weeks after emergence to permit plant development.*

b) Fertilizer

Apply 2 tons of poultry manure or 10 tons of horse or cattle manure per acre. (15 lbs poultry manure or 50 lbs horse manure/100 square feet). If using commercial fertilizer, apply 100-100P-100K per acre = 600 lbs of 17-17-17per acre (1 1/2 lbs per 100 square feet).

c) Weed Control

Hand or mechanical weeding only. There are no recommended herbicides for lettuce.

d) Diseases

Head lettuce - cool dry conditions during the moisture period will prevent the breakdown of head lettuce by bacterial rots (example - slime rot).

Botrytis, Rhizoctania and Sclerotina fungus infections of lettuce may be avoided or reduced by:

- working under lettuce crop refuse promptly after harvest
- avoid poorly drained soil areas
- avoid over-crowding of plants
- discard infected heads
- follow a 3-year crop rotation

e) Insect Control

Insects are not usually a problem with lettuce in the north. Insects which sometimes cause trouble are aphids, leafhoppers, cutworms.

X.8 Onions

a) Seedling Production

Plant seeds to a depth of 1/2 to 3/4 of an inch (1.5 to 2 cm). Seeding or planting date should be as early as land can be prepared.

i) *Spacing - rows may be planted 15 to 18 inches apart (35 - 45 cm) depending on equipment available for cultivation. Seeded onions should be thinned to an extent, depending on use intended.*

b) *Fertilizer*

In Yukon an application of horse manure at 20 tons per acre or poultry manure at 6 tons per acre could provide most of the nitrogen requirements for onions. If manure is not available, commercial fertilizer at 100N-100P-100K per acre will probably serve the purpose (600 lbs of 17-17-17 per acre = 2 lbs per 100 foot of row). The fertilizer should be side-banded.

c) *Weed Control*

Hand weed and hoe small plots.

d) *Irrigation*

Onions are shallow rooted and susceptible to dry soil conditions. Any setback from lack of moisture could result in:

- *early maturity of bulbs*
- *lack of bulb size*
- *lower yields*

e) *Harvest and Storage*

If onions are dried in the field they should be well cured before placing in storage. Provide air circulation to keep them dry during storage. Onions

store well at temperatures varying from 32 - 55°F (0° - 13° C). A constant storage temperature is more important than the actual temperature.

X.9 *Parsnip:*

a) *Seedling Production*

Seeding depth should be 1/2 - 1 inch (1.5 - 2.5 cm).

i) *Spacing - rows should be 18 - 24 inches (45 - 60 cm) apart.*

b) *Fertilizer (Same as for carrots)*

c) *Weed Control (Same as for carrots)*

d) *Disease Control*

Sclerotinia Rot. Handle the crop carefully to avoid wounds. Disinfect the storage area using 2% solution of copper sulphate (bluestone). Rotation crops can include beets, cereals, and onions.

X.10 *Peppers*

a) *Seeding Production*

Peppers are a greenhouse plant in Yukon. If you intend to grow peppers in the garden or field, start plants in the greenhouse 9 or 10 weeks before transplanting. Plastic covers are required to maintain vigorous growing temperatures of 77 - 86°F (25 - 30°C). If you attempt to grow peppers without cover, the plants should be temperature hardened before planting in the garden or field. To do this

reduce thewater supply and allow the temperature to drop to about 60°F (15°C).

i) Spacing - plant rows 2 - 2 1/2 feet apart (50 - 65 cm) and allow about 18 inches (45 cm) between plants in the row.

b) Fertilizer

Apply a starter solution at time of planting in the field or garden. The starter solution may be prepared by mixing 1 lb of 11-48-0 with a 1/2 lb of 0-0-62 in 10 gallons of water.

Field fertilizer application - 50N-100P-50K per acre (mix 1 lb of 11-48-0 or 11-55-0 with 3 lbs of 17-17-17 and apply 1 lb of the mixture per 100 square feet).

c) Disease Control

Verticillium wilt may become serious unless a proper 3 or 4-year rotation is used with non-susceptible crops. Avoid rotating with tomatoes, eggplant, sweet clover and potatoes.

d) Harvest and Storage

Peppers will store only briefly. Temperature should be kept at 45 - 50°F (7 - 10°C) and humidity at 85 - 90%.

X.11 Potatoes:

a) Seedling Production

Seed potatoes may be purchased as foundation stock from potato seed grower associations or from reputable local outlets, and should be purchased each year to avoid build-up of viruses, blackleg and ringrot, etc. Check with the Agricultural Branch for sources. Large tubers should be cut before planting. If you intend on cutting tubers for planting, disinfect your knife by dipping it in alcohol between potatoes to prevent disease spread. Care should be taken in cutting seed tubers to make sure that at least 1 eye exists on each seed piece. Seed pieces should be 1.5 - 2 ounces in weight in order to produce vigorous plants.

i) *Soil Preparation - soil should be worked thoroughly to a depth of 4 - 5 inches (10 - 12 cm) before planting. This practice will tend to warm the cool Yukon soil. Seed pieces should be planted to a depth of 2 - 3 inches (6 - 7 cm), keeping in mind that the upper layers of soil are warmer and this is important for germination and early development of plants. Seed potatoes may be green-sprouted by exposure to light before planting. This practice may reduce the time from planting to plant emergence by a week or more. This practice is more suitable for home garden production.*

ii) *Spacing - row spacings of 30 inches (75 cm) or more are generally satisfactory with plants spaced from 1.5 - 2 feet (45 - 60 cm) in the row. The*

interplant spacing may be reduced when irrigation is available. About 600 - 700 lbs of seed potatoes would be required to plant 1 acre at this spacing.

b) *Fertilizer*

Livestock manure should not be used on the year of planting for potatoes, and some other root crops if you with to avoid scab infection - use peat moss. Application of manure sponsors the development of scab infections as it raises pH. Potatoes should follow a minimum 3-year rotation to reduce diseases. Manure should be applied the year following potatoes in the rotation. Anything that raises pH tends to induce scab, depending on original pH, and vice versa.

If potatoes are to be grown commercially, a soil test should be taken to obtain information on the availability of plant nutrients, soil suitability and fertility recommendations. Otherwise a general application of 80N-80P-80K per acre may be used (500 lbs of 17-17-17 per acre). All commercial fertilizer should be side-banded for most effective results.

c) *Weed Control*

Surface cultivate close to plants to avoid damaging the root system. Cultivating for weed control should be done often enough to destroy weeds before they grow much beyond the seedling stage.

i) *Hilling - should be done gradually. Increase the "hilling" to cover the developing tubers.*

d) *Diseases*

- *rotate crops - minimum 3 years*
- *disinfect all potato equipment*
- *disinfect potato storage areas*
- *dispose of culls*
- *plant disease-free certified seed*

e) *Harvest and Storage*

The greatest single cause of loss of marketable tubers is mechanical damage. Most of the mechanical damage occurs during the harvesting operation and in the handling from field to storage. Most organisms that attack potatoes cannot penetrate the unbroken skin. Cuts and bruises should be kept to a minimum when handling potatoes.

X.12 *Radish:*

a) *Seedling Production*

Sow seeds 1/2 inch deep as soon as land can be worked in spring. Plant consecutively to increase the marketing season. Radishes will grow well on peat soils through out the summer. Rows may be quite close and radishes may be thinned to 1 per inch (2.5 cm) in the row.

b) *Fertilizer*

Use 50N-50P-50K per acre (3 tons of poultry manure or 8 tons of horse manure)

c) *Weed Control*

No recommended herbicides - weed by hand.

X.13 *Rutabagas:*

a) *Seedling Production*

Planting should not be deeper than 1 inch (2.5 cm).

i) *Spacing - rutabagas should have at least 2 feet of space (60 cm) between rows. Plants should be thinned to about 5 inches between plants while they are in the seedling stage.*

b) *Fertilizer*

Rutabagas do not require as much fertility as other root vegetables. Excess fertility can cause rapid growth and cracking at the shoulders. A fertilizer rate of 20N-20P-20K in lbs per acre should suffice.

i) *Boron Deficiency - may cause water core or brown heart. Borax may be applied at 10 lbs/acre.*

c) *Insect Control*

Root maggots are probably the most important insect problem in turnips and rutabagas and other root crops in Yukon. The recommended use of chemicals in each case is much the same. Chemicals which are useful are Dasanit 15 granular at 1.3 ounces per 100 feet of row - apply in a 6 inch band (15 cm) and work into

the top inch of soil. Plant seeds in the centre of the treated band.

d) Harvest and Storage

Rutabagas may be stored up to 8 months at 0^{o} and 95% humidity. When removing tops for storage, do not cut into the crown. Side roots may be removed. Waxing will keep roots from dehydrating.

X.14 VINE CROPS:

X.14.1 Cucumbers:

a) Seedling Production

Cucumbers are frost tender and should be grown in flats and transplanted to the field or garden in Yukon. Transplanting should be delayed until after spring frost danger is over. In most areas this crop will be confined to the greenhouse.

i) Spacing - 4 feet (1.2 m) between rows and 1 foot (40 cm) between plants in the row is a suggestion.

b) Fertilizer

As a starter solution use 1 lb of 11-48-0 or 11-55-0 dissolved in 10 gallons of water. 2 cupfuls of the starter solution per plant should assist plant establishment. Side band 75lbsN-75lbsP-75lbsK per acre (approximately 5 lbs of 17-17-17 per 100 feet of the row). Horse manure or compost may be applied and incorporated at 15 tons per acre (15 tons per

acre, 35 lbs per 100 square foot) or poultry manure at 5 tons per acre (12 lbs per 100 square foot).

c) *Disease Control*

Follow a 3-year rotation and destroy vines after harvest.

Bacterial Wilt - (cucumbers, pumpkins, squash) usually transmitted by insects - control the insects.

Damping-Off - use treated seed to plant in starter flats - seed treatments are Captan or Thiram.

d) *Irrigation*

Cucumbers require good moisture throughout the growing season. Wet the soil to 6 - 12 inches (15 - 30 cm) right after transplanting. Good moisture availability is necessary, particularly at flowering and fruit development stages.

e) *Harvest and Storage*

Cucumber may be stored for 7 - 10 days at 41 - 45°F (5 - 7°C). Moisture loss is a problem.

Squash and Pumpkin

Zucchini Types
Vegetable Marrow Types — *Summer Squash*
Scallop Types

Acorn Types
Butter Cup Types — *Winter Squash*
Hubbard Types

h) Other Recommendations

i) Pollination (All Vine Crops) - pollination depends on insects to transfer pollen from male to female blossoms (these are borne separately on the same plant). Honeybees are particularly useful in this process.

X.14.2 Pumpkin:

a) Seeding Production

Use only treated seed - if seed is not treated, Captan or Thiram may be used according to manufacturer's recommendations.

i) Planting - squash and pumpkin are warm-weather crops - there are few places in Yukon where these crops can be grown successfully under field conditions.

ii) Spacing - rows should be 6 feet (2 m) apart and plants 2 - 3 feet apart (60 - 90cm) in the row).

iii) Pollination - similar to cucumbers

b) Fertilizer

Similar to cucumbers except that added nitrogen will help when plants start to run. Rate should be approximately 1/2 lb per 100 feet of row.

c) *Weed Control*

Shallow intertilling for weed control prior to vining - hand hoe within rows.

d) *Irrigation - similar to cucumbers*

e) *Harvest and Storage*

Zucchini and Marrow have a storage life of 7 to 10 days.

Winter Squash and Pumpkin can be stored for extended periods at 41 - 45°F (5° - 7°C) and humidity of 70 - 75%. Cure at room temperature for 7 to 10 days prior to storing.

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