CLIMATIC REQUIREMENTS

Vegetables originated in different parts of the world: some came from tropical or subtropical countries and others from temperate zones; some from humid areas and others from more arid climates.

Each kind of vegetable has its own optimum growth requirements, with some more fastidious, and others less so. Breeding and selection of new cultivars have allowed for a greater adaptability to less favourable growing conditions than was possible in the past, but the inherent climatic requirements of a specific kind of vegetable have not changed materially. The following climatic factors are important :

Temperature

Temperature is the most important climatic factor to be considered in vegetable production. It determines when and where a certain crop can be grown, and vegetable crops can be broadly classified according to their temperature requirements. However, such groupings should not be seen as absolute, because of various factors:

Sudden extremes of temperature are much more harmful than more gradual ones.

Susceptibility to cold or heat may vary according to the growth stage of the crop. Cabbage and lettuce are most prone to frost damage at the heading stage, green peas at the flower and young pod stage, and so on.

Cultivars of a specific vegetable differ in their tolerance to temperature extremes. For example, Wintercrisp is a good lettuce cultivar when grown during the cooler months. However, for summer production, Commander would be a better choice. So, also, Hercules cabbage is grown over the summer months, because of its relative heat tolerance; Green Coronet has proved to be a good cultivar for winter production.

In spite of such factors, the following information can be helpful in determining probable production seasons for various vegetable crops. Reliable temperature records must be available for the production site.

Table 1.
Classification of certain vegetable crops according to their adaptation to field temperatures.

A. COOL-SEASON CROPS		
1. *Hardy (can withstand moderate frosts)*		
Asparagus	Garlic	Radish
Broad bean	Horseradish	Rhubarb
Broccoli	Kohlrabi	Spinach
Brussels sprouts	Mustard	Turnip
Cabbage	Parsley	
Chive	Pea (flowers & pods are more sensitive to frost)	
2. *Half-hardy (can withstand light frosts)*		
Beetroot	Chinese cabbage	Potato
Carrot	Globe artichoke	Swiss chard
Cauliflower	Lettuce	
Celery	Parsnip	
B. WARM-SEASON CROPS		
1. *Tender (sensitive to frost and low temperatures)*		
New Zealand spinach	Sweet corn	Tomato
Green bean		
2. *Very Tender (very sensitive to low temperatures)*		
Chili	Okra	Sweet pepper
Cucumber	Pumpkin	Sweet potato
Eggplant	Squash	Vegetable marrow
Lima bean	Sweet melon	Watermelon

Some crops can be planted as temperatures approach the correct tolerance range. For example, broccoli or cauliflower may be planted in hot weather in summer in order for the crop to mature in cooler, more favourable conditions. The ideal temperatures for various vegetable crops are listed in Table 2. It must be borne in mind, however, that crops can survive and still produce good yields, even though temperatures at times may, for short periods, fall outside the minimum and maximum ranges listed.

Table 2.
The approximate temperatures for best growth and quality of some vegetable crops.

Mean Monthly Temperatures (°C)			Vegetables
Optimum	**Minimum**	**Maximum**	
Cool Season Crops			
12 - 24	7	29	Chive, Garlic, Leek, Onion, Shallot
15 - 18	5	24	Beetroot, Broad bean, Broccoli, Brussels sprouts, Cabbage, Horseradish, Kohlrabi, Parsnip, Radish, Spinach, Swiss chard, Turnip
15 - 18	7	24	Artichoke, Carrot, Cauliflower, Celeraic, Celery, Chinese cabbage, Lettuce, Mustard, Parsley, Pea, Potato
Warm Season Crops			
15 - 21	10	27	Lima bean, Green bean
15 - 24	10	35	Sweet corn, New Zealand spinach
18 - 24	10	32	Pumpkin, Squash, Vegetable marrow
18 - 24	15	32	Cucumber, Muskmelon, Sweet melon
21 - 24	18	27	Sweet pepper, Tomato
21 - 29	18	35	Chili, Eggplant, Okra, Sweet potato, Watermelon

Note : At temperatures below about 7°C, many of the biennial crops (beetroot, broccoli, cabbage, carrot, cauliflower, celery, parsley, parsnip, spinach, Swiss chard and turnip) may be stimulated into producing seed prematurely. The severity of bolting induced is dependent on the degree and length of the cold period experienced. Cultivars of each vegetable react differently from one another.

Conversely, a crop such as lettuce may be induced to bolt to seed when temperatures rise above 30°C. At such high temperatures, particularly under dry or windy conditions, vegetable crops such as beans or tomatoes may shed some of their flowers, with a resultant poor fruit set. High temperatures may also detrimentally affect pollination of sweet corn, and give rise to poorly-filled ears. Cucurbits (the pumpkin and squash family) tend to produce mainly male flowers under high temperature conditions; as a result few fruits are set.

Prevailing temperatures also play a role in the speed of germination and emergence of vegetable crops, as can be seen from Table 3, and can also affect the plant stand (percentage emergence).

Table 3.
The number of days to emergence of various vegetable crops, from seed sown 12 mm deep, at various soil temperatures.

Vegetable Crop	Soil Temperature (°C)						
	5	10	15	20	25	30	35
Celery	41	16	12	7	N	N	N
Lettuce	15	7	4	3	2	3	N
Spinach, true	23	12	7	6	5	6	N
Radish	29	11	6	4	4	3	-
Pea	36	14	9	6	6	6	-
Parsnip	57	27	19	14	15	32	N
Cabbage	-	15	9	6	5	4	-
Cauliflower	-	20	10	6	5	5	-
Parsley	-	29	17	14	13	12	-
Beetroot	42	17	10	6	5	5	5
Carrot	51	17	10	7	6	6	9
Onion	31	13	7	5	4	4	13
Asparagus	N	53	24	15	10	12	20
Sweet corn	N	22	12	7	4	4	3
Tomato	N	43	14	8	6	6	9
Turnip	N	5	3	2	1	1	1
Bean, green	N	N	16	11	8	6	6
Cucumber	N	N	13	6	4	3	3
Muskmelon	N	N	-	8	4	3	-
Watermelon	N	N	-	12	5	4	3
Bean, lima	N	N	31	18	7	7	N
Pepper, sweet	N	N	25	13	8	8	9
Okra	N	N	27	17	13	7	6

N = No germination likely **-** = Not tested

From the table one can see that the cool-season crops have poor germination at temperatures of 35°C (celery 25°C), and that seed of warm-season crops lose germination ability at temperatures of 10°C or lower. For most vegetable crops, a mean soil temperature

of 20°C to 30°C appears to give the most rapid emergence.

This fast emergence is most important for the following reasons:

There is less time for pathogenic soil organisms to attack seeds and emerging seedlings, and thus a better plant stand results.
Less energy is expended in emergence, and stronger plants develop.
The cropping season is not unduly delayed.

Rainfall and humidity
Rainfall is one of the most important factors, especially when vegetables are grown under dryland conditions. Adequate soil moisture is necessary for good crop establishment, good yields and good quality. This moisture may be obtained from rainfall or irrigation. High rainfall episodes may cause flood damage, partial drowning on certain soil types, and will often favour disease development.

Humidity, or air moisture content, may also play a role. High humidity tends to temper the effects of high temperatures. Crops such as cucurbits prefer dry air and a high temperature, while leafy vegetables such as cabbage and lettuce prefer more humid conditions. High humidity is more conducive to heavy dew at night, which can be beneficial in reducing moisture stress, but which can favour the development of certain diseases, such as leaf rust and leaf spots, on some crops.

Sunshine and day-length
The day-length, or period of sunshine each day, may have a tremendous influence on the productive capacity of vegetable crops. As a classic example, one could cite the case of onions, where long-day cultivars will bulb only when planted below latitudes where summer daylight hours are long enough. Cloud or mist might also reduce the amount of light a crop receives, and thereby lower the potential yield of the crop.

Wind
Wind can cause significant damage from mechanical injury to plants, increased transpiration of plants and desiccation of the soil. On very sandy soils wind-blown grit can cause severe damage to plants. Obviously, very windy areas should be avoided as far as possible, unless adequate provision is made for the establishment of windbreaks.