

Horticulture Produce Cooling

Introduction

All horticultural crops have a limited storage life when kept in ambient atmospheric conditions. This storage life varies considerably for various types of produce. For example strawberries have a



storage life of only a few days, whilst potatoes can be stored for a few months.



Cool storage of produce extends storage life slowing down the process of deterioration which naturally occurs in any crop. Optimum storage conditions are dependent upon the physical nature of the produce.

Table 1 gives recommended storage conditions for a range of horticultural crops.

Many different techniques are available for cooling horticultural produce. These include:

- Conventional refrigeration
- 'Wet air' cooling including ice banks
- Hydro cooling
- Vacuum cooling

Each of the above systems is described in detail in the FEC publication '*Energy Efficient Cooling and Storage for Fruit and Vegetables*', a copy of which is available from the Farm Energy Centre. Guidance on the suitability of the various systems for use with particular crops is also given in this publication.

A summary of the advantages and disadvantages of each of the systems is given in Table 2.

Cooling of horticultural produce enables the grower to maximise the profitability of his enterprise by storing crops, so marketing can be scheduled to meet customer demand. Also by being the initial step in the 'cool chain' process, products arrive at the consumer in good condition.

Table 1

Recommended storage conditions and average time of storage for:

- (i) Vegetables
- (ii) Fruit in ambient & cool store
- (iii) Flowers
- (iv) Cuttings
- (v) Nursery stock in cool store.

Product	Storage Time in Ambient	Storage Time in Cool Store	Temp °C	RH %	Shelf Life at 20°C (68°F) after Cool Storage Days
(i) Vegetables					
Asparagus	3-5 days	14 days	0-1	90-95	3-5
Beetroot	14 days +	4-6 months	0-1	90-95	2-4
Brussels Sprouts	3-5 days	3-4 weeks	-1	90-95	3-5
Cabbage (Spring)	3-5 days	3-6 weeks	0	90-95	4-8
Cabbage (Winter)	6-7 days	up to 6 months	0-1	90-95	6-10
Carrots (Winter)	6-7 days	4-6 months	0-1	90-95	4-7
Cauliflower	3-5 days	3-6 weeks	0-1	90-95	3-4
Celery	3-5 days	4-6 weeks	-1	90-95	4-6
Cucumber	6-7 days	10-14 days	7-10	90-95	4-7
Leeks	3-5 days	6 weeks	-1	90-95	4-6
Lettuce	3-5 days	1-2 weeks	0-1	90-95	2-3
Mushrooms	3-5 days	4-5 days	0-1	90-95	-
Onions (salad)	3-5 days	-	0	90-95	-
Onions (bulb)	over 14 days	10 months	-1	80-85	7-10
Parsley	3-5 days	2-4 weeks	-1	90-95	-
Parsnip	6-7 days	2-6 months	0	90-95	5-8
Peppers (sweet)	6-7 days	2 weeks	0-1	90-95	3-5
Potatoes	over 14 days	4-9 months	2-7	90-95	10-15
Rhubarb	3-5 days	2-3 weeks	0-1	90-95	3-6
Spinach	2-3 days	10-14 days	0-1	90-95	2-5
Sweetcorn	3-5 days	4-8 days	0	90-95	2-4
Watercress	2-3 days	3-4 days	0-1	90-95	1

Table 1 *continued ...*

Product	Storage Time in Ambient	Storage Time in Cool Store	Temp °C	RH %	Shelf Life at 20°C (68°F) after Cool Storage Days
(ii) Fruit					
Apples	7-14 days	3-8 months	-1 to 4.5	90	-
Blackberries	2-3 days	2-3 days	-1 to 0	90-95	2-3
Melons (honeydew)	7-14 days	3-4 weeks	7-10	85-90	-
Peaches	6-7 days	2-4 weeks	-1 to 0	90	-
Pears	6-7 days	2-7 months	-1.5 to -1	90-95	-
Plums	6-7 days	2-4 weeks	-1 to 0	90-95	-
Raspberries	2-3 days	2-3 days	-1 to 0	90-95	1-4
Strawberries	2-3 days	5-7 days	0	90-95	2-3
Tomatoes (firm ripe)	6-7 days	1-2 weeks	1-3	75-80	-
(iii) Flowers					
Anemone	-	3-4 weeks	4-5	90-95	-
Camation	-	3-4 weeks	0-2.2	90-95	-
Chrysanthemum	-	3-6 weeks	0-1.7	90-95	-
Narcissus	-	10-21 days	0-1	90-95	-
Freesia	-	2 weeks	0-1	90-95	-
Gerbera	-	2 weeks	1-7	90-95	-
Hyacinth	-	2 weeks	0-1	90-95	-
Iris	-	2-4 weeks	-0.1 to 0	90-95	-
Lily	-	2-3 weeks	0-1.7	90-95	-
Orchid	-	2 weeks	7-10	90-95	-
Rose	-	1-2 weeks	0	90-95	-
Tulip	-	4-8 weeks	-1 to 0	90-95	-

Table 1 *continued ...*

Product	Storage Time in Ambient	Storage Time in Cool Store	Temp °C	RH %	Shelf Life at 20°C (68°F) after Cool Storage Days
(iv) Cuttings					
Azalea (unrooted)	-	4-10 weeks	-1 to 4.5	90-95	-
Camation (rooted & unrooted)	-	5-6 months	-1 to 0.5	90-95	-
Chrysanthemum (unrooted)	-	5-6 weeks	-1 to 0.5	90-95	-
Chrysanthemum (rooted)	-	3-6 weeks	-1 to 1.7	90-95	-
Other hardwood nursery stock (rooted)	-	5-6 months	0-1.7	90-95	-
(v) Nursery Stock, bedding plants, herbaceous perennials, etc					
Christmas trees	-	6-7 weeks	-5.5 to 0	90-95	-
Conifer seedlings	-	4-6 months	0-1.4	90-95	-
Bedding plant seedlings	-	2-6 weeks	1.7-4.5	90-95	-
Herbaceous perennials	-	48 months	-2.8 to 2.2	90-95	-
Rose budwood	-	1-2 years	-2.2 to -1	90-95	-
Rose bushes	-	4-5 months	0	90-95	-
Strawberry plants	-	8-10 months	-1 to 0	90-95	-
Trees & shrubs	-	4-5 months	0-2.2	90-95	-

Table 2

System	Advantages	Disadvantages
Direct expansion refrigeration	<ul style="list-style-type: none"> - both stores and cools the crop - low capital cost 	<ul style="list-style-type: none"> - variable cooling - slow cooling - may dehydrate crop causing weight loss - produce can freeze
Wet air cooling including ice bank refrigeration	<ul style="list-style-type: none"> - minimum weight loss - moderate cooling times - both cools and stores - cannot freeze produce - can use off-peak electricity to store ice (ice banks) - medium capital costs 	<ul style="list-style-type: none"> - difficult with packaged produce - good air distribution required to store - high grade cartons required
Hydro cooling	<ul style="list-style-type: none"> - fast - no weight loss - process is continuous - produce cannot freeze 	<ul style="list-style-type: none"> - wet produce - disease spread potential - requires effluent disposal - high capital cost
Vacuum cooling	<ul style="list-style-type: none"> - fast cooling - packed produce can be cooled - simple to operate 	<ul style="list-style-type: none"> - batch process - holding store required - some weight loss - high power requirement - produce can freeze - high capital cost