



## Growing capsicums and chillies

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Capsicums (*Capsicum annuum*) and chillies (*Capsicum frutescens*) originate from South and Central America. They are members of the Solanaceae family, as are tomatoes, potatoes and eggplant. Plants are bushy, about 60–80 cm high and are semi-perennials that are grown as annuals in cultivation. They supply good levels of carbohydrates, vitamin A and vitamin C.

Capsicums and chilli varieties may occur in many shapes and colours, and chilli varieties may have a range of pungencies. In Western Australia, the name capsicum is used in relation to fruit which is bell or cone-shaped with a sweetish flavour. The same fruit is called 'bell pepper' or 'peppers' in the USA and Britain. The term chilli refers to fruit which is usually cone-shaped, smaller and the pungency may be very mild to intensely hot. The main active compound for pungency is capsaicin. Within a chilli variety, the greatest pungency is with small, red fruit, especially in the cross-walls, close to the seeds and pith area.

Capsicums are used in salads, baked dishes, stuffed dishes, stews, stir-fries, salsa, for dicing (dried to 2–9 mm) for use in pizzas and cheeses, pickles and for stuffing olives. They may also be used for producing paprika which is used for colouring foods, flavouring and in sauces. Chillies are the most important spice crop in the world. They may be used fresh, in pickles, sauces, salsa, pizzas, flavouring or pastes. There is an increasing demand in Australia for new ways of using chillies for culinary use.

Capsicums are marketed throughout the year in Western Australia. Major production areas are the Perth Metropolitan Area in summer and autumn, and Carnarvon during winter and spring. The Australian Bureau of Statistics in 1996/97 show an area of 144 ha and a production of 2081 t. However, production is greater than this, because not all growers contribute to the census. For instance, a total of 6348 t of capsicums and 152 t of chillies were marketed through Market City, Canning Vale alone in 1996/97. Carnarvon produced 2069 t of capsicum valued at \$3.2 million in 1998.

Most capsicums and chillies are grown in soil, using trickle irrigation and polythene mulch. Production of capsicums in hydroponics, using a 'run-to-waste' system with rockwool or pine sawdust, is very small, but may increase as fruit is of good quality, especially for being clean and even.

### Climate

Warm conditions over a five-month growing period are necessary for high yields and good quality fruit. Capsicums and chillies require slightly warmer temperatures than tomatoes or cucumbers. Chillies are more tolerant of high temperatures than capsicums. Optimum temperatures for fruit setting are between 16°C and 21°C. For good fruit development, night temperatures of 15–17°C and day temperatures of 24–30°C are best.

Capsicums can be damaged by frosts. Plants retarded by cool weather tend to harden and seldom regain the vigorous growth necessary for high yields. During cold weather, the fruit remains small, hard and malformed because of uneven pollination. The fruit may also have numerous growth cracks.

The fruit may be sun-scorched during hot weather and fruit will show poor setting and poor colouring when temperatures are above 33°C.

### Soils

Soils must be well-drained, with optimum pH of 5.5–6.5 (by the water system of measurement) and with a low salinity.

### Varieties

Most varieties are hybrids. Varieties have a primary mature colour that is usually green, but may be yellow or purple. They also have a secondary mature colour that is usually red, but may be orange or yellow or other colours. Fruit picked at this stage is much sweeter than green fruit and has more vitamin A.

New varieties are always being introduced, so check with your local supplier or nursery. These varieties may be more resistant to disease, produce higher yields of fruit, produce more uniform fruit or be more suited to the latest market requirements for quality. The latter may change with regard to whether the variety should be blocky or have a long shape. Before planting new varieties on a large scale, compare them in small plantings to existing varieties under the same growing conditions. Good varieties are as follows:

### Capsicums

- Green ripening to red (long) Aries, Gedeon, Target
- Green ripening to red (blocky) Domino, Magnum

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- Purple/red (pick when purple) Purple Princess, Purple Star
- Green ripening to yellow (pick when yellow) Golden Gem
- Green ripening to orange (pick when orange) Ariane, Orange Grande

There are also black, cream, brown and lime varieties.

Yellow or orange capsicums are not heavy yielding varieties and may need higher temperatures for maturity, compared with green/red varieties.

## Chillies

Growers are trying many new varieties as well as standard chillies such as Firefly (9 cm long and 1.5 cm wide). These include the hottest variety, Habanero, and the most well-known world variety, Jalapeno. They may also include oval chillies such as Cherry Bomb and small chillies such as Cascabella. The pungent small mature green (primary colour) or red (secondary colour) chillies are in most demand. Long Sweet Yellow type varieties are grown on a small scale and are often called 'paprika' in Western Australia, but note that this term should be used for dried red capsicums or chillies. They are large, compared with most chilli varieties and have a very low pungency when picked at the yellow stage (before ripening to red). There are also yellow chillies that have a high pungency.

## Seedling production

Seedlings may be raised in beds or nurseries by the grower, but are usually ordered from specialised nurseries for delivery in single cell-packs in 8 to 10 weeks.

## Transplanting

Transplant by hand or by machine.

In Perth, plant early crops from July to September in warm, well-protected areas. Unprotected crops make slow early growth and harvesting is often delayed. Low plastic tunnels or cloches aid the production of early crops. Transplant the main capsicum crop from September to December. Chillies are slower to mature than capsicums.

In Carnarvon, transplant from late February to August. Transplanting early in the year is best so that crops can become well established before the onset of cool weather.

## Spacing

The choice of spacing depends on irrigation layout and tractor access for fertiliser application, boom spraying and harvesting. In Perth, a good spacing between plants is 75 cm (two rows per bed) by 40 cm which gives 30,000 plants per hectare. In Carnarvon, space plants in a double row with plants 40 cm apart between the rows and 30 cm apart within the rows, with row centres at 1.5 m apart. Wide spacings allow picking over a long period, while close spacings will give high yields over a short period and better pollination in hot periods.

## Fertilisers

### Sandy soils

Sandy soils are the main soil types on the Swan Coastal Plain from Eneabba to Busselton. The fertiliser program for this soil type is outlined in Table 1.

**Table 1. Fertiliser program for capsicums on sandy soils**

Before planting	After planting
A. Conditioned poultry manure at 30 m <sup>3</sup> /ha or compost at 50 m <sup>3</sup> /ha*	A. Commencing 1 to 3 weeks after planting, apply weekly ammonium nitrate at 55-75 kg/ha, or urea at 40-50 kg/ha, plus muriate of potash at 50-75 kg/ha**
B. If the above organic manures are not used, apply double superphosphate at up to 500 kg/ha (based on soil analysis)	B. Commencing three days after planting, apply weekly ammonium nitrate at 55-70 kg/ha, or urea at 40-50 kg/ha, plus muriate of potash at 60-80 kg/ha**
* It is probable that the use of raw poultry manure will be banned at the end of 1999. Trials are continuing with the replacement of this with conditioned poultry manure and compost. The recommendations for these products may change as more information becomes available. They may need extra nitrogen to establish new plantings.	
** Where salt is a problem in the soil or water, 6 kg sulphate of potash may be substituted for every 5 kg muriate of potash.	

Use Program A if organic manures are used before planting and Program B if these are not used. Trace elements and magnesium should also be applied before planting (see Table 2).

**Table 2. Trace element mix for capsicums**

Fertiliser	Rate (kg/ha)
Magnesium sulphate	50
Manganese sulphate	20
Copper sulphate	18
Zinc sulphate	16
Iron sulphate	18
Borax	12
Sodium molybdate	1
<b>Total</b>	<b>125</b>
Where organic manures are applied regularly or where fungicides containing manganese and/or zinc (for example, mancozeb, zineb) or copper are applied, then further application of these elements may not be necessary.	

Ammonium nitrate or urea and potassium fertilisers may be applied to the soil or by fertigation through the trickle irrigation system or sprinklers.

### Loamy, gravelly and clay soils

In their natural state, loams, gravels and clay soils (found at Geraldton, Jarrahdale and in the south-west of Western Australia) have little available phosphorus.

Double superphosphate is best applied before planting in lines or bands, 15–20 cm on each side of the planting line at a depth of 5–7 cm. Apply up to 1.3 t/ha depending on cropping history and results from soil testing. Double superphosphate is preferred to single superphosphate as it has less cadmium, which is a toxic, heavy metal.

Apply trace elements and magnesium before planting (see Table 2).

The post-planting fertiliser program for nitrogen and potassium is based on that in Table 1. Apply 50–75 per cent of rates in Table 1 depending on cropping history and applications may be made less frequently.

### **Alluvial soils**

Alluvial soils are common in the Carnarvon vegetable growing area. These soils contain adequate phosphorus, potassium and many other nutrients and only nitrogenous fertilisers may be needed.

Starting three weeks after transplanting, apply 35 kg/ha of urea or 50 kg/ha of ammonium nitrate every two weeks, which may be injected into the trickle irrigation system. For good yields and to maintain soil structure, addition of organic manures such as Dynamic Lifter® is recommended. Crops planted in August respond to foliar sprays of calcium nitrate at 2 g/L.

Yolo spot is seen as a green spotting on mature red fruit and may occur in cool weather in Carnarvon, especially where high fertiliser rates have been used.

## **Irrigation**

### **South-west**

Capsicums need uniform soil moisture conditions for high production. Dry periods may cause shedding of flowers and young fruits, and blossom end rot on the fruit.

When conditions are hot, water crops in sandy soil twice daily. In warmer months, apply three-fifths of the water in early to mid morning and two-fifths in early to mid afternoon. In cooler months, apply all of the water in early to mid morning.

Water used for irrigation should preferably contain less than 1000 ppm of total dissolved salts, or have an electrical conductivity (EC) reading of less than 1.8 millisiemens per centimetre (180 mS/m).

Apply water to replace 130 per cent of evaporation. To calculate how much water a crop grown on a sandy soil needs refer to Farmnote No. 66/95 'Irrigating vegetables on sandy soils' (Agdex 250/560).

An increasing area of capsicums is being watered by trickle irrigation in Perth. When combined with black plastic mulch, this results in less weeds and a saving in water. It is also useful for capsicums under cloches to increase soil temperatures in cooler weather. However, trickle irrigation may result in more mites and powdery mildew on the plants compared with the use of sprinklers. There may be two rows of capsicums per cloche, each with its own row of trickle irrigation. An evaporation replacement factor of 60–90 per cent is suggested for trickle irrigation of capsicums in Perth. Growers may also plant a double row on black or reflective plastic mulch, without clear polythene protection, and water by sprinkler irrigation from planting onwards.

### **Carnarvon**

When using trickle irrigation and polythene mulch, water at 25 per cent daily evaporation replacement rate during early growth and at 40–50 per cent daily evaporation replacement rate from flowering onwards. Tensiometers may be used for irrigation scheduling to apply irrigation at a suggested soil tension of 30–35 cb.

## **Protected cultivation**

Early crops are often planted in Perth in July and August and raised in cloches. These provide higher air and soil temperatures, and hasten crop growth, reduce pest problems and give protection from wind, heavy rain and sand blasting.

Cloches have wire hoops at 1.2 m apart, which are inserted about 30 cm into the soil and are about 50 cm high. A line of wire on top of the hoops helps to support the plastic. The plastic is 1.5 m wide and is tucked into the soil. The plastic should be raised on warm days. In late September, the plastic may be removed and the grower then waters by sprinklers or continues with trickle irrigation.

Capsicums may be protected from sunburn and wind by growing under shade cloth (25–40 per cent shade) which may be permanent or placed temporarily on hoops over the crop and moved to one side for harvesting. Shaded crops produce bigger and firmer fruit and increase the packout of premium fruits.

## **Pruning**

Capsicums and chillies generally do not need pruning or support. However, early crops in Carnarvon may need single horizontal wire trellising to prevent damage from storms and wind in winter.

After the first season's growth, some growers prune back capsicums to major branches and allow them to re-grow. This is not good practice, as yields are lower in the second year and frequent spraying is needed for pest and disease control.

In Carnarvon, crops planted in March are sometimes cut back in August/September with a slasher or 'whipper-snipper' in order to give a second major crop in November/December.

## **Pests**

Capsicums and chillies need frequent spraying to produce good yields and fruit quality. This especially applies to Carnarvon, where regular spraying at 7–14 days may be needed during certain seasons to control major pests such as aphids on the whole plant, grubs on the fruits and powdery mildew (*Leveillula taurica*) and bacterial spot (*Xanthomonas campestris*) on the leaves. Grubs and aphids are the major pest problems in Perth.

Capsicums are also affected by soil-borne diseases such as *Fusarium* rot, *Sclerotinia* rot, *Rhizoctonia* stem canker, and root knot nematode. Crop rotation is therefore recommended, with an interval of three years between capsicum crops. Soil fumigation with metham sodium or methyl bromide may also be necessary before planting to control pests and diseases, nematodes plus weeds. Methyl bromide will be phased out of horticultural use in 2005 due to its deleterious effect on the ozone layer.

Capsicums are very susceptible to viruses, for which there is no direct control. Tomato spotted wilt virus has been more common in Perth in recent years and is spread by thrips.

In unshaded areas, exposed fruit, especially at the red stage, may be unmarketable because it is sunburnt.

Hot weather, high nitrogen and low watering may increase losses from blossom-end rot which appears as sunken brown spots on the sides or end of the fruit. A shortage of calcium is also associated with blossom end rot and growers may spray calcium nitrate at 2 g/L in summer to try to control this.

### Further reading

- Farmnote No. 2/92 'Diseases of capsicums' (Agdex 261/633).
- Farmnote No. 20/97 'Pests of capsicums' (Agdex 261/622).
- Farmnote No. 41/93 'Tomato Spotted Wilt and Impatiens Necrotic Spot - Viruses spread by thrips' (Agdex 261/622).

### Weed control

Capsicums have a long period of cropping but do not cover the ground well. Good weed control is therefore essential to aid insect and disease control and harvesting. There are no registered residual herbicides and capsicums are sensitive to these. Black or reflective plastic mulch will control weeds, except in the planting holes. If plastic mulch is not used, much hand-weeding will be necessary.

Weeds which grow between beds of black plastic mulch can be controlled with paraquat (Gramoxone®), diquat (Reglone®) or a mixture of these chemicals (Spray.Seed 200®) using a shielded nozzle to avoid spray-drift onto the plants. These sprays will control all annual weeds and seedlings of perennial weeds.

### Fruit set

Capsicums are mainly self-pollinating and do not need bees for pollination. Green fruit is mature for picking 30-35 days after flowering and red fruit takes a further 20-25 days. Pollination may be poor in hot or cold weather, after low watering, where the humidity is too low and in high winds.

Fruit is ready for harvesting 10-15 weeks after planting, depending on season and stage of maturity.

### Harvesting

Capsicums or chillies are cut or carefully snapped off by hand and the stem is trimmed with secateurs or a knife. Avoid damaging the shoulders of the fruit and the branches, as this may lead to bacterial soft rot. Capsicums may be picked at the mature primary or secondary colour stages. This gives more flexibility in harvesting compared with most crops. Harvest at 7 to 21-day intervals depending on the season and the need to pick. Harvesting at 14-day intervals gives good yields and quality.

Pick capsicums at the mature primary stage (usually green), when they are firm, with thick walls and dark green. If picked too early, they have thinner walls and are inclined to wilt. If desired, capsicums can be left on the plants to the secondary stage (usually red) before harvest. At this stage, they are sweeter, but not so firm. Also, yields may be reduced by 25-50 per cent, but prices for fruit at the secondary stage are usually higher than for fruit at the primary stage. You can pick only fruit of one colour, or pick both colours.

Once the initial fruit has set, few additional flowers will set until the first fruits are picked. The heaviest crops are from the first three picks.

Some pickers are allergic to picking chillies.

Yields of capsicums vary between 10 and 30 t/ha, but yields of 50 t/ha are not uncommon, with some of the highest yields up to 80 t/ha.

### Storage

Cool the fruit with forced-air cooling or by vacuum cooling. Store at 7-10°C and 90-95 per cent relative humidity for up to three weeks. Fruit which is to be stored for some time must not be stored with fruit such as tomatoes and apples which will give off ethylene gas and reduce the storage life. Green fruit has the longest storage life.

### Marketing

Machines are available that will wash, brush and grade capsicums for size. The fruit also need to be visually graded for colour, so the package contains fruit only of one colour. They may also be voluntarily graded into special or premium (best) and No. 1 grades. Fruit are preferably packed on their sides in cartons, but plastic returnable containers may also be used for marketing. Chillies may be packed into small ventilated 1 kg polythene bags with eight bags per carton or into trays.

About three-quarters of capsicums are sold as green fruit, and the remainder are a mixture of colours, mainly red, but yellow are also popular. Most chillies are sold as red fruit. Fruit which is turning from one colour to another should not be picked. Fruit will not change colour after harvesting. However, to obtain higher prices, some varieties may be red-ripened with ethylene gas providing the fruit are gassed at the 30 per cent 'chocolate or turning' stage.

Varieties with long fruit were most popular for many years, but recently there has been a bigger demand for varieties with blocky fruit.

Capsicums are consigned on a small scale to interstate markets in cartons. Contact the Australian Quarantine Inspection Service in other States and in Western Australia for details of fumigation against fruit fly as these are subject to change.

Imports of capsicums are significant from the Eastern States and from overseas, if there is a shortage from Western Australian growers or quality is inferior. There is also flexibility in time of picking. For these reasons, very high prices are not received with capsicums.

Capsicums and chillies are not exported to overseas markets from Western Australia.

### Paprika

Most paprika is imported. Red capsicums or chillies are dried with forced-air heaters and ground to a fine powder. Strict attention must be paid to hygiene. Oleo-resins may also be distilled from paprika and used in pharmaceutical products.

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