

Cucurbita pepo (summer squash)

ble to infection. Avoid overhead watering to help reduce the relative humidity.

For infected vegetables and other annuals, removing as much of the plant and its debris in autumn as possible reduces disease spread. This decreases the ability of the fungus to survive the winter. Temperatures often are not hot enough to kill the fungus.

Selective pruning to overcrowded plant material helps to increase air circulation. This helps reduce relative humidity and infection.

Gummy stem blight (*Didymella bryoniae*) can cause serious problems on stems, leaves and fruit of squash. This disease is often first noted as a developing rot in the lower vine stem area, but it also may affect the foliage.

Control methods

Planting in a well-drained soil free from surface runoff water can be used as a control. A weekly spray programme with a recommended fungicide beginning at the first true leaf stage should be followed. Practising a clean plow-down after harvest or discarding all plant debris is also needed.

Crop rotation. Cucurbits should be grown only once every 4 years. Control both cucurbit weeds and volunteer cucurbit plants during this period.

Some of the most serious disease problems with squash, as with many cucurbits, are caused by viruses. Viruses cause mottling and distortion of leaves and fruit. Aphids and whiteflies can transmit viruses from surrounding fields and weeds to the very young emerging cotyledon leaves. Viruses such as CMV, watermelon mosaic virus (WMV), zucchini yellow mosaic virus (ZYMV) and papaya ringspot virus (PRV) are transmitted by aphids in a non-persistent manner (requiring only seconds to a few minutes for the aphids to probe the leaf surface and transmit the virus).

Pollination and fruit set

Squash is monoecious (the male and female flowers develop on the same plant). During the main growing season the ratio of male to female flowers is usually 3:1 or higher. The female flower is distinguished by the presence of an ovary at the base; female flowers are borne on very short stems, and male flowers are borne on long stems. Honeybees are the primary pollinators and one to two hives of bees per hectare should be provided for a good fruit set.

Poor pollination results in small, young fruit that turn yellow, shrivel and fall off. Incomplete pollination may also cause misshapen fruit that is unmarketable. Squash fruit grow about 1,9 to 2,5 cm per day. Cross-pollination between the same species of squash can occur (e.g., between zucchini and crookneck) but this is not a concern unless the crop is being grown for seed production. Cross-pollination does not occur between cucurbits of different species (e.g., between zucchini and cucumber).

Harvesting

The fruit varies greatly in length but is generally long and cylindrical with the stem end about equal in width to the blossom end. Summer

squashes are usually eaten at immature stages, in contrast to the hardy or winter types, which are eaten when the fruit is mature; the male flowers are also harvested and sold.

Summer squash fruit is generally harvested when the rind is still tender and the seeds are immature. Care should be taken not to damage the soft skin. Wearing gloves can reduce damage to the fruit by fingernails. A clean, dry rag may be used to clean dirt and dust off the fruit.

Depending on the variety, fruit reaches harvestable size of 4 to 8 days after pollination. If the fruit is allowed to remain on the plants too long before picking, the plants tend to set fewer fruit. Zucchini is more desirable at 12 cm to 15 cm long and sometimes at 18 cm to 20 cm long, depending on the type of markets.

Fruit is hand-picked into containers and usually sorted, graded and packed in the field. Fruit should be cooled to 10°C as soon as possible. Delaying cooling adversely affects fruit quality and shortens the shelf life.

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BACKGROUND FOR SQUASH

Summer squash is a subset of squashes that are harvested when immature (while the rind is still tender and edible). All summer squashes are the fruit of the species *Cucurbita pepo* (although not all squashes of this species are considered summer squashes), but they are considered vegetables in terms of culinary use. The name "summer squash" refers to the short storage life of these squashes, unlike that of winter squashes.

Origin and distribution

Zucchini, the most popular type of summer squash, can be found in dark, medium and light-green colours, as well as yellow-orange.

The word zucchini is the Italian name for the plant, which is why it is the more common name in Italy (zucchina/e), but also in North America, Australia and Germany, while courgette is the French name for the vegetable and is more commonly used in France, but also in Ireland, the United Kingdom, Greece, New Zealand, the Netherlands, Belgium, Portugal and South Africa. Zucchini can be dark or light green, and generally have a similar shape to a ridged cucumber, although some round varieties are also available.

SOIL AND CLIMATIC REQUIREMENTS

Summer squash is a warm season crop that will grow in nearly all climates of South Africa. Because summer squash is a short-season crop, it thrives in cooler climates better than other cucurbits such as cantaloupe (mushmelon, muskmelon, rockmelon or spanspek and watermelon. Although summer squash production often slows in cool climates, virus pressure is often lower, with improved yield and quality.

Well-drained soils favour squash production. The optimal pH is 5,8 to 7,0; limestone or sulphur can be used to adjust the pH if needed. Sandier soils require more frequent watering and fertilisation than heavy-textured clay soils.

USES

When used for food, zucchini are usually picked when under 20 cm in length, when the seeds are still soft and immature. Mature zuc-



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chini can be as much as 1 m long, but the larger ones are often fibrous and with the flowers attached are a sign of a truly fresh and immature fruit, and are especially sought by many people.

Unlike cucumber, zucchini is usually served cooked. It can be prepared using a variety of cooking techniques, including steamed, boiled, grilled, stuffed and baked, barbecued, fried, or incorporated in other recipes such as soufflés. It also can be baked into bread, zucchini bread or incorporated into a cake mix. Its flowers can be eaten stuffed and are a delicacy when deep fried, as tempura.

The zucchini has a delicate flavour and requires little more than quick cooking with butter or olive oil, with or without fresh herbs. The skin is left in place. Quick cooking of barely wet zucchini in oil or butter allows the fruit to partially boil and steam, with the juices concentrated in the final moments of frying when the water has gone, prior to serving. Zucchini can also be eaten raw, sliced or shredded in a cold salad, baked into bread similar to banana bread, as well as lightly cooked in hot salads, as in Thai or Vietnamese recipes. Mature (larger sized) zucchini, while not often eaten by themselves, are well suited for cooking in breads.

CULTURAL PRACTICES

Soil preparation

Autumn plowing is desirable to eliminate plant debris and residue in which disease and insects overwinter. In the spring, prior to planting, a thorough discing should follow. The seeds must be grown on raised beds 12 cm to 20 cm high, depending on soil drainage. Rows should be prepared 7 to 10 days in advance and bed formed at planting. Bed forming will improve the uniformity of the seed bed, therefore resulting in more uniform plant stands.

PLANTING

Summer squash usually is direct seeded or planted by transplants for early markets. The use of black plastic and transplants also increases early yields in cool springs. Seed germination is normally best when soil temperatures reach 18°C to 24°C. The seedlings are subject to frost damage. The optimal germinating temperature range is 21° to 35°C, and the maximum germinating temperature is 38°C. Below 15,5°C germination may take as long as 2 weeks. Zucchini grows to maturity in about 60 days.

Squash plants have an extensive root system up to 1,2 m deep with the majority of the roots in the top 30 cm to 45 cm. Direct seeding is preferred over transplants because squash is very sensitive to transplant shock, but transplants can be used successfully if they are not allowed to remain in the greenhouse for too long. Squash seed remains viable for as long as 4 years if stored in a cool, dry place.

Growers usually plant 4 to 7 kg/ ha. This allows for one seed every 23 cm to 30 cm on beds that are 1,5 m wide. Plants are later thinned to 30 cm to 38 cm between plants. The seed is planted 2,5 cm to 4 cm deep.

FERTILISATION

Nitrogen (N) fertiliser is needed to produce maximum summer squash yields. A soil test will help to determine specific nutrient needs, but the following general guideline can be used. If the soil is cold (10° C to 15°C), as is often the case with early-spring plantings, about 67 kg/ha of nitrogen (N) and 22 to 28 kg/ha of phosphorus (P) should be applied before planting. Broadcasting the preplant fertiliser and tilling it into the bed or band the fertilisers 7 cm to 10 cm below the seed-line and offset slightly toward the water furrow.

The total recommended quantities of fertiliser for the crop are 90 to 168 kg/ha of nitrogen; 67 to 134 kg/ha of phosphorus and 0 to 168 kg/ha of potassium. Side-dressing with the remaining nitrogen is best when the plants are 7 cm to 12 cm tall. Do not apply more than 67 kg/ha of nitrogen in any fertiliser application. In drip systems, the quantity of nitrogen can be broken down into three to four smaller applications.

IRRIGATION

Squash roots develop rapidly, with roots in the top 45 cm of soil. Irrigations should be scheduled to avoid excessive moisture or water stress. If clay or loam soil is moist to at least 1,2 m at planting, the soil has sufficient moisture to carry the crop well into the growing season. Early-season irrigation tends to cool the soil and slow plant growth. At least 1,854 mm of water is required for the season.

Sandy soils require more frequent irrigations than clay soils. Lack of adequate moisture at harvest can result in misshapen fruit; too much moisture can aggravate root and stem rot diseases.

WEED CONTROL

Weeds can cause yield reductions, especially if left uncontrolled early in the season. In addition, weeds interfere with harvest by making fruit difficult to find. The vigorous growth of many cucurbits makes integrated weed management feasible. Fields with high populations of certain weeds such as common purslane (*Portulaca oleracea*), field bindweed (*Convolvulus arvensis*) or nutsedge (*Cyperus* spp.) as these weeds are not adequately controlled by registered chemicals or non-chemical methods.

During cooler seasons squash needs a more diligent weed control programme for optimal yield and quality. Just before planting cucurbits, pre-irrigating the field to germinate weed seeds and cultivating to destroy the grown weeds is an important cultural method normally used.

PEST CONTROL AND DISEASE CONTROL

Insects

Seed-maize maggot larvae (*Delia platura*) feed on germinating squash seed. High levels of decaying organic matter in the soil may encourage seed-maize maggots. Wireworms (*Limoniuss* spp. and others) can kill off young plants and weaken older ones by feeding on the root system.

Control methods

For control of seed-maize maggots in field or vegetable crops, shallow planting in a well-prepared seedbed, late planting so that seed germi-

nation is ensured, is one means of preventing injury. A field where manure is heavy or where a cover crop is turned under should be plowed early in autumn, if possible; it will be less attractive to the egg-laying flies the following spring. Prompt resetting or replanting of damaged crops will usually give a good stand.

Whiteflies can also destroy squash plants with their feeding. The silverleaf whitefly (*Bemisia argentifolii*) was named for the physiological disorder it causes in various cucurbits, a “silvering” of the leaves caused by feeding of only a few of the young. Feeding whiteflies suck plant sap, resulting in silvering, defoliation, stunting and poor yields.

Control methods

Destroying heavily infested plant parts and alternate hosts. Heavily infested plant leaves can be pruned out, especially in infested parts and again destroying them before the whiteflies can spread. Infested weeds such as pigweed, ground cherry and field bindweed are known to harbour the silverleaf whitefly.

Seasonal vegetables must be destroyed immediately at harvest or after harvesting. Old plants can be a source of future infestations. Squash, tomatoes, pumpkins, melons, peppers, cucumbers, egg-plant, broccoli, cauliflower, cabbage and okra are especially important hosts of the silverleaf whitefly.

Transplants. The silverleaf whitefly has been brought into new areas on transplants. Transplants should be checked carefully for whiteflies before every planting season.

Whiteflies are very difficult to control with insecticides. Repeated applications may make the situation worse by selecting strains of the whitefly that are resistant to pesticides. If insect sprays are required, use an insecticidal soap or an insecticidal oil.

Biological control. Whitefly nymphs are preyed upon by bigeyed bugs, lacewing larvae and other general predators. Several tiny wasps can parasitise the whitefly. It is important to preserve these natural enemies by avoiding sprays with broad spectrum insecticides that could kill them.

Planting times. If the silverleaf whitefly becomes a serious problem, adjusting planting times for susceptible vegetables to avoid high populations of the pest also helps as a good control method.

Leafminers (*Liriomyza* spp.) may damage newly emerged cotyledon leaves. The population of natural predators is usually adequate to control leafminers if not disrupted by insecticide applications.

Diseases

Powdery mildew (*Erysiphe cichoracearum*) is common in squash fields throughout the growing season. This fungal disease can be a problem at any time in coastal growing areas and can be a problem in late summer and autumn.

Control methods

Late-summer applications of nitrogen fertiliser should be avoided to limit the production of succulent tissue, which is more suscepti-