HAWAII COOPERATIVE EXTENSION SERVICE
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COMMODITY FACT SHEET GIN-3(A)
RHIZOME

GINGER ROOT PRODUCTION IN HAWAII

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Family: Zingiberaceae
Scientific Name: *Zingiber officinale* Roscoe
Origin: Unknown (probably Southeast Asia)

Description

Edible ginger is a herbaceous perennial plant that is grown as an annual in commercial production. It is cultivated in the tropical and subtropical regions of the world. Internationally, processed ginger "root" (rhizome) is the standard of commerce and is traded as a dried spice or candied. The harvest season varies by location, with northern hemisphere locations such as Hawaii having harvests that begin in December and southern hemisphere locations having harvests beginning in July.

The ginger plant grows from 2 to 4 ft (61–122 cm) high under commercial conditions. Edible ginger is asexually propagated from a portion of the rhizome. The ginger rhizome grows horizontally in the wild and develops a greenish color when exposed to sunlight, due to chlorophyll development. Abundant rainfall, sunlight, and warm temperature are required throughout its growth cycle.

In Hawaii, edible ginger is grown for the fresh market, which returns substantially greater revenue than processed products. The ginger root industry produces approximately 9 million lb (4.08 million kg) of fresh ginger each year. The Hawaiian ginger industry has developed a reputation of producing a superior quality product in the fresh market. Hawaiian ginger root is available in the marketplace beginning in December and continuing as late as September of the next year. Production is concentrated in the Hilo area, which has annual rainfall of 125–250 in (318–636 cm) per year.

Varieties

Although many cultivars of edible ginger are grown worldwide, only two types are cultivated in Hawaii. The small rhizome type, with a rich yellow flesh color, is referred to as Japanese ginger. The plant is small, growing to a height of 18–36 in (46–91 cm). The rhizome has a pungent flavor, but due to low production and market preference, it is not commercially cultivated in Hawaii. The predominant commercial variety is referred to as the Chinese type. It is characterized by large rhizomes and light yellow flesh and is less pungent than Japanese ginger. Commercial production averages 40,000 lb (18,144 kg) per acre, but yields up to 70,000 lb (31,752 kg) have been reported.

Soils

The ginger plant grows best in deep, loose, well drained soil with a pH of 5.5 to 6.5. The soil should be high in organic matter, available calcium, and nutrients. It should be free of weeds that can harbor cutworms, which attack young shoots as they emerge, and disease-causing organisms.

Culture

Field preparation begins in late fall with plowing of the soil to a depth of 18–24 in (46–61 cm) and incorporation of liming material to adjust the soil pH and supply the high calcium requirement of the ginger plant. The use of a nematicide or soil fumigant is essential to eliminate nematodes,

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which can make a crop unmarketable. The soil should be tilled before nematicide treatment to ensure that the soil is well aerated and free from clods. The soil should be fumigated at a soil moisture that is neither too wet nor too dry, i.e., approximately at field capacity, to ensure effective penetration of the nematicide to a depth of 18–24 in (46–61 cm).

The best time to plant edible ginger is in the early spring, beginning in March. Optimum yield is obtained when the growing season is 10 months long. Earlier plantings may result in poor and uneven sprouting due to low soil temperatures. Fields planted too early usually produce yields substantially lower than fields planted later in the season. Commercial crops planted late in the season will result in reduced yield and size of rhizomes.

Because edible ginger is susceptible to many diseases and pests, field sanitation is of paramount importance. Once treated, the field should be kept free of contamination from runoff water and from outside soil. Multiple drainage ditches should be dug around the perimeter of the field. Entry into the field should be limited to disease- and soil-free equipment, machinery, and personnel. Supplemental foliar nematicide applications can be made as necessary during the season to prevent nematode population increase.

To overcome the tendency of the ginger root to grow horizontally, soil is periodically hilled (mounded) in the plant row to ensure vertical growth. The desired long, plump "hands" result from proper timing of the hilling operation. Three to five hillings are made during the crop cycle, with the depth of cover determined by the rate of growth. The early hillings are thin and made by hand. Later hillings are made with the assistance of a hand-held tiller with the capability to throw soil onto the ginger row. Ginger rhizomes that are thin and elongated result from too-deep covering during the hilling operation. Rhizomes that are knobby and show horizontal growth result from inadequate hilling.

Seed

A successful crop is initiated with the use of clean, good quality "seed." The rhizomes to be used for seed should be from the best ginger available to the grower. The seed should be free of root-knot nematode, Fusarium wilt, bacterial wilt, and other diseases. The seed should be carefully selected and treated with hot water at 122°F (50°C) for 10 minutes to kill any undetected nematodes and to surface-sterilize the rhizomes. The temperature must be accurate and kept constant, because lower temperatures will not effectively control the nematodes and higher temperatures will damage the seed. Incorporation of a fungicide will help in reducing certain seed-borne diseases and prevent decay of the seed after planting. The seed should be planted immediately after treatment to minimize recontamination by aerial fungal organisms. Overtreating seed (time or temperature) results in an overabundance of small and yellow shoots. Plants derived from these shoots will not develop properly and will remain stunted throughout the crop.

About 2000 lb (907 kg) of seed is required to plant an acre of ginger with the average conversion ratio of seed to crop of 1:20. Seed size used in commercial production varies from 4 to 8 oz (113–227 gm), depending on the time of planting. The yield is not affected by seed size when planting occurs in early spring; however, late plantings benefit greatly from larger seed size. Increased seed density results in increased yield but also in an increase of tangled rhizomes, which creates problems in harvesting and in rhizome quality.

Figure 1. "Hand" of mature ginger root that has been cured.

Figure 2. Young ginger plants that have been hilled with the aid of a tiller.

Planting

After soil fumigation, the field should be furrowed with lines spaced 4.5–5.0 ft (137–152 cm) apart. Furrows are cut with a hand-held tiller in one or two passes to a depth of 12–18 in (30–46 cm). Preplant fertilizer is applied and tilled into the bottom of the furrow before seeding. The seed pieces are planted 6–8 in (15–20 cm) apart and covered with 2–4 in (5–10 cm) of soil. The initial furrow, which serves as the planting row, will eventually be the hill at harvest, as the soil is moved during the hilling process.

Fertilizer

The fertilizer incorporated into the planting row is important in getting the crop off to a strong start. The preplant application includes a complete fertilizer, additional phosphorus, calcium, and organic matter. Nitrogen is supplied as a complete fertilizer (NPK) in the ratio of 1:3:1 (i.e., 10-30-10) or 1:1:1 (i.e., 14-14-14) at 300–500 lb (136–227 kg) per acre. Phosphorus is additionally supplied as treble superphosphate (0-47-0) at 1000 lb (454 kg) material or 470 lb (213 kg) P_2O_5 per acre. Calcium is supplied as either calcium carbonate or dolomite at 1000–2000 lb (454–907 kg) per acre. Organic matter is supplied as composted chicken or cow manure at 1000–2000 lb (454–907 kg) per acre.

Fertilization after planting is made as a side-dress application 10–12 in (25–30 cm) from the plant row, since ginger is susceptible to fertilizer damage. Application intervals vary from two to three weeks but should not exceed three weeks because of the time lag in nutrient uptake. Application of fertilizer normally begins at first emergence of shoots with low rates of a complete fertilizer or an application of compost manure at 200–400 lb (91–181 kg) per acre. Subsequent fertilizer applications are made at rates of 600–1000 lb (272–454 kg) per acre. The use of a high-nitrogen fertilizer results in excess foliar growth at the expense of the rhizomes. Commercial growers use a low-nitrogen fertilizer with a ratio of 1:2:2 (i.e., 10-20-20).

Complete fertilizer applications are stopped at the end of September when flowering begins. Several applications of a potassium fertilizer such as K-mag (0-0-26) or muriate of potassium (0-0-61) are made late in the crop to increase the plumpness of the rhizomes and to produce a shiny skin surface. Calcium amendments may be applied several times during the crop to minimize tip rot.

Harvest

"Young ginger" is a specialty product prized for tender, low-fiber texture and is used primarily for pickling. It is harvested before the rhizome develops a high fiber content. Young ginger dehydrates easily and should be protected from direct sun exposure. This type of ginger is marketed with about 1.0–1.5 in (2.5–3.8 cm) of pseudostem attached to the rhizome. Since fiber development is a function of the age of the plant, time of planting has a great effect on the availability of this product. Ginger planted in early spring is harvested in July and August. Ginger planted later in the season will still be marketable as young ginger later in the year, due to the later development of fiber. The yield of young ginger is significantly less than that of mature ginger.

The natural senescence of ginger, which occurs in January, is triggered by flowering in late September, regardless of time of planting. Harvesting before senescence can be facilitated by trimming the tops of the ginger plant two to three weeks before the anticipated harvest date. This stimulates the formation of an abscission zone between the rhizome and the pseudostem.

Figure 3. Ginger plants flowering in late September.

Figure 4. Harvested ginger roots being washed by hand.

Extreme care should be used when washing ginger harvested in the early season, because the epidermis is fragile and subject to damage. The blue-gray tinge in the tissue surrounding the pith reflects healthy ginger and is observable until resprouting occurs. Ginger rhizomes will put on a major part of their total weight during the last month of growth, so early harvest will reduce yield. Premature yellowing, wilting, or dying of plants before or during the flowering stage is usually caused by Fusarium or bacterial wilt.

Normally, ginger is harvested after the leaves turn yellow and dry down completely and the stem falls over. At this stage, the rhizomes have a fairly firm skin and will not bruise easily in the harvest and washing operations. Ginger rhizomes can be harvested by hand with a modified potato digger or mechanically with a tractor-pulled cutter bar that cuts the major roots and lifts the ginger stool. The harvested rhizomes are boxed and transported to warehouses, where they are washed and dried on screened racks, which allow air movement. The rhizomes are cured for three to five days, depending on the humidity, temperature, and time of harvest. Insufficient curing will result in the development of mildew on the cut ends. Excessive curing will result in weight loss and in loss of the desired shiny skin surface.

Marketing

After curing, ginger is packed and sold in 30-lb (13.6-kg) containers. The rhizomes are graded in accordance with the standards established by the Hawaii Department of Agriculture. The major market for fresh Hawaiian ginger root is the continental United States, with small amounts sold in the international market. The primary distribution mode is through local brokerage firms or direct sales to West Coast wholesale firms by large producers.

Diseases

Bacterial wilt (*Pseudomonas solanacearum*): wilt of entire plant, rhizome rot.

Bacterial soft rot (*Erwinia* sp.): leaf, pseudostem and rhizome rot.

Bacterial leaf blight (*Xanthomonas* sp.): leaf blight.

Fusarium yellows and rhizome rot (*Fusarium oxysporum* f. sp. *zingiberi*): wilt of entire plant, rhizome rot.

Red rot (*Pyrenochaeta* sp.): rhizome rot.

Root-knot nematode (*Meloidogyne incognita*): rhizome and root galls.

Burrowing nematode (*Radopholus similis*): rhizome lesions.

Alligator skin (*Rhizoctonia solani*): rhizome tip cracks and epidermis russeting; also causes root and rhizome rot.

Postharvest decay, caused by a variety of fungi and bacteria if rhizomes are not cured and stored properly. The more common fungi are *Penicillium* spp., *Aspergillus* spp., *Fusarium* sp., *Colletotrichum* sp., and *Thielaviopsis* sp.

Pythium soft rot (*Pythium graminicola*, *P. splendens* and *P. aphanidermatum*): root rot, and soft rot of rhizomes.

Leafspot (*Phyllosticta zingiberis*): leafspot.

Tip rot, calcium deficiency, breakdown of rhizome tips.

Insects

Banana aphid (*Pentalonia nogronervosa*): a minor pest of ginger, the aphid feeds on plant sap.

Chinese rose beetle (*Adoretus sinicus*): the most serious insect pest of ginger in Hawaii; adults cause direct damage to foliage at night.

Ginger maggot (*Eumerus figurans*): considered a secondary pest of ginger; adults are attracted to injured or rotting roots, where they lay eggs; larvae sometimes feed on healthy tissue.

Lesser cornstalk borer (*Elasmopalpus lignosellus*): caterpillars can cause serious injury to shoots and stems in dry climatic conditions.

Nigra scale (*Parasaissetia nigra*): feeds on plant sap and if numerous can reduce plant vigor.

Turmeric root scale (*Aspidiella hartii*): found on the island of Hawaii in 1986 and is thought to have been eradicated from the state; sucks plant sap and if numerous could reduce the storage life of ginger roots.

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