

# **Strawberry Production and the Royal Project Foundation, Thailand**

Narongchai Pipattanawong\*

Faculty of Agriculture, Kasetsart University, 50 Ngamwongwan Rd., Ladyao, Chatuchak, Bangkok, Thailand

The Royal Project Foundation was established in 1969 by His Majesty King Bhumibol Adulyadej of Thailand to develop and improve the economic and living standards of the hill tribe peoples in the north by using cash crops to replace opium cultivation and preserve the forests and environment. Research on strawberries as a replacement crop was begun in 1974. The research outcomes gave the hill tribes and local peoples a source of income from the production of strawberries and daughter plants. Strawberries now offer a source of quick, high-return investment.

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## **Introduction**

Strawberries have been grown for many years in the north of Thailand but became economically important from the early 1980s. An unknown cultivar introduced by the British in Chiang Mai province in 1934 (Sukumalanandana, 1988) with very soft flesh, small fruit size, poor color, and low yield nevertheless spurred widespread interest as a new fruit in Thai home gardens. Until the early 1970s, some commercial producers tried to grow it.

The Royal Project Foundation was established in 1969 by His Majesty King Bhumibol Adulyadej of Thailand to develop and improve the economic and living standards of the hill tribe peoples in the north by using cash crops to replace opium cultivation and preserve the forests and environment. The Foundation and Kasetsart University researched strawberries as a replacement crop from 1974 to 1979. Strawberry cultivars were introduced mainly from the USA and planted at several research stations. The research showed that the hill tribe farmers could expect a high return on their investment 3 months after planting the crop.

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## **Production**

### **Cultivar history**

In 1972, the cultivars ‘Cambridge Favorite’, ‘Sequoia’, and ‘Tioga’ were trialed in the lowlands and northern highlands of Chiang Mai province. In the highlands, only the June-bearing ‘Tioga’ was suitable (Pipattanawong *et al.*, 1995). Therefore, from the early 1980s, most growers switched to ‘Tioga’ for its superior fruit quality (firmer, with better flavor and color) and earlier start to production in both lowlands and highlands. However, its short harvest season, small fruit, and tendency to decap when picked pose problems in growing for the fresh market (Chandler, 1991). Farmers continued to grow ‘Tioga’ until 1991.

In 1985, ‘Aiko’, ‘Pajaro’, and ‘Douglas’ were introduced from California and trialed at the Royal Inthanon Research Station (1300 m a.s.l.) but were not successful. In May 1986, ‘Nyoho’, ‘Toyonoka’, and ‘Aiberry’ were introduced from Japan and showed good fruit qualities (Sukumalanandana, 1988).

Now, farmers grow ‘No. 329’ for fresh fruit in the early season and for processing in the mid- to late season, and ‘Parajatan #80’ for fresh fruit.

Field observations suggest that in the year-round short-day conditions of the tropics, short-day treatment

to induce flower buds is not necessary, and the high insolation might strengthen the effects of the short-day conditions (Fujime, 1993). June-bearing cultivars in Thailand resemble everbearing strawberries. Some short-day cultivars with minimum chilling requirement may initiate flower bud formation in summer and thus be classified as day-neutral (Ahmadi *et al.*, 1990).

### Production areas

Strawberry production is confined mainly to Chiang Mai and Chiang Rai provinces, in northern Thailand, where the cool climate during December to March permits production.

*Chiang Mai.* In Chiang Mai province, strawberries are grown mainly in Fang and Sa Moeng districts and on Inthanon Mountain. Most berries are grown for direct sale on the farm or locally and for shipping to the Bangkok market. Those of the Royal Project Foundation are grown for the fresh market. Sa Moeng district expanded its production area from 104 ha in 1993 to 560 ha in 2013. The Royal Project Foundation had 20 ha in 2013. Production in Fang district covered 16 ha in 2013 and mainly supplied the Royal Fang factory for processing.

*Chiang Rai.* Strawberry cultivation is concentrated in Mae Sai district, where there is a small trading post bordering Myanmar at the northernmost part of Thailand. Most production (60%) is shipped fresh to Bangkok, with 20% for processing and 20% for sale on the farm or locally (20%). The decline in production in this province is a result of strawberry diseases and the use of the land for other agricultural purposes.

Most strawberry enterprises in these two provinces comprise small to medium family farms with an average size of 0.5 to 5 ha. Strawberries are also grown in the mountains in a few provinces of northeast Thailand, but production is relatively unimportant.

### Cultivation

Strawberries are grown as an annual crop in Thailand. Plants are grown 20–30 cm apart in two- or three-hill rows 0.8–1.0 m apart at a density of 50 000 to 70 000 plants per hectare.

All runner plants are forced before planting to induce flower buds and to improve vigor. The production of runners in highland nurseries from April to October under the low night temperatures there induces earlier flowering than in the lowlands.

*Lowland planting.* From June, runner plants grown in small polyethylene bags (75 mm × 12.5 mm) to eliminate the shock of transplantation are moved from

the lowlands to highland nurseries (1000–1400 m a.s.l.) for the production of new runners. They are transplanted as early as weather permits in the rainy season from June to October to extend the growing season and to facilitate early December harvest. After the chilling requirement is met, new runner plants, again in bags, are returned to the lowland fields in early October and planted at a spacing of 30 cm × 40 cm in two-row beds or 25 cm × 30 cm in four-row beds at a density of 50 000–62 500 plants per hectare in the open fields. Straw and dry leaves of *Dipterocarpus tuberculatus* are normally applied between the rows and up the sides of the beds within 2 to 3 weeks of planting. The first flower can bloom as early as November. The harvest period spans about 3 ½ months (mid-December to March) in Chiang Mai and about 5 months (early December to April) in Chiang Rai. Production peaks in January and February.

During the end of the harvest period (late March to mid-May), when the temperature begins to increase in the lowlands, runners are planted directly in small polyethylene bags and grown in the field until their return to the highlands.

*Highland planting.* From late June until late September (planting time), runner plants are grown as in the lowlands. Leaving them in the field ensures that they receive early chilling to stimulate flower bud formation. The hill tribe growers cover the raised beds with dry leaves of *D. tuberculatus* before planting. Planting trials in highland areas (>1000 m a.s.l.) have consistently demonstrated that the optimum planting time is late August, but planting no later than the first week of September achieves a high yield in most cases. The plants are planted at a spacing of 25 cm × 30 cm in single- or double-row beds, as terrace farming in the highlands necessitates the use of narrower beds. Fruit is harvested from early November to May. After the harvest period, runners are allowed to develop for propagation of new plants.

In the lowlands and highlands, fertigation is commonly used. Water may come from wells, ponds, or canals, but not surface water sources, which can contain pathogens.

A north–south bed orientation is generally recommended, as an east–west orientation can cause plants on the south side of the beds to shade those on the north side. Before planting, most strawberry fields are not fumigated, and management for the control of soilborne diseases, nematodes, weeds, and insect pests,

which can build up in continuously cropped fields, is poor. Instead, the general practice in Thailand is to crop strawberries continuously on the same land because of the market location considerations.

The demand for strawberries requires the production of 35 million runner plants each year. One daughter plant sells for THB 3–5 (USD 0.10–0.17), depending on demand and size.

### Harvesting

Strawberries are non-climacteric fruits that must be picked at or near the fully ripe stage to ensure the best eating quality; they do not ripen off the plant (Kader, 1991). Maturity is defined against US standards on the basis of fruit color ( $> 1/2$  or  $3/4$  of surface showing red or pink, depending on the grade). In Thailand, strawberries are harvested at different stages according to market demand.

Fresh fruit is harvested without stems but with the cap left on, and is graded in the field by color development: 61%–80% for local fresh sales, 41%–60% for on-farm sales, and 21%–40% for Bangkok and export markets (Kosiyachinda *et al.*, 1984). Because transportation from the highlands to the lowlands is still a big barrier, some hill tribe growers harvest the fruits at 10%–15% color development. For shipping, the fruits are packed in trays ( $> 250$  g/tray) and secured with cling film. For on-farm and local sales, they are normally sold by weight.

Fruits intended for processing are decapped and graded in the factory before washing. Quick-frozen whole fruits are most commonly used for making jam. Some unripe white fruits are also harvested for processing with food coloring according to demand. Total production is mainly for fresh shipping to Bangkok (50%) and processing (30%), with minor sales on farm or locally (20%).

### Economics and marketing

In 2013, 600 ha of strawberry production generated sales of about THB 500 million (USD 17 million). Strawberry is an important fruit crop in Chiang Mai and Chiang Rai provinces, which produce about 11 250 t annually. Gross returns can range from THB 625 000 (USD 20 800) to just over THB 2.5 million (USD 83 000) per hectare, with an estimated THB 1.25 million (USD 41 700) in total costs per hectare.

Fruit ripens from November to May in the highlands and from December to April in the lowlands. Early fruit is of excellent quality and commands high prices in November and December (THB 200–500/kg; USD

6.70–16.70/kg) on the fresh market. Fruit size decreases quickly later in the growing season, fetching THB 100–200/kg (USD 3.30–6.70) during January to mid-March.

Expanding exports and an increase in domestic demand have been responsible for expansion of the strawberry industry. Japan is now the largest export market for processed strawberries from Thailand, importing more than 3000 t per year. Fresh strawberries are also exported to Hong Kong, Singapore, and Europe, accounting for about 5% of production.

### Problems

1. Because of the lack of selection of good mother plants for runner plant production, poor field management before planting, and non-use of virus-free plants, plant vigor is poor, yields are low, and fruit quality is poor. The resultant reduction in the percentage of larger fruit increases the percentage of unmarketable fruit. Solving these problems should improve fruit quality and the profitability of farming.
2. Immature fruits have poor flavor, but more mature fruits are easily bruised and rapidly become unmarketable, especially in hot weather. Optimal harvest indices of strawberries grown in Thailand should be determined for commercial production.
3. The prevalence of several fungi that attack strawberry crowns and roots indicates reduced production in the next several years. With more than 50% of producing areas in Mae Sai district and 30% in Fang district having crown diseases in 1994–95, this is a serious problem. Other common diseases include leaf scorch, leaf spot, leaf blight, powdery mildew, and anthracnose. Pests include white grubs, spider mites, and snails.
4. Fruit prices of THB 30–50 (USD 1.00–1.70) per kg for processing and THB 200–500 (USD 7–17) per kg for fresh consumption have been too high for the respective markets.

### Industry needs

- New, earlier-bearing cultivars with improved disease and pest resistance and high-quality fruit suitable for the fresh market and processing.
- The development of better techniques of cultivation, disease detection and control, temporary storage, packaging, postharvest handling, transportation, and breeding.

- Further expansion of strawberry cultivation in Thailand to meet increasing demand. There is still some potential for expansion in the highlands. A longer harvest season will be important for exports. Techniques for forcing strawberry plants should provide the opportunity to expand the harvest season. A better understanding of how earlier planting in highland fields accelerates flower bud initiation will help to optimize this. New early-bearing June-bearing and day-neutral cultivars may be needed to take full advantage of these improvements.

### Conclusions

The Thai strawberry industry needs new, early-bearing cultivars with good-quality firm fruits and high yields for fresh product and export. The improvement of day-neutral cultivars will be necessary. Strawberries for processing may have a better future when problems connected with cultivar, cultivation, and fruit price are resolved.

The Royal Project Foundation retains an important role, as most strawberry growers depend on situational research to solve problems. The combination of a good climate, better resources, and further research will advance the Thai strawberry industry.

### Acknowledgements

I thank the Royal Project Foundation and the Faculty

of Agriculture, Kasetsart University, for the data, and the Agricultural and Forestry Research Center, University of Tsukuba, for its invitation and funding to attend the Agricultural Education for Sustainable Development Symposium 2014.

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