# Cultivation of Horticulture Crops


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# Chapter 3

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## 1. Fruits

Fruits have a lot of nutritional elements, anti-oxidants, vitamin C and dietary fibers, which inhibit cancer-inducing substances. These also contain K which promotes Na release for maintaining blood pressure. The Japanese government has published guidelines, stating the importance of eating at least 200 g of fruits everyday for good health. This standard can be fulfilled by eating either one piece of apple or a cluster of grapes or 40 pieces of cherry or one piece of pear or 7 pieces of prune or 2 pieces of orange a day.

Fruit farming in Hokkaido was started upon the advice of Horace Capron, the Commissioner and Adviser to the Development Commission. Many kinds of saplings were imported mainly from United States. Primary fruit trees were apple, grape and cherry, which were grown mainly in the southern (Nanae), and central Hokkaido (Yoichi, Niki, Sohbetsu, Mashike and Takikawa) (Fig. 3-1, 3-2). Fruit acreage, mainly of apple, peaked to about 7,000 ha in the 1960's. Subsequently, it decreased and was only 3,152 ha in 2004. This was due to the disease valsa canker, freezing damage, urban sprawl and decline in the market price. Acreage of grapes remained comparatively stable. On the other hand, cherry acreage increased to 630 ha; 1.6 times of that in 1990 (Fig. 3-3). Many orchard farmers in Hokkaido have been trying modern methods including growing dwarf trees of apple and cherry for saving physical labor, building greenhouses for early harvest of grapes and putting plastic sheet roofs for preventing cracking of cherry fruits due to rain. These days many consumers visit orchards to enjoy fruit picking and buy fresh fruits, especially apple, cherry, grape, blueberry etc.

### (1) Apple

Apple cultivars bloom in second half of May, and fruits are harvested from August to November (Table 3-1). In Honshu island, the main island of Japan, 'Fuji' is the most popular cultivar. Over 50% of total apple production is in Honshu Island. In Hokkaido, many other apple cultivars are also grown. There, 'Fuji' is not the main cultivar.


Fig. 3-1. Main fruit trees produced in Hokkaido
1.Apple (‘Hacnine’)
2.European pear (‘Brandy wine’)
3.Cherry (‘Nanyo 2’)
4.Grape (‘Cambell early’)
5.Blueberry
6.Honey berry (haskap)

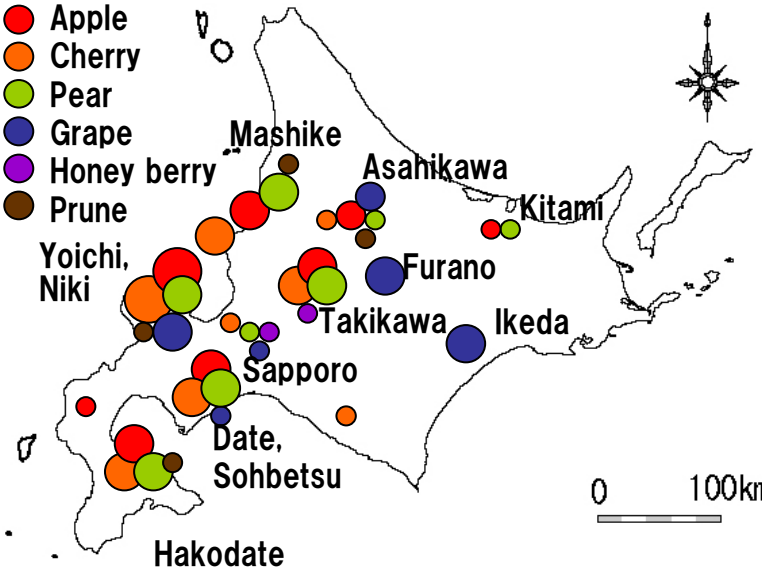


Fig. 3-2. Production area of main fruit trees in Hokkaido

Table 3-1. Harvest season of apples in Hokkaido

| Month | Cultivars |
|---|---|
| August | 'Natsu-no-beni', 'Natsu-no-mai' |
| September | 'Kitakami', 'Tsugaru' |
| October | |
| early | 'Sansa', 'Akane', 'Senshu', 'Jonathan',Himekami', |
| middle | 'Red gold', 'Golden delicious', 'New jona gold', 'Hacnine', |
| late | 'Orin', 'Mutsu' |
| November | 'Fuji' |

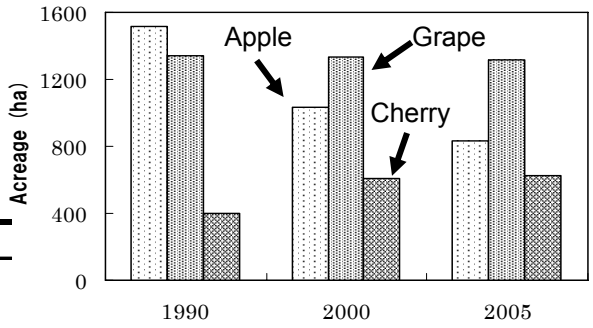


Fig.3-3. Change of production acreage in apple, grape and cherry in Hokkaido


Fig.3-4. Dwarf apple. Grafting with dwarf root stock in apple nursery production(1). Lodging of dwarf apple tree by typhoon because of poor root system(2).

In general, fruits of early harvested cultivars are sour and can not be stored for long time. ‘Tsugaru’, a typical middle harvest cultivar, produces big and sweet fruits. ‘Hacnine’ (Hokkaido Apple Clone No. 9) that had originated in Hokkaido, was established by the Hokkaido Central Agricultural Experimental Station in 1985. Approximately 93% of the apples are sold fresh and only remaining 7% are used for processing, mainly for juice and jam.

Rootstocks M9, M26 and JM7 etc. have been used for production of dwarf trees. Dwarf trees are convenient for spraying fungicides and pesticides, pruning, training and also for harvesting of fruits (Fig. 3-4). These can also be planted at higher density. However, due to their weak rootstock, some dwarf apple trees fell down during typhoon no.18, which attacked Japan in 2004 with a wind velocity of more than 40 m/s.

(2) Cherry

Although cherries are more expensive compared with other fruits, yet these have been popular among many consumers. Cherries are harvested from early July to early August. Some famous cultivars such as ‘Sato-nishiki’, ‘Beni-shyho’ and ‘Nanyo’ etc. are very sweet, and their price can be more than 1,000 yen/kg. A new cultivar named ‘June Bride’ has been developed by the Hokkaido Central Agricultural Experimental Station. This cultivar is harvested in late June, fairly earlier than other cultivars. It also has higher tolerance to low temperature. It sets well by pollination with almost all cultivars that are grown in Hokkaido. In order to protect cherry fruits from cracking by rains, cultivation of cherry under poly-tunnels (of height more than 2.5 m) is increasing (Fig. 3-5). Besides, dwarf cherry is gradually spread by using dwarf root stock (Fig. 3-6).

(3) Grape

In Hokkaido, grapes production per year is 10,000 t of which 38% is processed into wine and juice. The main cultivars for fresh use are ‘Delaware’, ‘North-black’, ‘North-red’, ‘Buffalo’, ‘Portland’, ‘Niagara’ and ‘Tabiji’, while ‘Seibel 13053’, ‘Seibel 5279’, ‘Kerner’, ‘Muller Thurgar’ and ‘Zweigelt Rebe’ are mainly processed into wine. Hokkaido has the highest grape production for wine in Japan. There are many wineries, big and small, near grape farms in Hokkaido. Gibberellin is sprayed on grape wines for production of seedless grapes, especially of early cultivar ‘Delaware’.

Fig.3-5. Field work for cherry production. 1. Working with extension Ladder. 2. High tunnel for rain shelter.

Fig.3-7. Fruit of raspberry (1), haskap (2) and cherry (3).

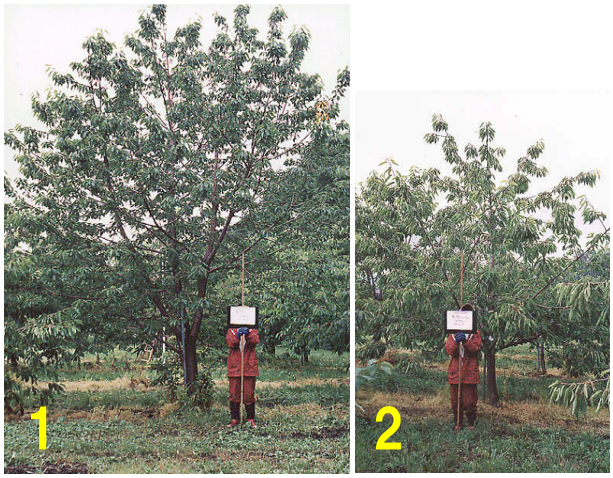

Fig.3-6. Dwarf production in Cherry. 1. Cherry tree grafted with ordinary root stock cultivar 'Colt' 2. Dwarf tree grafted with 'Chishima' .

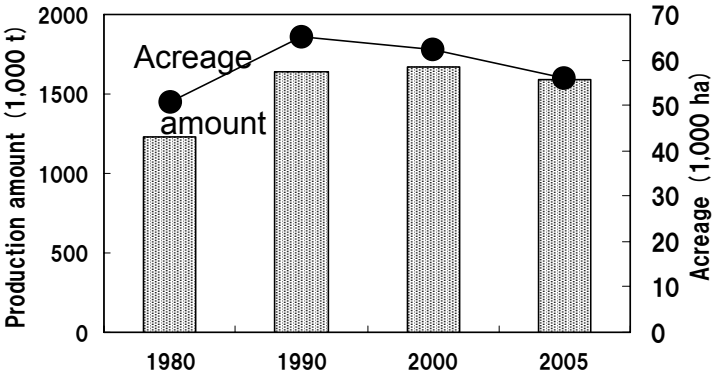


Fig.3-8 Change of production Acreage and production amount of vegetable produced in Hokkaido

Table 3-2. Change of Production acreage of main vegetable in Hokkaido

| Vegetables | Production Acreage (ha) | | |
|---|---|---|---|
| | 1,990 | 2,000 | 2,005 |
| Japanese radish | 5,410 | 5,090 | 4,390 |
| Carrot | 5,680 | 6,410 | 5,140 |
| Chinese yam | 1,490 | 1,890 | 2,130 |
| Cabbage | 1,870 | 2,800 | 1,680 |
| Welsh onion | 801 | 1,100 | 868 |
| Onion | 11,700 | 12,800 | 11,600 |
| Asparagus | 4,540 | 2,330 | 1,850 |
| Broccoli | 474 | 683 | 1,680 |
| Pumpkin | 6,620 | 8,080 | 8,090 |
| Sweet corn | 14,500 | 9,940 | 8,780 |
| Tomato | 459 | 687 | 780 |
| Melon | 2,030 | 2,020 | 1,610 |

Table 3-3. Change of production acreage of vegetables produced in greenhouse and high tunnel, Hokkaido

| Vegetables | Acreage (ha) | | |
|---|---|---|---|
| | 1990 | 2000 | 2005 |
| Tomato | 152 | 424 | 575 |
| Cucumber | 136 | 127 | 130 |
| Welsh onion | 49 | 174 | 134 |
| Strawberry | 105 | 123 | 117 |
| Watermelon | 286 | 140 | 181 |
| Melon | 592 | 1093 | 1079 |
| Spinach | 445 | 703 | 740 |

4) Other fruits

Prune, blueberry and honeyberry (haskap) are gaining popularity among health conscious Japanese. Honeyberry locally called ‘haskap’ had originated in Hokkaido. Production of blueberry, raspberry and honeyberry is increasing as these are used for cakes (Fig. 3-7). Honeyberry grows wildly in Hokkaido. Farmers cultivate the plants collected from mountains. However, harvesting of honeyberry is labor intensive because of the small size and soft texture of the mature fruit. Hokkaido University has been carrying out selection of individual plants from native honeyberries to breed cultivars with bigger and tastier fruits.

## 2. Vegetables

The cool climate in summer and autumn has made Hokkaido the main supplier of vegetables. The vegetable production accounted for 15.4% of total agricultural production in Hokkaido. Approximately 70% of vegetables produced in Hokkaido are transported to other islands in Japan. Hokkaido can be proud of its high share in Japan’s vegetable production: onion (51%), sweet corn (23%), carrot (24%), Japanese radish (11%), Chinese yam (29%) and melon (15%)（Table 3-4）.

The acreage of vegetables has been expanding in Hokkaido since 1970 (Fig. 3-8). In 1995, area and production of vegetables reached a maximum of 66,000 ha and 1,876 t, respectively. Area under major vegetables was: Japanese radish: 5,400 ha, carrot: 5,700 ha, onion: 12,000 ha, pumpkin: 6,600 ha and sweet corn: 14,500 ha (Table 3-2). However, due to labor shortage and low sale price in 2006, area and production reduced to 55,000 ha and 1,592 t, respectively. Compared to 1995, the production of Japanese radish, cabbage and sweet corn reduced, whereas that of Chinese yam (Nagaimo), pumpkin, tomato and broccoli increased. In recent years, vegetable production has been stable and valued at 1,600-1,700 billion yen, which accounted about 8% of total vegetable production in Japan.

Use of greenhouses (GH) and high tunnels (HT) are increasing, and these covered an area of 2,900 ha in 2005 (Table 3-3). The average area of GH and HT per farm is about 20 a. Tomato, cucumber, welsh onion, strawberry, watermelon and spinach are mainly produced in GH and HT.

(1) Onion

Growing of onions in Japan started in Sapporo in 1871 on a trial basis. On

Table 3-4. Comparison of output of vegetable produced in Hokkaido and other prefectures

| Vegetable | Output (Billion Yen) | | | |
|---|---|---|---|---|
| | Total | 1st | 2nd | 3rd |
| Onion | 73.2 | Hokkaido 37.0 | Hyogo 8.5 | Saga 7.8 |
| Sweet corn | 30.9 | Hokkaido 7.2 | Chiba 3.9 | Ibaraki 2.5 |
| Carrot | 60.8 | Chiba 15.4 | Hokkaido 14.7 | Tokushima 6.6 |
| Japanese radish | 106 | Chiba 14.2 | Hokkaido 14.3 | Kanagawa 9.7 |
| Chinese yam | 44.9 | Aomori 14.9 | Hokkaido 13.1 | Chiba 3.9 |
| Melon | 90.2 | Ibaraki 18.4 | Hokkaido 13.9 | Kumamoto 13.2 |

Fig. 3-10. Harvest and washing of carrot, Otofuke Town, eastern Hokkaido


Fig.3-9. Onion production 1,2.Growing of Seedlings with plastic tray in plastic tunnel from March to May. 3.Planting machine. 4. Growing of onion plant in summer. 5,6. Mature of onion bulb and under-cutting before harvest for effective drying on the field. 7,8. Harvest of onion bulb and storage in September. 9. Clean up of bulb for marketing.

commercial basis production began in 1878, after the success of the cultivar ‘Yellow Globe Danver’. Later, this became the ancestor of modern Hokkaido cultivars. In 2005, onion’s acreage was11,600 ha.

Cultivars’ choice depends on the growing season i.e. spring or autumn. In Hokkaido, onion is grown during spring. Seeds are sown in late February or early March, transplanted in May and harvested in September. Onion cultivation is completely mechanized from sowing to harvest, and also packing (Fig. 3-9). The Hokkaido Agricultural Experimental Station has developed a new onion cultivar 'Quer rich', which has higher content of quercetin than the ordinary cultivars. Quercetin has anti-thrombus effect.

(2) Carrot, Japanese radish and Chinese yam

These vegetables are mainly produced in the Tokachi region of eastern Hokkaido. Carrots as well as radish are harvested, and also washed and packed using automatic machines (Fig. 3-10).

Seed tubers of Chinese yam are planted in May and harvested in October-November (Fig. 3-11). Chinese yam has sticky texture, which is good for various traditional Japanese foods. This vegetable can be stored for a long period at low temperature and is transported to Honshu Island and exported to south-eastern Asian countries.

(3) Cabbage and welsh onion

Cabbage is also mainly cultivated in Tokachi region. Nurseries are grown in greenhouses and transplanted by planter. However, harvesting is done manually (Fig. 3-11).

Welsh onion is one of the traditional materials for Japanese food. Usually, welsh onion is added to noodles such as soba, udon etc. The nursery of welsh onion is transplanted by a unique planter and ridging is performed 2 or 3 times until harvest to produce white leaves. This activity is called ‘blanching cultivation’ (Fig. 3-11).

(4) Pumpkin

Pumpkin is popular among people of all ages. However, its cultivation involves tedious activities such as arranging lateral shoots and harvesting in large fields. To solve such problems, a new cultivar named ‘TC2A’ (commercial name ‘Hottoke Kuritan’) with short internodes and fruiting at lower nodes has been developed by the National Agricultural Research Center for Hokkaido

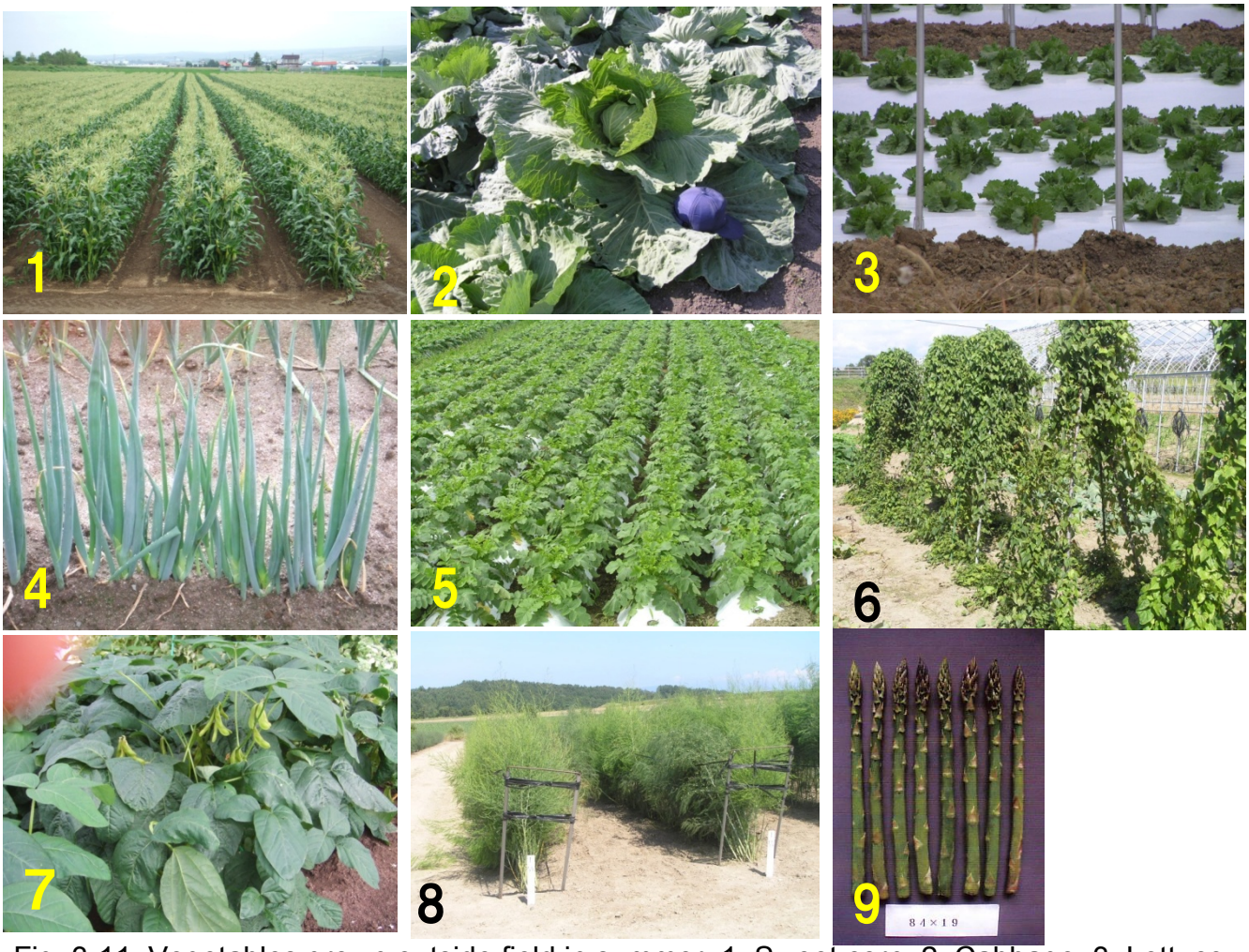


Fig. 3-11. Vegetables grown outside field in summer. 1. Sweet corn, 2. Cabbage, 3. Lettuce, 4. Welsh onion (banching onion), 5. Japanese radish called 'Daikon', 6. Yam called 'Nagaimo' 7. Immature soybean called 'Edamame' 8,9. Asparagus , Hokkaido University established a new cultivar named 'Yujiro', with cooperated with National Agricultural Research Center for Hokkaido Region and Hokkai Can Co., Ltd.


Fig. 3-12. Melon and watermelon produced in Hokkaido
1. Orange-colored melon 2,3. Ordinary and black peel-watermelon

Region.

(5) Asparagus

Though asparagus is an important vegetable of Hokkaido, its acreage has decreased remarkably after the 1990's. Asparagus if grown continuously on the same field for years, its productivity decreases. Thus it needs to be replanted in new fields. Since this involves time and money, which are constrains for the traditional farmers who have gone old now, little replanting has been undertaken.

The production of green asparagus, however, is increasing as new cultivars were imported from United States and Europe (Fig. 3-11). Long-term harvesting of asparagus by cultivating in high tunnels has been established. The production of green asparagus is higher than its demand, whereas the demand for white asparagus for use as salad is increasing.

(6) Strawberry

Strawberry cultivars are of two types: i) flowering only for short period and ii) those flowering nearly through out the year. Almost all cultivars in Japan flower for short period. Strawberry is harvested from December to April in Honshu islands and from May to June in Hokkaido. In summer, a large amount of strawberry is imported. For strawberry production both in summer and autumn, all season flowering cultivars such as 'Pechika' and 'HS183' are now cultivated in Hokkaido. These are planted from May to July. Now strawberries are grown on high beds for comfortable work (Fig. 3-13). Strawberries are mainly used for cakes.

(7) Melon and watermelon

Melon is one of the symbolic fruits of Hokkaido. In 2003, melon was cultivated on 1,760 ha. The cultivar called 'Spicy' came from the United States in 1922. A hybrid between 'Carter's Earl's Favourite' and 'Spicy' was developed by the Hokkaido Agricultural Experimental Station in 1935. It became the base cultivar of Hokkaido. 'Yubari King', the most popular brand in Japan, is one of its progenies. It has orange and soft flesh (Fig. 3-12). Large quantities of delicious melons are produced in Hokkaido and transported to all over Japan from July to September. Unique watermelon with black peel and red fresh is cultivated around Iwanai town (Fig. 3-12).


Fig. 3-13. Strawberry in high tunnel. 1. Nursery 2, 3. Production by low bed and high bed. 4,5,6. Many fruits attacked in one cluster and fruit thinning for large fruit production.


Fig. 3-14. Tomato production and tomato fair. 1.Grafting in young seedling 2.Training of tomato plant in high tunnel. 3. Growing tomatoes. 4,5. Hand packing of tomato 6. Automatically packing of small size tomatoes. 7. Tomato fair held at supermarket. 8. Middle size tomato for cooking. 9. Harvest season of processing tomato

(8) Tomato

Tomato is produced in glasshouses and high tunnels in order to prevent their damage by rain (Fig. 3-14). Previously, tomatoes were harvested about 7 days before full maturity in order to maintain their hardness and freshness till these reach consumers. But these tomatoes used to loose their original flavor and taste. Now tomato cultivars, such as “Momotaro” have been developed, which are good enough to maintain their hardness, freshness, as well as flavor and taste for some duration even when these are harvested at their full maturity. These cultivars are becoming very popular.

Main production areas of tomatoes are near Hakodate, Takikawa and Biratori. Processing of tomatoes into juice, and as boiled etc. is increasing Tomato fair is held for commercial purpose every year.

Hokkaido now has the policy to promote ‘Clean Agriculture’, which is friendly to environment. The objective is to reduce the use of chemicals and fertilizers, so as to produce safe agricultural products. In vegetable production, plastic mulch or plant residue mulch is used for effective weed control, and net covering is used for pest control (Fig. 3-15). Farmers who do not use chemicals and fertilizers can label their products as ‘Yes Clean’ (Fig. 3-16).

**3. Flowers**

(1) History of flower production

Flower cultivation in Hokkaido started in 1875 when an American, Lewis Barman, planted 74 foreign species in a greenhouse at Sapporo Agricultural School. In those days, flowers were also grown in some parks. After World War II, the demand for flowers increased. Farmers living near the cities began growing flowers. After 1960’s, with rapid economic growth, the flower production increased. In 1965, cut-flower production became one of the substitutes to rice cultivation. Since 1975, ‘Baby’s Breath’ of Hokkaido has received maximum nationwide awards. Hokkaido supplies large shipment of cut-flowers to other prefectures from summer to autumn. Flower production is also carried out as a part-time job by rice farmers.

(2) Flower calendar in Hokkaido

Main flowers produced in Hokkaido are shown in Fig. 3-17 and Fig. 3-18. Cut-flowers are produced mainly from May to November except Alstroemeria

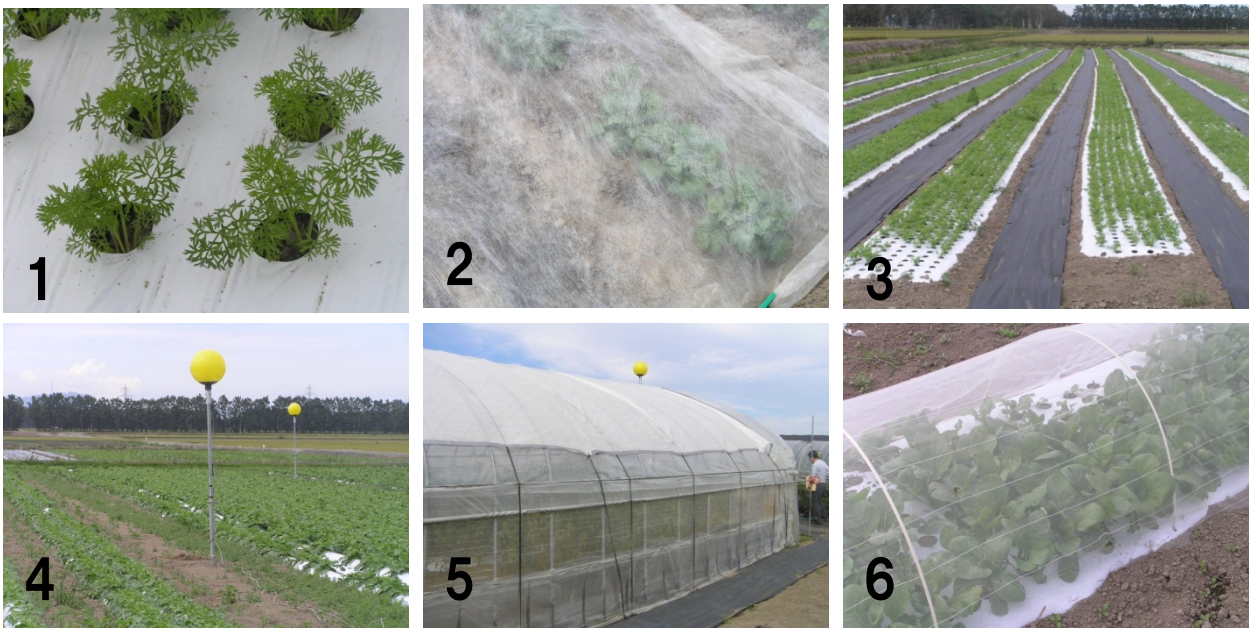


Fig. 3-15. Some materials for reduction of application of agricultural chemicals. 1. Mulching of plastic film 2. Covering by non-woven fabric at juvenile stage 3. Black sheet for controlling weeds 4. Yellow light for confusing flight of moth. 5, 6. Setting of net for protecting from some insets


Fig. 3-16. Yes! Clean label certificated as the vegetable production with reduced fertilizer and agricultural chemicals(1). Green manure plants are incorporated to modify of soil properties before vegetable production (2).


Fig. 3-17. Main flowers produced in Hokkaido. 1.New lily cultivar named ‘Kita-kirari’, 2,3. Alstroemeria, 4. Prairie gentian, 5. Carnation, 6. Cyclamen

and Freesia, both of which have year-round production (Table 3-5). Farmers grow seedlings for cut-flowers in greenhouses or high tunnels in winter and transplant them in early spring. Some farmers transplant them in winter itself for forced production.

Cool summer weather of Hokkaido allows farmers to supply flowers to other prefectures where it is still off-season. The climate of Hokkaido gives flowers a vivid color, thereby creating a huge demand for theses in Honshu. Shipments from Hokkaido in July-September, 2005 accounted for 60% of the 174 million yen cut-flowers production in Japan in that year. In 2005, in Hokkaido flowers were grown on 694 ha and production earned 12.9 billion yen, of which 72% was from cut -flowers, and 18% from potted flowers and seedlings (Table 3-6).

Some companies have large greenhouses (Fig. 3-21) with modern facilities for regulating temperature, humidity and nutrition etc. Expensive flowers like orchids and fruits with high quality can be produced under these conditions. However, their running and maintenance cost is too high (Fig. 3-21).

(3) New cultivars and technology

1) Lily cultivar

Hokkaido Ornamental Plants and Vegetables Research Center in Takikawa city, has developed a new lily cultivar ‘Kita-kirari’ in 2002 (Fig. 3-17). This cultivar produces small flowers. The petal is vivid reddish-orange with small dark-brown spots. The inflorescence is compact raceme, and thus this cultivar is suitable for Japanese traditional flower arrangement ’Ikebana’, and small bouquets. This cultivar produces more cut-flowers per unit area than other lily cultivars because of its numerous branches.

2) Wet-transporting system

Maintenance of freshness in cut-flowers is important, especially, while transporting them by trucks (73% of total transportation) from Hokkaido to big cities in Honshu islands. In order to achieve this a small space in which water is stored is set in each packing case so that cut-flowers are able to absorb water and remain fresh (Fig. 3-18). A chemical solution ‘PAT’ (Plant Active Technology), is added to vases to prolong the life of cut-flowers.

3) Cultivation under artificially prolonged days

Long-day treatment has been used to control flowering time in

Table 3-5. Production season of main flowers in Hokkaido

| Flower | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cut | Baby's breath | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | Carnation | | | | | ● | ● | ● | ● | ● | ● | ● | ● |
| | Statice | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | Prairie gentian | | | | | | ● | ● | ● | ● | ● | ● | |
| | Alstroemeria | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | Lily | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | Stock | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | Antirrhinum | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | Turip | ● | ● | ● | ● | ● | | | | | | | |
| | Freesia | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | Color | | | | | ● | ● | ● | ● | ● | ● | | |
| | Rose | | | | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | Delphynium | | | | | ● | ● | ● | ● | ● | ● | ● | |
| | Cosmos | | | | | | | ● | ● | ● | ● | | |
| | Sunflower | | | | | ● | ● | ● | ● | ● | | | |
| | Sweet pea | | | | ● | ● | ● | ● | ● | ● | ● | ● | |
| | Gladiolus | | | | | | | ● | ● | ● | | | |
| | Sunder sonia | | | | | | | ● | ● | ● | ● | ● | |
| Pot | Cyclamen | | | | | | | | | ● | ● | ● | |
| | Poinsettia | | | | | | | | | ● | ● | ● | |
| | Primula | ● | ● | ● | ● | | | | | | | | |
| | Lavender | | | | | ● | ● | ● | | | | | |
| | Lily of the valley | | | | | ● | | | | | | | |


Fig. 3-18. Flower production and baby's breath in wet transportation. 1.Tulips in box, 2.Statics, 3.Lily, 4.Prairie gentian, 5.Carnation, 6. Wet transportation

Chrysanthemum. This technique was adapted in Delphinium and *Prairie gentian* flowers in autumn in Hokkaido. 'Long-day treatment' elongates inter-nodes of Delphinium. In Prairie gentian, the same technique prevents blasting of the flower buds and helps them have fine blooms.

4) Flower parks

There are many flower parks in Hokkaido: Lily park in Sapporo, Lavender park in Furano, Tulip park in Kami-yubetsu, moss phlox in Takinoue, Sunflower park in Hokuryu and English style garden in Uni town (Fig. 3-19).

(4) Future

The flower production in Hokkaido has been growing and these are produced all over Hokkaido. However, these days demand of cut-flowers is unstable due to recession, spread of flower production in the whole country and increase in imported flowers etc. On the other hand, the demand of flowers for home-gardening and room decoration is increasing. In order to stabilize the demand, it is important to have access to the marketing information and an efficient distribution system. These days, many events are organized for exchanging information among farmers, consumers and designers etc. (Fig. 3-20).

Acknowledgement

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Fig. 3-19. Flower garden in Hokkaido. 1,2.Lavender and Salvia (Furano city)
3,4. Yuni garden (Yuni town), 5,6. Marygold and sunflower (Nakafurano town)

Fig. 3-20. Festival of baby's breath for expanding of production and consumption.

Table 3-6. Change of production acreage in flowers in Hokkaido

| Flowers | Production acreage (ha) | | |
|---|---|---|---|
| | 1990 | 2000 | 2005 |
| Cut flower | 421 | 700 | 629 |
| Potted flower | 15 | 34 | 21 |
| Seedlings for garden | 14 | 50 | 44 |
| Flower farmer | 2,737 | 2,402 | 1,946 |

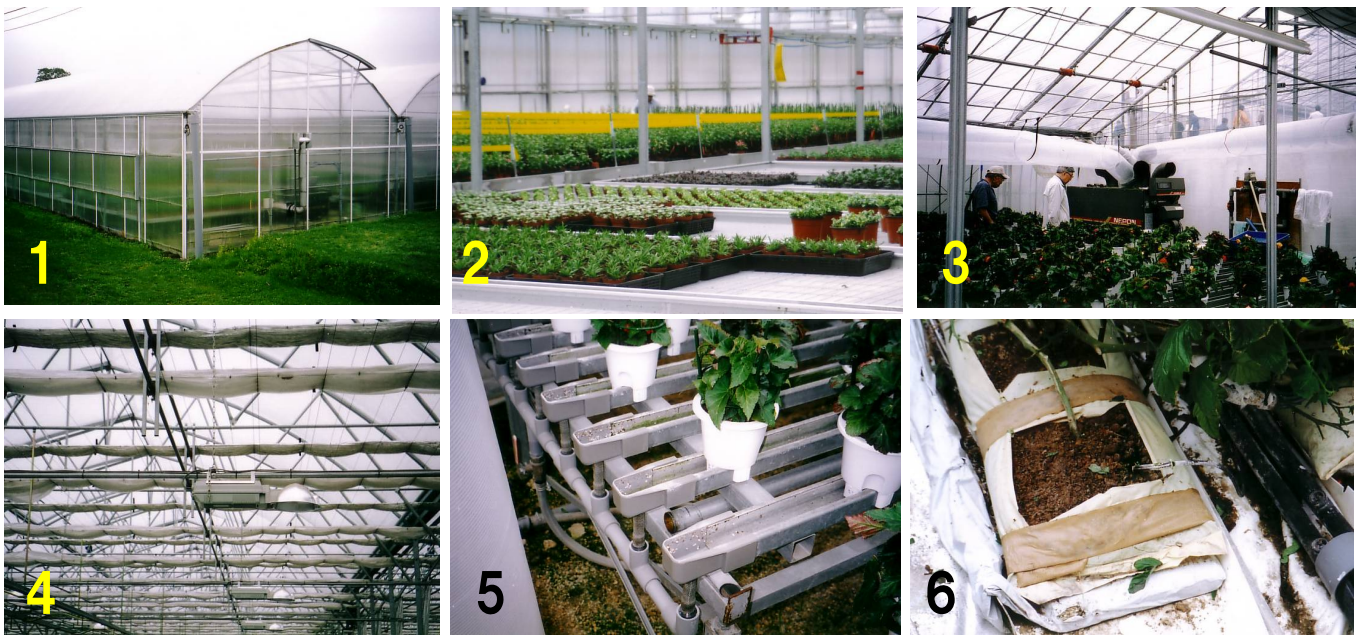


Fig. 3-21. Modern facilities. 1 Plastic high tunnel with roof, 2. Moving bench, 3.Warm duct, 4.Filter for shading, 5. Liquid fertilizer application, 6. Tomato production with drip irrigation.