Year-round Production of Chrysanthemums in Japan

By JOICHI KAWATA

Researcher, Laboratory of Floriculture, Horticultural Research Station

Chrysanthemum is a national flower in Japan as well as cherry blossoms. Though it seems to have originated from China, the Japanese have deeply admired it and bred so many varieties with various types of flower during the Tokugawa era (17th–19th century) as we can see them now. These varieties were introduced to Europe in the 17th century, and then to the United States.

At present they have become one of the most important flowers for cut flowers as well as potted plants comparable to roses, carnations and cyclamens.

They can also be grown abundantly in Hawaii and Formosa under the subtropical climatic condition where the day-length and temperature are suitable to flowering all year round, even if supplementary light is applied

Table 1. Classification of chrysanthemum varieties in Japan based on the responses to temperature and photoperiod (Okada, M., 1963)

No. of Group	Group	Respone to photoperiod		Response to temperature
		Flower bud initiation	Flower bud development and flowering	
I	Autumn flowering	Short day	Short day	Usually flower bud initiation is acomplished, provideed that minimum temperature is above 15°C. and flower bud development and flowering are not inhibited by high temperature.
II	Winter flowering	Short day	Short day	Flower bud development and flowering are inhibited by high temperature.
III	August flowering	Day neutral	Day neutral	Usually flower initiation is accomplished about 10°C.
IV	August flowering	Day neutral	Day neutral	Flower bud initiation is accomprished, provided that minimum temperature is above 15°C, similarly to autumn flowering chrysanthemums. Usually flower bud development is inhibited by lower temperature and flower bud is differentiated into crown bud.
V	September flowering	Day neutral	Short day	Same response as August flowering chrysanthemums as far as temperature is concerned.
VI	Okayamaheiwa type	Short day	Day neutral	Same response as autumn flowering chrysanthemum as far as temperature is concerned.

for some duration after cutting or planting to promote vegetative growth to some extent.

Temperature and photoperiod have proved to be important factors in the control of flower initiation and its development in crysanthemum. Consequently the time of flowering can be regulated by artificially controlled temperature and day length. By using normal autumn or fall flowering varieties, satisfactory blooms can be produced at any season of the year.

In the United States and Europe, year round production of chrysanthemum is only carried out by controlling temperature and day-length, while in our country it is also done by the same method on a larger basis, and on the other hand by using various ecological types of which responses to temperature and day-length are different from type to type. These varieties have been introduced by some breeders in Japan who can be proud of their achievement, admired by the world's horticulturists.

According to an extensive study conducted by Dr. M. OKADA*, chrysanthemum varieties in Japan can be classified basing on the difference in their responses to temperature and photoperiod for flower initiation and its development. The results are formulated as shown in Table 1.

Year-round cut flower production

Chrysanthemums are propagated by cutting or by using suckers which break from the base of stem or stool. The rooted young plants should be planted in bed and be grown under inhibiting condition of flowering to keep vegetative growth by the time they will be able to produce enough number of leaves on a long stem which is required as good quality cut flowers. The inhibiting condition for flowering is different with varieties as is mentioned above.

1) Year-round production without regulation of photoperiod

a) Cultivation of autumn flowering varieties in the open.

Cutting should be done from the beginning of May to the Middle of June. After rooting they are provisionally planted in bed by the time their roots are well developed. And then they are again transplanted to bed. One week after, starting stage of growth, their terminal growing point with a few unexpanded leaves are removed. When the date of pinch is early, the branch will produce crown buds which will not be able to develop normal flower. These crown buds should be removed to produce normal flower buds.

The date of flower initiation is from the middle of August to the beginning of September according to variety. Flowering date is from the beginning of October to the end of November.

b) Cultivation of winter flowering varieties.

The photoperiod requirement of this type of varieties is the same as the autumn flowering varieties, while high temperature prevents the initiation of flower buds or its development. Cutting and planting should be done one month later than that of the autumn flowering varieties. Otherwise, they will often produce crown buds or flower of poor quality on aged plants. The flowering time is from December to the beginning of February.

c) Cultivation of summer flowering varieties under structures.

Suckers from the plants which are propagated by cutting from the end of August to the end of September are planted in bed under structures from December to January, After planting, temperature must be kept low not to initiate flower buds by the time they grow enough to produce satisfactory cut flower in length. In general, when they expand to 10 leaves and reach to 20~30 cm in length, temperature should be raised to 15~20°C to promote flower initiation and its development. Flowering time is from the end of February to May.

* OKADA, Masatsugu; Studies on Flower Bud Differentiation and Flowering in Chrysanthemum. Memories of the Faculty of Agriculture, Tokyo University of Education. Vol. 9, 63–202, 1963.

d) Cultivation of autumn flowering varieties under structures.

Suckers are planted from the end of December to the beginning of January. Cold requirement of suckers for break dormancy is much larger in general than that of the summer flowering varieties. Therefore, much attention should be paid whether the cold requirement of suckers is satisfied or not by the time of planting under structures. Suckers produced in highland where the temperature by the end of autumn is low enough to break dormancy are used for early planting for early flowering.

As minimum temperature for flower initiation is higher than that of the summer varieties, temperature can be kept higher to keep vegetative growth, and should be kept higher than 15°C after they reach enough height to produce satisfactory cut flower in length. With the exception of the above mentioned points, the method of cultivation is not different from that of the summer flowering varieties.

e) Cultivation of Okayamaheiwa type.

The responses to photoperiod and temperature before flower bud initiation is almost the same as the autumn flowering varieties. However, the development of flower buds can progress under any day length. Therefore, they can flower without shading after the end of May or under long day whenever they already initiate flower buds.

f) Cultivation of summer flowering varieties in the open.

From the end of Septmber to the beginning of October stock plants are divided into a stool with a few suckers, and they are planted in bed. The flowering time is from the end of May to July according to varieties.

g) Cultivation of August flowering varieties.

Though they are day neutral as well as summer flowering varieties, the required temperature for flower bud initiation is above 15°C. This is the reason why their flowering time is later than that of the summer flowering varieties.

Cutting should be done in the middle of April. After one month, they are planted in bed. Time of flower initiation is the end of June.

h. Cultivation of September flowering varieties.

The responses to photoperiod and temperature for flower bud initiation is the same as the August flowering varieties. However, short-day is required for the development of flower buds. Planted at the same time as the August flowering varieties, they initiate flower buds under long day and keep standstill or turn to crown buds. Cutting should be done in the middle of May, one month after the time of the August flowering varieties.

2) Production of autumn flowering varieties with regulation of photoperiod

Both flower initiation and its development of the autumn flowering varieties can be regulated by controlling of photoperiod. Under long-day condition above 13.5 hours from May to August they continue vegetative growth, while under short-day condition under 13.5 hours from September to April they can flower provided the temperature is satisfactory.

a) Production from the middle of May to the beginning of July by shading under structures without heating.

Suckers are planted during winter months under structures without heating. Shading must be done every day after the end of April to keep short-day condition of 10~11 hours. Materials of shading are black plastic film or cloth to keep dark inside.

b) Production from July to the beginning of October by shading.

One hundred thirty to 150 days are required from cutting to flowering. Thirty days are from cutting to planting, and 50 days are from pinching a week after planting to starting date of shading. Duration of shading is from 45 to 60 days depending upon varieties. High temperature inside the shade has an injurious effect on the flower quality. Therefore this type of cultivation is prevalent in the highland where the climate in summer is

mild.

c) Production from December to March by light or long-day treatment.

Cutting should be done from the end of June to the beginning of August, and they are planted from August to the beginning of September. The later the cutting date and the higher the temperature becomes, the more difficult the rooting is. When cutting date is early, they should be pinched twice so as not to produce crown buds. Supplementary illumination to make long-day must be applied after the beginning of September.

Light for two to three hours during midnight is perfectly enough in any season and more effective than in the evening. An 100-watt incandescent lamp is used in practice, and each lamp can cover the plants within 2 m. Date of light stoppage must be decided by proposed date of flowering and variety. Stopping in the beginning to the middle of October is for the end of December flowering, and in the end of October is for February to March flowering in late varieties. This type of cultivation is prevalent under structures without heating with low production cost.

Year-round potted flower production

Potted chrysanthemums have been much appreciated since the Tokugawa period. Thousands of wonderful specimens of potted chrysanthemum can be seen at some chrysanthemum flower show in autumn in Japan.

However, the method of year-round production of potted chrysanthemum was introduced from the United States several years ago, and quickly became a great fad. It seems probable that they will become more popular.

Stock plants are grown under long-day condition and high temperature above 15°C. The idea of regulation of flowering is the same as mentioned above on cut flower production of autumn flowering varieties. But the vegetative growth is far shortened to produce dwarf plant. Some rooted cuttings are inserted at an angle outside in a pot. They are pinched once during three weeks following planting, and then moved to short-day condition by shading or stoppage of light. Height of plants can be regulated by the starting time of short-day treatment. Nine to 11 weeks are required from the starting of short-day treatment to flowering.

Value of production of cut chrysanthemums occupies 32% of the total cut flower production in Japan. That of potted chrysanthemums rank No. 2 after cyclamens as potted flowering plants. Statistics published by Ministry of Agriculture and Forestry in 1968 are shown in Table 2.

Table 2. Area and value of production of chrysanthemum in Japan (1967).

Type of cultivation	Under structure				Open		Total value
	Heated		Unheated				
	Area of cultivation	Value	Area of cultivation	Value	Area of cultivation	Value	
Cut flower	a	million yen*	a	million yen*	a	million yen	million yen*
Lightening	3551	350	21239	1874	1773	57	2281
Shading	—	—	3375	334	3193	90	424
Others	4428	443	14298	979	180844	3490	4911
Total	7979	793	38912	3187	185810	3637	7616
Potted	71	140	679	135	1	3	278

* 360 yen = 1 $

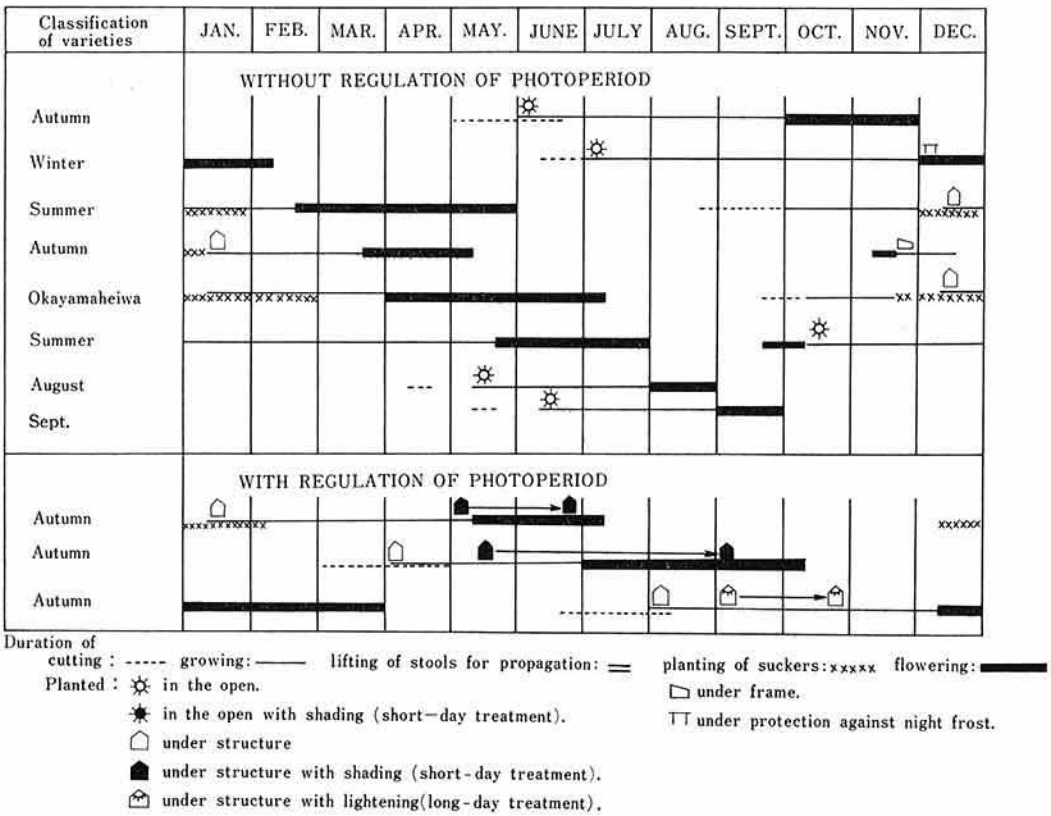

Fig. 1. Cultivation types for year-round production of chrysanthemum in Japan.

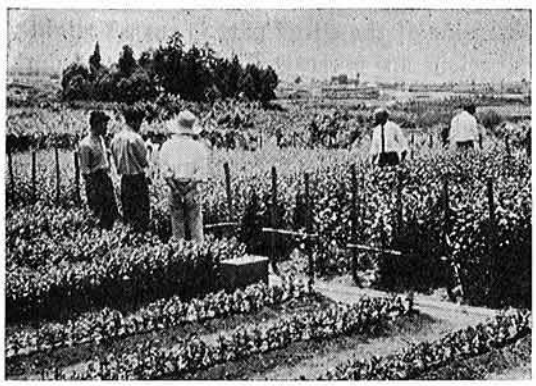

Fig. 2. Continuous production of chrysanthemum from May to December in the open on highland (Yamanashi Prefecture) by using various ecological types on temperature and day length.

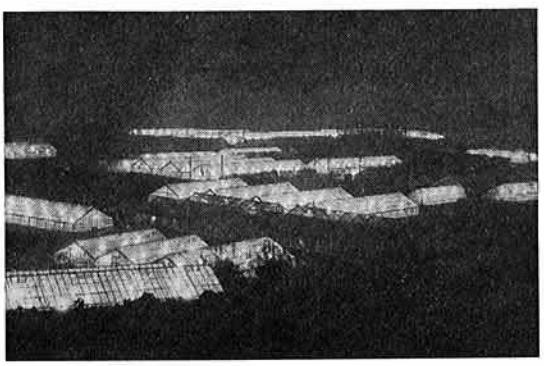

Fig. 3. Light culture of chrysanthemum under glass in Atsumi, Aichi Prefecture.