

Chrysanthemum Production in the Age of Energy Conservation

By JOICHI KAWATA*

Breeding Division, Vegetable and Ornamental Crops Research Station
(Ano, Age, Mie, 514-23 Japan)

Over a decade has passed since the author reported the Japanese way of year-round chrysanthemum production in JARQ.⁴⁾ During this period the chrysanthemum growing area increased to 1543 ha in glass and plastic houses, and 2932 ha in open fields (Table 1). These areas are 3.3 times and 1.6 times those in 1967,⁴⁾ respectively. On the other hand, the chrysanthemum industry in Japan has partly been modified owing to the energy crisis which occurred in 1973 and severely struck the flower industry in heated glass houses or plastic houses.

Most growers wondering whether the heating oil would be available or not, began to grow April to May-flowering cultivars which do not need so high temperature as required by autumn-flowering cultivars traditionally grown for winter to spring production in heated glass or plastic houses. As a result, in the following spring a great deal of cut flowers of April to May-flowering cultivars were shipped to flower markets and sold at extremely low price because of their inferior quality in flower type and in vase life.

Table 1. Cut flower production in Japan (1981)

	Area (ha)		Value (million Yen)	
	Glasshouse and plastichouse	Field	Glasshouse and plastichouse	Field
Chrysanthemums				
Lighting	930	187	16759	2819
Shading	51	14	847	147
Others	562	2731	7705	23514
Total	1543	2932	25312	26481
Carnations	352	14	14148	191
Roses	263	14	10779	234
Lilies	132	157	3691	1256
Stock	169	103	2073	1125
Gentiana	25	376	249	1820
Gladiolus	23	285	252	1661
Tulip	49	7	1699	56
Ornamental Branch	48	2427	907	6142
Others	686	2520	10393	10315
Total	3290	8837	69505	49281

* Present address: Toyama Prefectural Vegetable and Ornamental Crops Research Station (Goromaru, Tonami, Toyama, 939-13 Japan)

Research for energy saving

Konishi⁸⁾ announced that low temperature treatment to chrysanthemum rooted cuttings is effective to avoid rosette formation under low temperature, and results in promoted stem elongation and flowering (Fig. 1). Therefore, the low temperature treatment to chrysanthemum cuttings for winter to spring production has practically been adopted throughout the country, but in some cultivars it caused troubles such as overgrowth and delayed flowering. Higuchi and Hara³⁾ carried out an extensive work on the low temperature treatment to both unrooted and rooted cuttings, and classified the cultivars according to the pattern of flowering response shown in Fig. 2; flowering was a) promoted by low temperature treatment, such as cultivar Ohdai-no-tsuki, b) not influenced by low temperature treatment, such as cultivar Otomezakura, and c) delayed and staggered by low temperature treatment, such as cultivar Iyasaka. Fukuda and Higuchi²⁾ found out that these favorable or unfavorable effects of low temperature treatment can be reversed by high temperature treatment at 25°C for a few weeks to planted cuttings.

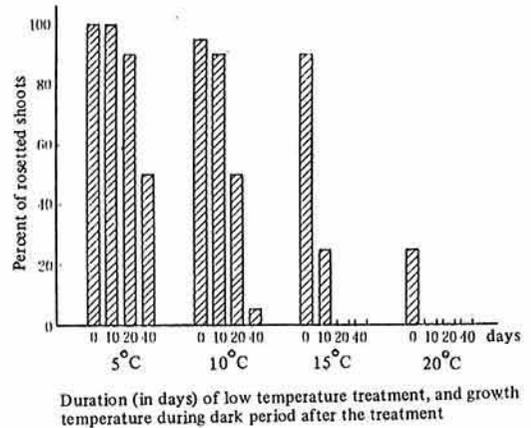


Fig. 1. Effect of low temperature treatment to rooted cuttings and growth temperature after the treatment on rosetting of the shoots (Konishi⁸⁾, Experiment 1)

Data on the 60th day after the end of the low temperature treatment.

At present, low temperature treatment for promoting flowering is applied to only effective cultivars such as Shuho-no-chikara and Tenju, which are commercially most important because of their beauty of flowers and long

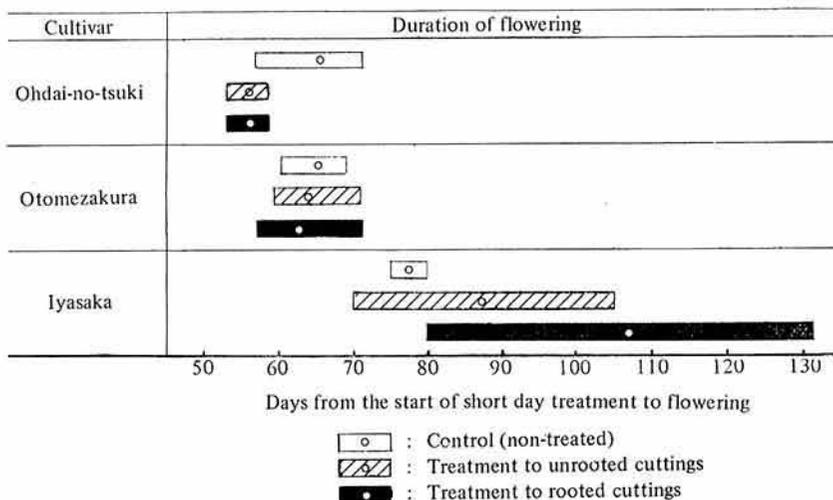


Fig. 2. Effect of low temperature treatment at 2°C for 30 days to unrooted and rooted cuttings on days to flowering in three representative cultivars (Higuchi and Hara³⁾)

Table 2. Relation between gross income and heating cost* in chrysanthemum cut flower production in April at Toyokawa, Aichi Prefecture, in 1980 (Kawata⁵⁾)

Cultivar	Natural flowering time	Average wholesale price per stem (yen)	per 3.3 m ²			Minimum night temperature (°C)	Growing period (days)
			No. of shipped	Gross income (yen)	cost of heating (yen)		
Tenju	September	90	140	12,600	3,000	17-18	150
Shuho-no-chikara	November	90	130	11,700	3,000	17-18	150
Meimon	October	90	170	15,300	1,500	15-16	120
Shinseiko	June	60	140	8,400	1,000	13-14	120-150
Kinseiko	June	70	140	9,800	1,000	13-14	120-150
Dramatic (spray)	October	80	150	12,000	1,200	15-16	100
Marble family (spray)	October	80	140	11,200	800	14-15	105
Horim family (spray)	November	80	175	14,000	800	13-14	110

* Calculated on the basis of 70 yen of heating oil price per liter.

vase life. However, the both cultivars require rather high temperature for normal growth and flowering even if the cuttings are treated by low temperature. Therefore, a lot of effort has been made to find low temperature tolerant and more economically productive cultivars in some prefectural experiment stations as well as in private firms. Productivity and heating cost of these cultivars are shown in comparison with Shuho-no-chikara and Tenju in Table 2.⁵⁾

Through the experience of low temperature treatment to cuttings, the growers learned how to produce cuttings in stead of winter sucker and to cool-store them. The mother plants for cutting production are mostly grown in glass or plastic houses without heating till November. The cuttings for winter to spring production are harvested by November and cool-stored at 1-2°C for some weeks. This method can regulate more precisely the quantity of cutting supply than the direct supply from mother plants, and save heating oil which otherwise is required for growing mother plants in heated glass houses in winter.

Winter production in Okinawa

The Okinawa Islands, the southernmost part of Japan, are located at the latitude of 26°N. After their restoration in 1971, many kinds of agricultural products were shipped to the mainlands without quarantine inspection

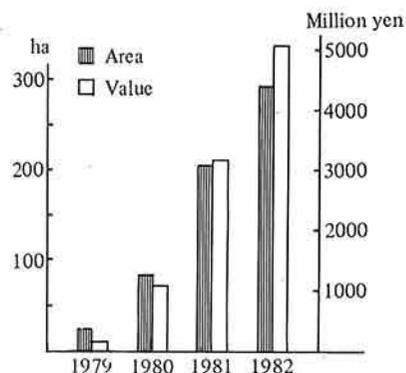


Fig. 3. Development of chrysanthemum production in area and value in Okinawa (Aka¹⁾)

which is required for importing overseas agricultural products. Chrysanthemum cut flower grown in open fields was one of them. The growing area rapidly increased to 290 ha in 1982, showing the total production worthy of 5036 million yen (Fig. 3). All of the cultivars there have been introduced from the mainland, and a majority of them form rosette even in Okinawa where the average minimum temperature in January and February is 10°C and 7°C, respectively. The Okinawa Agricultural Experiment Station has conducted large scale varietal tests since the restoration, and has contributed a great deal to the development of chrysanthemum industry

there. Quality of cut flowers produced in Okinawa is, in general, highly evaluated in the markets of the mainland because of their strong leaf and stem owing to the better light condition in winter.

Three basic problems in Okinawa are: 1) rather short duration of shipment from December to April, 2) unstable quality and quantity owing to climatic damages by low temperature, typhoon and long spell of rain in winter and, 3) limited air service¹⁾ to transport the products to the main islands. Continuous cropping injury caused by soil born diseases including nematoda will become another problem.

Summer production in highlands

Most cut flowers of chrysanthemums in summer are grown in open fields of highlands with a moderate summer climate such as Nagano Prefecture or the northern part of Japan. One of the problems in summer production is that almost all growers depend on natural flowering, so that the flowering time fluctuates by yearly variations of climate, resulting in unstable shipping quantity and market price just like the case in Okinawa.

Table 3. Flowering response to photoperiod of July to October-flowering cultivars. (Kawata et al.⁷⁾

Group of cultivars	Critical daylength	Optimum daylength
July flowering	over 17 hr	12-14 hr
August flowering	17 hr	12-14 hr
September flowering	16 hr	12-13 hr
October flowering	14-15 hr	12 hr

The author carried out some experiments to know the flowering response to photoperiod and temperature since 1974. The result shows that most summer flowering cultivars are short day plants as given in Table 3⁷⁾ and their flowering time can be regulated by the combination of lighting (long day treatment) and shading (short day treatment), like that of autumn flowering cultivars. Difference in the

response to photoperiod between summer and autumn cultivars depends on the critical daylength for flowering. As the critical daylength of the summer-flowering cultivars is longer than that of autumn-flowering cultivars, the summer-flowering cultivars require less hours of short day treatment than autumn-flowering cultivars, and some July-flowering cultivars can flower without short day treatment even in the season of the longest daylength. Their growth and flower color related to anthocyanin are much better than those of autumn cultivars in summer. Appropriate application of the photoperiodic control of flowering will be useful to improve the present situation.

Introduction of the spray type chrysanthemums and year-round production

The spray type chrysanthemums have been introduced from the Netherlands and U.S.A. since 1974 by the author. Most of the flower types introduced are single or spider and the color ranges much wider than that of the Japanese standard type (single flower on a stem). They well harmonize with modern furniture such as that of North European countries and with western style flower arrangement. The demand is gradually increasing mainly in large cities where the western way of living is prevalent.

The benefit and defect of the spray type chrysanthemums as compared with Japanese standard type are as follows; 1) saving labor for disbudding, 2) short growing period, 3) uniform growth and flowering, and 4) necessity of accurate control of photoperiod and temperature.

At the initial stage of the introduction, weak stems and reflexed flower petals of the spray type chrysanthemum were thought to be unfavorable to the Japanese traditional flower arrangement. Toyoda and the author conducted the cross breeding of it and released three cultivars, Pink Pearl, Orange Charm, and Yellow Queen, to our industry. However, the number of the growers are still limited



Plate 1. A spray type chrysanthemum cultivar, Pink Pearl

because the year-round production of the spray type chrysanthemums requires special attention on harvesting time and cutting supply which must be done by themselves, and also on photoperiod control. Especially, shading in midsummer in warm areas often causes the delay of flowering with poor quality. Koido, one of the representative chrysanthemum breeders for the summer flowering group, tried to improve the spray type chrysanthemums by crossing them with his summer flowering cultivars and succeeded in obtaining some summer flowering spray type cultivars, although their quality and color of flower petals are somewhat inferior to those of original spray type chrysanthemums. The author confirmed that their flowering response to photoperiod is quite similar to that of his summer flowering standard type cultivars mentioned above. The breeding programme to improve the defect of them continues in our laboratory.

Perspective

The number of chrysanthemum growers in the Main Island of Japan tends to decrease, while the growing area and production of chrysanthemum, particularly the cut flower production are increasing. This tendency would continue and specialization in chrysanthemum growing would steadily progress. To improve the labor distribution and to widen the harvesting period, the growing under structure will develop in warm areas. It will enhance the year-round production in some growing areas as in the case of spray type chrysanthemums.

Most Japanese cultivars for cut flower production are bred for growing in open fields. Therefore they are characterized by rosette formation in winter in order to survive extremely low temperature. This characteristic is not required by the growing under structure in winter and ought to be eliminated as in the case of western cultivars used for year-round production.

In Okinawa the number of growers and acreage of chrysanthemum would continue to increase. However, the problem is lack of stability in quality and quantity owing to the climate. The growers will have to adopt the growing under structure as in the Mainland, and to find another profitable crops other than chrysanthemums to utilize their structures in summer.

There is a general question, where the ideal area for growing chrysanthemum is. It depends on the balance between gross income and production cost consisting of production materials, heating oil, labor and shipment. Further perspective of the relationship between Okinawa and the mainlands in horticultural products would be quite similar to the relationship between Mediterranean countries and North European countries.

References

- 1) Aka, Y.: The present situation and problems on the cut flower production in winter and spring on Okinawa. *News of Okinawa Agr. Exp. Sta.*, No. 28 (1982) [In Japanese].
- 2) Fukuda, M. & Higuchi, H.: Effect of the high temperature treatment on the growth and flowering of cuttings treated by low temperature in chrysanthemum. Abstract of Cong. Jpn. Hort. Sci. (1980) [In Japanese].
- 3) Higuchi, H. & Hara, M.: Effect of chilling treatment of cutting on the growth and flowering of chrysanthemum. *Bull. Aichi Agr. Res. Center*, B 6, 62-67 (1974) [In Japanese with English summary].
- 4) Kawata, J.: Year-round production of chrysanthemum in Japan. *JARQ*, 4(2), 23-27 (1969).
- 5) Kawata, J.: The improvement on the productivity in chrysanthemum cut flower production. Proc. Symposium on the flower production in the age of energy conservation Jpn. Soc. Hort. Sci., (1980) [In Japanese].
- 6) Kawata, J.: The responses to photoperiod and temperature in Japanese July to September flowering chrysanthemums. *Acta Horticulture*. 125, 93-99 (1982).
- 7) Kawata, J. et al.: Flowering responses to photoperiod in chrysanthemums. V. The responses to photoperiod in the July to October flowering cultivars. Abst. Cong. Jpn. Hort. Sci. (1983) [In Japanese].
- 8) Konishi, K.: Rosetting prevention in chrysanthemum by chilling the rooted cuttings. *J. Jpn. Soc. Hort. Sci.*, 44(3), 286-293 (1975). [In Japanese with English summary].

(Received for publication, May 18, 1983)