Flower Induction In Japanese Chrysanthemums With Gibberellic Acid*

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The discovery that gibberellic acid (GA) induces bolting and flowering in several species has stimulated much research on the flower-inducing properties of this compound. Gibberellic acid, however, seems to be unable to induce flowering in the cocklebur (*Xanthium pennsylvanicum*) and in short-day varieties of chrysanthemum (*Chrysanthemum morifolium*). This situation raises the following point: Is gibberellic acid ineffective, in the cited cases, because the two species, *Xanthium pennsylvanicum* and *Chrysanthemum morifolium*, happen to be nonresponsive for genetic reasons, or is it ineffective because of the physiological short-day character which these species have in common?

In order to elucidate this question, three varieties of Japanese chrysanthemums which can be induced to flower regardless of the photoperiod were selected: Shuokan, Kinkazan, and Shin-misono. These varieties require a cold treatment near 1°C for 3 to 4 weeks in order to be able to flower, whether under long-day or short-day illumination; without a cold treatment, they may remain in a rosetted condition for almost a year.

The following procedures were carried out, with eight replications per treatment for each of the three varieties: (i) controls were kept in a greenhouse at a temperature above 15°C during the whole growing period; (ii) plants were subjected to temperatures of 1° to 5°C for 4 weeks in an outdoor cold frame, then returned to the greenhouse; (iii) plants were kept in the greenhouse but were treated once, at the growing point, with about 5 mg of a lanolin paste containing 10 ug of gibberellic acid per milligram. At all times, including the periods of cold treatment, all the plants were given long 18-hour days by supplementing the hours of natural daylight with periods of incandescent light. From each plant the lateral shoots were removed, only one main stem being left.

The results obtained were as follows. Two weeks after treatment with either gibberellic acid or cold, the stems of the respective plants started to elongate. Later on, flower buds appeared, and 19 weeks after the beginning of the treatments the plants were in full bloom. At that time the controls were still in a rosetted state and without any flowers. The controls eventually bolted and finally bloomed also, but much later—some 11 weeks after the treated plants had bloomed. Results were essentially similar in all three varieties, except that in the Shin-misono variety the plants treated with gibberellic acid bloomed 2 weeks later than the cold-treated ones. As is shown in Table 1, the cold-treated plants flowered at a lower node than those treated with gibberellic acid and had longer internodes.

Table 1. Effect of flower-inducing treatments on three varieties of Japanese chrysanthemums.

Variety	Controls	Gibberellic Acid	Cold
	Total height (cm)*		
Shuokan	17.8	95.4	85.0
Kinkazan	36.0	106.8	99.4
Shin-misono	25.2	64.0	66.6
	Average length of internodes (cm)*		
Shuokan	0.31	2.27	2.64
Kinkazan	0.49	2.07	2.42
Shin-misono	0.39	1.40	2.08
	*Average nodes to flower**		
Shuokan		42.0	32.2
Kinkazan		51.6	41.0
Shin-misono		45.6	32.0
	Number of weeks to anthesis (from beginning of treatments)		
Shuokan	30	19	19
Kinkazan	29	20	19
Shin-misono	31	22	20

* Nineteen weeks after the beginning of treatments.

These experiments show that gibberellic acid can induce bolting and flowering in varieties of chrysanthemum which normally require a cold treatment in order to flower. They indicate that it is not the species *Chrysanthemum morifolium*, as such, which is insensitive to the flower-promoting effect of gibberellic acid but rather the short-day characteristic of some of the varieties belonging to this species. This result strengthens the idea that gibberellic acid is not effective in inducing flowering in short-day plants.

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