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THE EFFECTS OF FLOWER INDUCTION REGIMES AND DISBUDDING AGENTS ON SPRAY-FORM OF CHRYSANTHEMUM

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INTRODUCTION

In Chrysanthemum a rather strange aberration can be seen. Cuttings, clearly only having inactive meristems. These will develop roots and primordial leaves will grow out normally, but no new primordia are differentiated and growth soon stops. Eventually, some lower side branches may come up, but not always.

Kofranek c.s. (2, 3) recognized this phenomenon to be a phyto-effect of insecticides formulated on emulsifier basis. They demonstrated that these materials may cause pinching of shoots or may prevent branching. The same phenomena can be obtained with quite different chemicals also (4, 1).

It was suggested that this activity might be used for disbudding purposes in commercial growing of Chrysanthemum. However, a satisfactory procedure never was published.

In Naaldwijk, after some preliminary screening of a large number of potentially active formulations, on a series of Chrysanthemum varieties, in a range of applications with respect to timing, dose, single or in repetition, a large experiment was set up to test a series of 'near-optimum' combinations. Some of the data of this experiment are presented and evaluated below.

METHODS AND MATERIALS

The formulation Ekatin (Sandoz, Switzerland), a 25% emulsion of the insecticide thiometon, was applied in three concentrations on the cv. 'Fred Shoesmith'.

Cuttings were planted on 23 February, in 10 l buckets filled with good quality potting compost, five in a bucket,and were placed in a heated greenhouse. Plant density was slightly less than normal.

Buckets were divided into groups and were subjected to three photoperiodic treatments. One lot (A) received short days during the whole duration of the experiment, from 1 April until the end of May, when the plants were harvested for analysis. The second (B) received four short days, ten long days and short days again (4SD/10LD/SD). The third (C) received eight short days, ten long days and short days again (8SD/10LD/SD). The natural long days were shortened by covering the plants with black plastic sheet, from 17-9 hours. Covering was done daily during the first month, thereafter daily but not on weekends.

Ekatin (4(I), 8(II) or 12(III) ml/l) was sprayed on various groups of

plants on the following dates in April 1968: 9, 12, 16, 19, 23 and/or 26.

Application dates were cloudy, with otherwise moderate conditions. 19 April was a sharp sunny day, 23 was relatively dark with heavy clouds.

The average application of all three concentrations sprayed onto the plants was 15 l/application/480 buckets with five or four plants each (about 10% insufficient-quality plants had to be removed).

RESULTS

Killing or inactivation of the terminal bud was observed due to some of the treatments, as can be seen from table I. Application as short as 9 or 12 days after the beginning of short day treatment caused considerable percentages of missing terminal buds, and more so with higher concentrations (I → III), and with earlier long day interruption of the short day induction treatment (C → A).

Development of malformed, 2.4-D-type, leaves followed the same trend as the killing of terminal buds. These leaves do reduce the selling value considerably, since they are narrow and too small, with bright and yellowish veins. Moreover, it are the last leaves before the flower. Evidently, the youngest leaf primordia are the most susceptible. From the data in table II, clearly the conclusion can be drawn that too early application of too high concentrations on too recently induced plants must be avoided, since too many malformed leaves are the result.

Disbudding for standard growing thus cannot be done within this series of early sprays. However, there is a number of applications that do neither cause terminal bud inactivation nor induction of too many malformed leaves. In the figures of this last group (fig. 1-7), treatments are compared to one another with respect to axillary bud killing effects. If not specially indicated, data are given of concentration III.

In these graphs, percentages of inactivated buds for each axil are plotted. Position 0 is the terminal bud, axils are numbered downward along the stem. Below axil 25 branching normally does not occur in commercial growing, so the stem section from 20 up to 1 is the important area for disbudding.

Looking at figure 1 (day length treatment A: continuous short day induction), it can be seen that only with early applications some axils are inactivated. However, very few in the top region above axil number 9. Application at the 19th day is completely ineffective.

For daylength treatment C (8SD/10LD/SD), figure 2 shows the effect of time of application, as figure 1 does for treatment A. A spray at day 12 results in approximately the same effect as with A. However, later applications have much stronger disbudding effects, especially high on the stem. Only above axil 4 disbudding did not occur.

It can be concluded from these data that with interrupted induction, plants for a longer period remain susceptible for disbudding sprays. When induction allows spraying over an extended period of time, sprays may be applied repeatedly to obtain accumulated effects.

Figure 3 does substantiate this suggestion. Repeated application gives the strongest effect. However, over the whole range of action, and not

specifically only in the top region, as might have been expected.

Figures 4 and 5 present data indicating another important feature. It seems clear from these graphs that axils near node 20 are very sensitive, since they can be inactivated with the lowest concentration. To the tip of the stem increasingly higher concentrations being necessary to obtain disbudding.

Also, as in figure 1 when spraying was done too late (after day 16) disbudding below node 10 was not possible any more, even not in combination with treatment C (figure 6).

It is remarkable that 50% of all top position axils could be inactivated with treatment C/12/III, without any damage to the terminal bud (figure 5).

Finally, figure 7 shows the influence of the induction treatment on the effect of the disbudding sprays. Of each treatment, the optimum application not giving terminal bud effects is chosen. Clearly, slower induction allows much more disbudding.

DISCUSSION

From the above data it can be concluded that in Chrysanthemum cv. 'Fred Shoesmith' some of the commercially available insecticides that are formulated on emulsifier basis can cause quite complete inactivation of terminal, or axil buds. However, buds must be vegetative, generative buds being much less sensitive. And vegetative buds must be active, buds in rest not being effected. Non-induced, vegetative Chrysanthemums grow without developing side branches, with an active terminal bud and all lateral buds in rest because of strong apical dominance, as far as 15-20 positions down the stem. Upon flower induction, the terminal meristem turns generative and its dominance over the lower growing points is lost. Hereafter, the laterals become active, from top to bottom successively.

The above conditions mean that disbudding must be done on plants that are minimally induced, just to differentiate the terminal bud. After this first initiation, apical dominance being lost, axil buds will become active. These must be kept vegetative for them to stay sensitive, and when a sufficient number of them has become active, the spray can be applied.

Hereafter, induction must be continued to grow a large terminal flowerheat. With 'Fred Shoesmith' minimal induction is obtained with 3-6 SD. The interruption with long days must last some 12 to 20 cycles.

The chemicals must not be given within 13 days from the beginning of short day treatment. With sprays within this period terminal buds may be killed and larger numbers of malformed leaves will result. In winter this period may even be longer, because of very slow growth rates.

Concentrations must be determined for each chemical formulation and for each variety of plant.

And finally, of course, with such precise demands as for proper induction and axil shoot activity, a very uniform and homogeneously vigorous crop must be grown.

Also weather conditions are important. One should aim at similar

spraying conditions as much as possible for successive treatments. To fulfill this requirement it is once more important that the vegetative growth period of various buds be long, so that spraying may be delayed beyond extreme days without loss of effect.

In conclusion, data are presented showing that with a treatment of interrupted induction in combination with disbudding sprays, it is possible to grow standard Chrysanthemum, such that only very few side shoots remain to be removed by hand.

Table I. Percentages of apical buds killed in glasshouse-grown Chrysanthemum cv. 'Fred Shoesmith' sprayed with Ekatin 12 ml/l. Application was done on various days (numbers 9-26) after the beginning of short-day treatment on 1 April, 1968. A, B and C are daylength treatments (see text).

Days of application						% Apexes killed		
						A	B	C
9						16	36	56
	12					0	0	15
		16				0	0	0
			19			0	0	0
				23			0	0
					26			0
9	12					92	100	100
	12	16				0	8	25
		16	19			0	0	0
			19	23			0	0
				23	26			0
9		16				17	77	82
9			19			8		
	12		19			0	0	15
		16		23			0	0
			19		26			0
9		16		23			69	67
	12		19		26			25
9	12	16				85	100	100
	12	16	19			8		
		16	19	23			0	
			19	23	26			15
9	12	16	19			67		
9	12	16	19	23			100	
9	12	16	19	23	26			100

REFERENCES

1. H.M.Cathey et al. Chemical pruning of plants. Science 153(1966) 1382-83.
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3. A.M.Kofranek and L.Markiewicz. Selected naphtalenes as disbudding agents for Chrysanthemums. The Florists' Review 139(1967)3612.
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Table II. Numbers of malformed leaves per plant in glasshouse-grown Chrysanthemum cv. 'Fred Shoesmith' sprayed with Ekatin 12 ml/l. Application was done on various days (numbers 9-26) after beginning of short-day treatment on 1 April, 1968. A, B and C are daylength treatments (see text).

Days of application						Leaf malformation leaves/plant		
						A	B	C
9						9.7	8.6	7.8
	12					7.8	9.0	5.8
		16				0.3	1.8	4.2
			19			0	0.3	0.3
				23			1.2	0
					26			1.6
9	12					10.7	9.8	9.3
	12	16				8.3	9.3	9.7
		16	19			2.3	3.5	7.0
			19	23			0.3	6.1
				23	26			4.0
9		16				7.9	7.8	9.4
9			19			8.9		
	12		19			7.2	10.8	8.7
		16		23			4.0	6.9
			19		26			1.9
9		16		23			7.7	8.8
	12		19		26			7.3
9	12	16				11.7	10.2	9.0
	12	16	19			9.0		
		16	19	23			7.0	
			19	23	26			3.9
9	12	16	19			10.6		
9	12	16	19	23			9.1	
9	12	16	19	23	26			10.3

Onderschriften

Figure 1. Chrysanthemum cv. 'Fred Shoesmith'. Percentages of inactivated buds in the various axils along the stem upon Etakin sprays applied at different times. Daylength treatment A: continuous short-day treatment from 1 April 1968. A3: sprayed on day 12, A4 on day 16, A5 on day 19 and A13 on days 12, 16 and 19.

Figure 2. Chrysanthemum cv. 'Fred Shoesmith'. Percentages of inactivated buds in the various axils along the stem upon Etakin sprays applied at different times. Daylength treatment C: 8SD/10LD/SD. C3: sprayed on day 12, C4 on day 16, C6 on day 23, C7 on day 26.

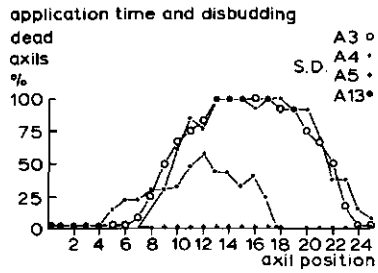
Figure 3. Chrysanthemum cv. 'Fred Shoesmith'. Percentages of inactivated buds in the various axils along the stem upon repeated applications on different days of Ekatin. Daylength treatment C: 8SD/10LD/SD. C4: sprayed on day 16, C10 on days 16 and 19, and C15 on days 16 and 23.

Figure 4. Chrysanthemum cv. 'Fred Shoesmith'. Percentages of inactivated buds in the various axils along the stem upon application of different concentrations (I = 4 ml/l; II = 8 ml/l; III = 12 ml/l) of Ekatin sprays. Daylength treatment B: 4SD/10LD/SD. B13 sprayed on days 16 and 23.

Figure 5. Chrysanthemum cv. 'Fred Shoesmith'. Percentages of inactivated buds in the various axils along the stem upon application of different concentrations (see figure 4) of Ekatin sprays). Daylength treatment C: 8SD/10LD/SD. C12: sprayed on days 23 and 26.

Figure 6. Chrysanthemum cv. 'Fred Shoesmith'. Percentages of inactivated buds in the various axils along the stem upon application of Ekatin sprays on two different days and the combination of both. Daylength treatment C: 8SD/10LD/SD. C4: sprayed on day 16, C6 on day 23, and C15 on days 16 and 23.

Figure 7. Chrysanthemum cv. 'Fred Shoesmith'. Percentages of inactivated buds in the various axils along the stem of differently induced plants upon application of Ekatin sprays. A8: SD, sprayed on days 16 and 19; B13: 4SD/10LD/SD, sprayed on days 16 and 23; C15: 8SD/10LD/SD, sprayed on days 16 and 23.


application time and disbudding
dead
axils
%
A3 o
A4 ·
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A13•
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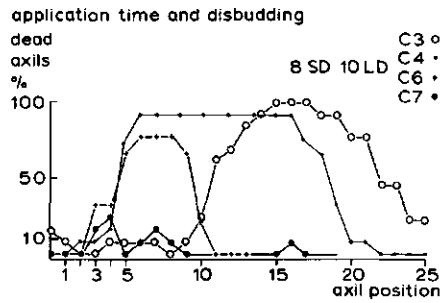
75
50
25
0
2 4 6 8 10 12 14 16 18 20 22 24
axil position

1


application time and disbudding
dead
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8 SD 10 LD C4 ·
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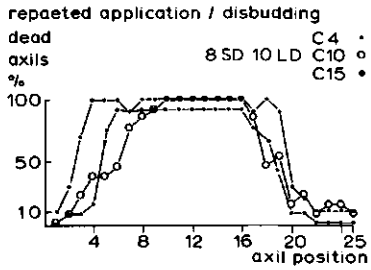
1 3 5 10 15 20 25
axil position

2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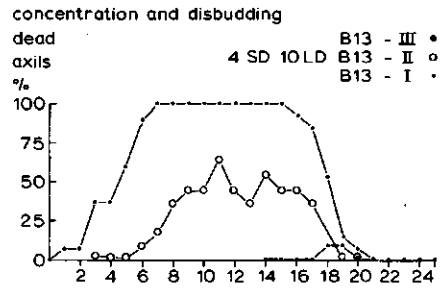
3


concentration and disbudding
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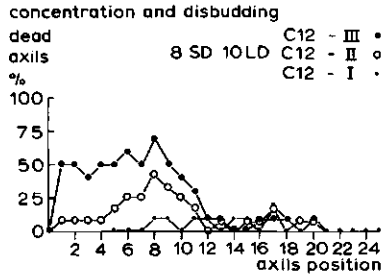
4


concentration and disbudding
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C12 - III •
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C12 - I ·
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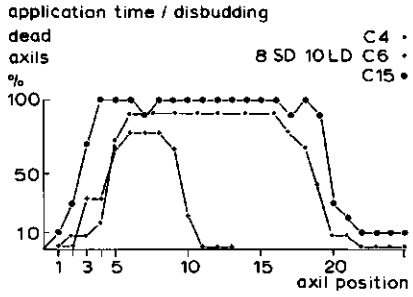
axils position

5


application time / disbudding
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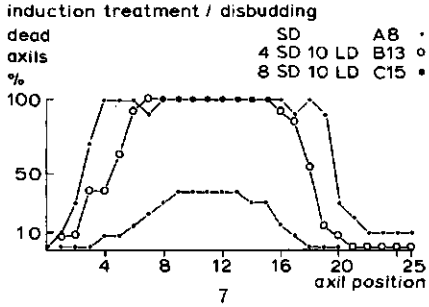
axil position

6


induction treatment / disbudding
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SD A8 ·
4 SD 10 LD B13 o
8 SD 10 LD C15 •
100
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4 8 12 16 20 25
axil position

7