THE EFFECT OF TEMPERATURE AND ETHYLENE ON DORMANCY OF FREESIA CORMS

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Publication 516

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Abstract

A decrease of storage temperature to 25, 20 or 17°C after 4 weeks at 30°C accelerated root emergence and thereby advanced planting date of dry Freesia corms. Storage at 30°C for 4 to 8 weeks, followed by storage at 20°C till root emergence reduced the period of dormancy by about 30%. A treatment with 50 $\mu l.l^{-1}$ ethylene for 6 hrs on the last day of storage at 30°C had a small promotive effect on root emergence.

Neither the change of temperature during storage, nor a treatment with ethylene affected the time from planting till flowering. Flower quality was not affected by storage temperature. Ethylene increased the number of flowering stems, but decreased weight and length of the flowering stems.

1. Introduction

Since Hartsema and Luyten (1944) and in more detail Hartsema (1962) reported on the effect of storage temperature on sprouting of Freesia corms, it has been common practice to store the corms at 28 to 31°C for a period of 12-16 weeks. This period of high temperature can be reduced by treatments of the corms with ethylene (Hayashi, 1974; Imanishi and Fortanier, 1983). Imanishi and Berghoef (1985) showed that earliest sprouting date was obtained by an ethylene treatment after 4 weeks storage at 30°C. After planting at 17°C corm sprouting took about 5 weeks, however. During late autumn and winter, soil temperature in the glasshouse will be 13-15°C, resulting in an even longer period before sprouting. Moreover, at these lower temperatures corms may pupate when dormancy is not completely broken, i.e. when roots have not yet emerged (de Lint, 1969). For this reason experiments have been done to investigate whether root emergence can be advanced by different storage temperatures in combination with ethylene treatment.

2. Material and methods

Corms of Freesia 'Ballerina', 6-7 cm circumference were used in all experiments. In 1983, corms were lifted on June 5th, kept at 23°C for drying and cleaning till July 7th and stored at 2°C till November 18th. In 1984, corms were lifted on June 10th, kept at 23°C till July 9th and stored at 2°C till August 8th. In 1984/85 corms were lifted on December 1st and kept at 23°C till December 18th. The last date of each year indicates the start of the experiments.

Corms were stored for various periods, as indicated in results, at 30°C, followed by storage at 25, 20 or 17°C. At the last day of storage at 30°C, corms were exposed to ethylene, 50 $\mu l.l^{-1}$ for 6 hrs. Corms were regularly observed for root emergence. When 80% of the corms showed roots, they were planted in the glasshouse at 15-17°C (1983) or at 12°C

(day) and 8°C (night) in 1984. In 1984/85 the corms were planted in the phytotron at 17°C, 8 hrs of light (35 $W.m^{-2}$). In 1983 and 1984/85, 50 corms and in 1984 150 corms per treatment were used. Statistical analysis of flowering date was done by analysis of variance and regression analysis techniques (Steel and Torrie, 1982).

3. Results

3.1. Effect of storage temperature

Corms were stored at 30°C for 4 weeks and then transferred to 25, 20 or 17°C till 80% of the corms showed root emergence. In both experiments presented in Table 1, a decrease in storage temperature gave earlier root emergence of the corms, a decrease to 25°C being a little less effective than 20° or 17°C. Application of ethylene on the last day of storage at 30°C resulted in a small acceleration of root emergence in both years when temperature was decreased to 25°C but in 1984 only when temperature was decreased to 20° or 17°C (Table 1). In 1983, all corms sprouted in 10-16 days and in 1984 within 14-18 days after planting.

The number of days from planting till 50% flowering was not affected by storage temperature or ethylene. Thus, an earlier planting date resulted in an earlier flowering date.

3.2. Effect of storage duration at 30°C

Corms were stored at 30°C and weekly transferred to 20°C after 2 to 8 weeks. A storage period of only 2 weeks at 30°C before transfer to 20°C resulted in accelerated root emergence (Table 2). Earliest root emergence, however, was obtained after 3 weeks (1984) or 4 weeks (1984/85) at 30°C before transfer to 20°C. In 1984/85 ethylene was applied on the last day of storage at 30°C. Root emergence was strongly promoted by ethylene after 2 or 3 weeks at 30°C, but only slightly after 4 to 7 weeks at 30°C (Table 2). All corms sprouted 12-18 days after planting. In 1984, time from planting till 50% flowering was not affected by the duration of storage at 30°C. In 1984/85 flowering data were not recorded.

3.3. Flower quality

Corms were planted in the glasshouse to observe flower quality, except the corms in 1984/85, of which only sprouting date was recorded. In 1983 (data not presented) nor in 1984 storage temperature affected the number of flowering stems, weight and length of the flowering stems and the number of flower buds per spike (Table 3). Ethylene significantly increased the number of flowering stems at all storage temperatures, whereas weight and length of the flowering stems decreased. Ethylene had no effect on the number of flower buds per spike (Table 3). Storage temperature or ethylene did not affect spike shape ('thumbing') and the number of flowering lateral spikes (data not shown).

4. Discussion

We have shown that a decrease in temperature during storage after 4 to 8 weeks at 30°C, accelerates root emergence, thereby advancing planting date. Temperatures below 17°C were not investigated as Hartsema and Luyten (1939) already demonstrated that too short a period of high temperature, followed by 9 or 13°C caused pupation of the corms. On the other hand Gilbertson-Ferriss et al. (1981) found that Dutch grown corms of 'Moya' showed earliest sprouting after 6 weeks storage at 13°C. Between corm lifting and the start of their experiments, however, there

were 45 days. During the first 25 days their corms were stored at 25°C for drying and cleaning, which is comparable with our experiments. Transportation of the corms from the Netherlands to USA took 20 days. Although temperatures during transportation are not presented, it is likely that these were rather high as it was July. Therefore, the condition of the corms at the start of their experiment may have been comparable with our experiment in 1984 in which the corms were stored for 3 weeks at 30°C before transfer to 20°C (Table 2). This indicates that temperature may also be lowered to 13°C instead of 17 or 20°C. They found, however, pupation of the corms after prolonged storage at 13°C. This makes it unadvisable to use lower temperatures than 17°C.

Corms have to be stored at 30°C for 3-4 weeks before temperature can be decreased. Moreover, the effect of ethylene on sprouting date was maximal after 2-4 weeks storage at 30°C (Imanishi and Berghoef, 1985). This indicates that after about 4 weeks the state of dormancy in the corms has been changed. Gilbertson-Ferriss et al. (1981) suggested that the period of dormancy of Freesia corms is about 4-6 weeks, after which they enter a state of imposed dormancy by the prevailing high temperature. Probably root development is delayed by the high temperatures, which is obligatory for initial dormancy-breaking. One has to remember that all corms are stored at 23°C for about 4 weeks before the start of the experiments. As this period will always be necessary for drying and cleaning of the corms, it falls outside the scope of experiments.

Corms in the experiment of 1984/85 required a much longer storage period at 30°C for root emergence than the corms used in the preceding years. In 1984/85 the corms were lifted in December, whereas the other corms were lifted in June. These latter corms will have received part of their requirement for high temperature before lifting. Irrespective of corm history i.e. lifting date, however, a decrease of storage temperature from 30°C to 20°C after 4 to 8 weeks advanced the planting date by about 30%.

5. References

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Table 1 - Number of days till planting and from planting till 50% flowering.

Temperature after 4 weeks at 30°C	No. of days till planting		No. of days from planting till flowering	
	$-C_2H_4$	$+C_2H_4$	$-C_2H_4$	$+C_2H_4$
1983 (50 corms/treatment)				
30	108	102	102	100
25	83	74	110	102
20	74	74	104	104
17	70	74	103	95
1984 (150 corms/treatment)				
30	89	89	136	131
25	68	61	140	142
20	65	61	138	141
17	65	61	130	138

Table 2 - Number of days till planting and from planting till 50% flowering.

No. of weeks at 30°C before transfer to 20°C	No. of days till planting		No. of days from planting till flowering
	$-C_2H_4$	$+C_2H_4$	
1984 (150 corms/treatment)			
no transfer (control)	89	-	133
2	76	-	135
3	68	-	139
4	65	-	138
5	65	-	138
6	68	-	138
8	68	-	139
1984/85 (150 corms/treatment)			
no transfer* (control)	153	133	
2	137	81	
3	116	81	flowering
4	85	81	not
5	85	81	recorded
6	81	81	
7	85	81	

(-) not included

* C_2H_4 applied after 4 w at 30°C

Table 3 - Effect of storage temperature and ethylene on flowering (1984).

Temperature after 4 weeks at 30°C	Number of flowering stems		Weight* of flowering stems (g)		Length* of flowering stems (cm)		Number of flower buds	
	$-C_2H_4$	$+C_2H_4$	$-C_2H_4$	$+C_2H_4$	$-C_2H_4$	$+C_2H_4$	$-C_2H_4$	$+C_2H_4$
30	1.3	1.7	11.2	9.7	51.6	48.0	11.3	11.0
25	1.3	1.5	10.6	9.3	46.4	44.7	10.5	10.2
20	1.1	1.4	11.0	9.2	47.4	42.1	10.9	10.4
17	1.1	1.6	10.4	8.6	50.2	43.4	12.0	13.4

* Stems were cut with one lateral spike