Effects of an Exposure of Bulbs to Ethylene and Smoke on Flowering of Dutch Iris

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Effects of an Exposure of Bulbs to Ethylene and Smoke on Flowering of Dutch Iris.

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Abstract

Smoke treatment of Dutch iris bulbs during storage period by burning wheat straw, or ethylene treatment with 50 ppm for 4 days resulted in reduction in the occurrence of non-flowering three-leaved plants and in earlier sprouting and flowering. Ethylene treatment had a little less effect than smoke.

Introduction

The occurrence of "three-leaved plants" (driebladers) in early forcing of Dutch iris is a serious problem[1]. In order to solve the problem it has been a common practice in Japan to smoke bulbs of Dutch iris before the start of the low temperature treatment. Hayashi (1971, 1972, 1977)[2-4] demonstrated that smoked bulbs of Dutch iris produced flowers earlier and at a higher rate, even when bulb sizes are too small for flower-bud initiation. He also found that ethylene was contained in a smoked air sample and it was particular effective in reducing the number of three-leaved plants and inducing an earlier flowering. Kamerbeek and De Munk (1976)[5], however, could not reproduce the beneficial effects of ethylene when applied to bulbs grown in Holland.

The present experiment was undertaken to investigate whether bulbs grown in Holland show a similar response to smoke or ethylene as those in Japan.

Materials and Methods

Experiments were carried out using two cultivars, 'Ideal' of 7–8cm in size and 'Royal Yellow' of 6–7cm. The bulbs which had been stored at 20°C after harvest were sorted according to weight. They were divided into three groups. Ethylene or smoke treatment started on October 24, 1977.

One of the groups were exposed to an atmosphere containing 50 ppm ethylene in a sealed container of 1 m^3 at 25°C for 4 days. The container was shut close for 48 hours, then opened and aerated for 1 hour, after which the treatment was repeated.

Another group were exposed to smoke for 4 days which was also produced in a sealed container of 1 m^3 at 25°C, by burning 260g of wheat straw each day. The temperature increase in the container during one hour of burning was about 3°C. Air samples taken at random contained ethylene from 56 to 77 ppm, which was determined on a gas chromatograph equipped with Alumina F1 and flame ionization detector. Oxygen centents ranging from 12 to 12.5% and carbon dioxide from 8 to 8.5% were determined

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using a portable analyzer.

The third group were placed in a sealed container without any treatment at 25°C for 4 days and served as controls.

After the treatments bulbs were stored at 17°C for 2 weeks and planted in a greenhouse with a minimum temperature of about 13°C on November 11. Observations were made on sprouting and flowering.

Results

Bulbs treated with smoke for 4 days and with 50 ppm ethylene for 4 days showed a rapid sprouting in both cultivars. Smoked bulbs sprouted earlier than bulbs to which ethylene had been applied (Figs. 1 and 2)

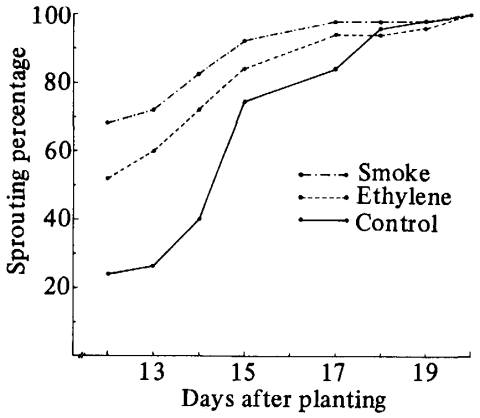

Fig. 1. Effects of an exposure to smoke and ethylene on sprouting of 'Ideal' bulbs.

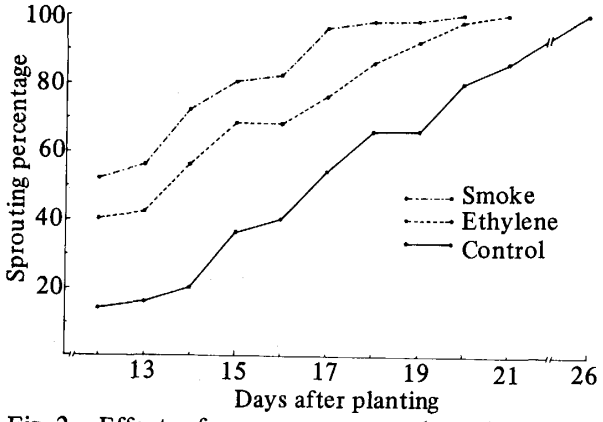

Fig. 2. Effects of an exposure to smoke and ethylene on sprouting of 'Royal Yellow' bulbs.

In the control lots, especially in 'Ideal', the flowering percentage increased and the percentage of three-leaved plants decreased proportional to the weight of the bulbs at planting time (Tabs. 1 and 2)

All plants from bulbs treated with smoke flowered, irrespective of bulb weight. Bulbs treated with ethylene showed a higher flowering percentage than the control. Ethylene, however, was less effective than smoke.

Plants from bulbs treated with smoke or ethylene flowered 6 to 7 days earlier than the controls in 'Ideal' and 3 to 4 days earlier in 'Royal Yellow'.

No appreciable difference was observed in the length of the flower stalk.

Table 1. Effect of an exposure of bulbs to ethylene and smoke on flowering ('Ideal').

Bulb weight	No. of bulbs used	Cont.				Ethylene				Smoke			
		Percent of		Flowering date	Length of flower stalk	Percent of		Flowering date	Length of flower stalk	Percent of		Flowering date	Length of flower stalk
		3-leaved plants	flowered plants			3-leaved plants	flowered plants			3-leaved plants	flowered plants		
6–7[g]	17	94.1%	5.9%	Mar. 13	45.0cm	37.5%	62.5%	Mar. 9	40.9cm	0.0%	100.0%	Mar. 7	44.6cm
7–8	15	78.6	21.4	Mar. 16	43.3	13.3	86.7	Mar. 8	38.8	0.0	100.0	Mar. 7	44.7
8–9	11	45.5	54.5	Mar. 16	46.5	0.0	100.0	Mar. 7	42.3	0.0	100.0	Mar. 7	46.5
9–10	7	0.0	100.0	Mar. 12	47.6	0.0	100.0	Mar. 7	44.0	0.0	100.0	Mar. 7	45.6
Avg.	–	65.3	34.7	Mar. 14	46.3	17.8	82.2	Mar. 8	40.9	0.0	100.0	Mar. 7	45.2

Table 2. Effects of an exposure of bulbs to ethylene and smoke on flowering ('Royal Yellow').

Bulb weight	No. of bulbs used	Cont.				Ethylene				Smoke			
		Percent of		Flowering date	Length of flower stalk	Percent of		Flowering date	Length of flower stalk	Percent of		Flowering date	Length of flower stalk
		3-leaved plants	flowered plants			3-leaved plants	flowered plants			3-leaved plants	flowered plants		
4–5[g]	12	16.7%	75.0%	Apr. 12	50.8cm	9.1%	81.8%	Apr. 8	53.1cm	0.0%	100.0%	Apr. 9	49.9cm
5–6	22	15.0	75.0	Apr. 12	60.1	5.0	90.0	Apr. 9	56.0	0.0	100.0	Apr. 8	57.6
6–7	16	7.1	78.6	Apr. 11	57.0	6.3	87.5	Apr. 9	55.9	0.0	100.0	Apr. 8	53.1
Avg.	–	13.0	77.8	Apr. 12	56.7	6.4	87.2	Apr. 9	55.3	0.0	100.0	Apr. 8	54.3

Discussion

The conclusion of Hayashi (1971, 1972)[2-3] that the number of non-flowering three-leaved plants could be drastically reduced by exposing stored bulbs to smoke was confirmed also in bulbs grown in Holland. Similar results were obtained by burning fields of iris before harvesting the bulbs. This 'burning over' resulted in an earlier flowering and higher flowering percentages[6-8]. Such an effect of 'burning over' may be due to smoke penetrating into the soil.

Exposure of iris bulbs to ethylene, however, had a lower preventive effect on the occurrence of three-leaved plants than exposure to smoke. Hayashi (1977)[4] showed that an air sample taken 4 to 5 hours after smoking in a sealed box contained a high concentration of carbon monoxide (9,727 ppm) and that this gas in concentration above 2,000 ppm had a preventive effect on the occurrence of three-leaved plants. Large amounts of carbon monoxide must have been present also in this experiment, although this was not examined.

Stuart et al. (1966)[9] found that the flowering of American-gown iris was accelerated significantly by treating bulbs with ethylene before a low temperature treatment. Uhring (1973)[10] observed that a treatment of American-grown iris bulbs with 25 ppm ethylene prior to the initial heat curing apparently stimulated floral initiation. Also in Japan-grown iris bulbs, ethylene application is known to induce an earlier flowering and higher flowering percentages[3-4]. Kamerbeek and De Munk (1976)[5] did not get any effect of ethylene, however, when this was applied to Dutch-grown iris bulbs before or after low temperature treatment, although spraying in the field with ethephon, ethylene releasing compound, reduced the number of three-leaved plants[1]. They suppose that these contradicting results may be ascribed to differences in response to ethylene of bulbs grown in the USA and Holland.

From the present results it is clear that Dutch-grown iris responded well to ethylene and that ethylene application promoted flower induction, initiation and development. Masuda and Asahira (1979)[11] pointed out that freesia corms should be kept at a temperature above 25°C during ethylene application for breaking their dormancy. Stuart et al. (1966)[9] applied ethylene to iris bulbs at 21°C and Hayashi (1972, 1977)[3-4] applied it at high room temperature above 25°C. In the present experiment iris bulbs were treated with ethylene at 25°C. Although Kamerbeek and De Munk (1976)[5] did not mention the temperature at which ethylene was applied, lower temperature during their treatment could have been responsible for the lack of iris bulbs to ethylene.

The present results suggest that smoke or ethylene treatment could solve the problem of the occurrence of three-leaved plants in early forcing of Dutch iris. Later experiments have confirmed this conclusion[12].

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