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Effects of Uniconazole and Gibberellic Acid Application on Elongation of Hypocotyl and Internodes in Figleaf Gourd for Rootstock

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Abstract
In mechanical grafting, as the axes of scions and rootstocks are grasped by mechanical hands, it is necessary to control the length of axes in the grafting procedures. Therefore, this study was conducted to analyze effects of uniconazole and gibberellic acid application on the axis length of figleaf gourd, a rootstock for cucumber. Elongation of hypocotyl and internodes was more inhibited by immersion of seeds in uniconazole at increasing concentrations ranging from 1 to 100 mg/l. However, spraying of 50 mg/l gibberellic acid at the cotyledon-unfolded stage enabled to recover the inhibition of internode elongation by uniconazole. The elongating effect was enhanced by the increase of the concentration of gibberellic acid up to 50 mg/l, but not at 100 mg/l. It was suggested that the length of the hypocotyl and internodes of figleaf gourd can be controlled by the application of uniconazole and gibberellic acid.

Discipline: Horticulture
Additional key words: axis, grafting, mechanization

Introduction

In Japan, failure of vegetable production associated with continuous cropping was ascribed in 80% of the cases to the incidence of soil-borne diseases and nematodes[13]. To prevent the occurrence of soil-borne diseases and nematode damage, grafted plants have been used for the production of fruit-bearing vegetables. In Japan, 93% of watermelons, 72% of cucumbers, 50% of eggplants, 32% of tomatoes and 30% of all types of melons are produced using grafted plants[6].

Grafting, however, is laborious and time-consuming. Since the labor required for grafting accounts for 52% of that for growing transplants[5], farmers and nurseries need a grafting aid. To address this problem, mechanical grafting of fruit-bearing vegetables has been studied in Japan since 1987, including the use of adhesive and hardener system for mechanical grafting[4,10], hardware system[2,11] and software to increase the survival rate[8,9]. Recently, five small tomato plants have been grafted simultaneously with grafting plates[7] which is considered to be the optimum method for mechanical grafting due to the high adaptability to small plants growing in plug trays. In mechanical grafting, since the axes of scions and rootstocks have to be grasped by grafting plates or mechanical hands, the length of the hypocotyl and internodes must be controlled for effective grafting by the instruments.

Growth regulators may be applied to control the hypocotyl and internode elongation. Gibberellic acid promotes stem elongation, whereas uniconazole inhibits it. Foliar spray application of uniconazole reduced the plant size of petunia, impatience, salvia and marigold[1], height of tomato[15] and potted lisianthus[12]. On the other hand, gibberellic acid was effective in promoting the shoot elongation of hibiscus previously delayed by a drench application of uniconazole[14]. Izumi et al.[3] reported that uniconazole inhibits gibberellin biosynthesis in rice plants.

In the present study, the control of the length of the hypocotyl and internodes of figleaf gourd, a rootstock for cucumbers, was examined by treatment with various concentrations of uniconazole and gibberellic acid at different stages of the plant.

Materials and methods

1) Inhibition of axis elongation by uniconazole

Seeds of *Cucurbita ficifolia* Bouche cv. Kurodane were immersed in solutions of uniconazole at concentrations of 0, 1, 10, 100 or 500 mg/*l* for 20 hr. The seeds were sown in plastic pots (700 m*l*) containing an equal amount of both Andosol and bark compost fertilized with 0.21N–0.21P–0.18K g/*l* on 21 July 1989 and grown in a glasshouse at 25 ± 6°C (air-temperature). Gibberellic acid (0.5 m*l*) at a concentration of 50 mg/*l* was sprayed on each plant which had unfolded cotyledons on 28 July. Length of hypocotyl and internodes of six plants in each treatment was measured on 11 August, 21 days after sowing. Pictures of the plants were taken on 2 and 11 August.

2) Promotion of axis elongation with gibberellic acid

Seeds of 'Kurodane' were immersed in 1 mg/*l* uniconazole for 20 hr and sown in potted soil on 23 August. They were grown in a glasshouse. Gibberellic acid was sprayed on the plants at the 1.3-leaf stage on 4 September. Twelve plants were treated with 2 m*l*/plant of gibberellic acid at concentrations of 0, 1, 10, 50 or 100 mg/*l*. Length of hypocotyl and internodes was measured 9 days after spraying of gibberellic acid.

Results and discussion

Seeds of figleaf gourd were immersed in uniconazole at various concentrations and sprayed or not sprayed with 50 mg/*l* gibberellic acid when cotyledons had unfolded. The length of the hypocotyl and internodes 14 days after spraying of gibberellic acid is shown in Fig. 1. The length of the hypocotyl and internodes decreased with the increase in the concentration of uniconazole, but no germination was observed at 500 mg/*l* uniconazole. Seed immersion in uniconazole solution was effective in inhibiting the hypocotyl and internode elongation with increasing concentration of uniconazole. On the other hand, the length of the hypocotyl and internodes increased by spraying of gibberellic acid at 50 mg/*l*. In the plants treated with gibberellic acid, the total length of the hypocotyl and internodes decreased with higher concentration of uniconazole up to 10 mg/*l*. However, the length at 10 and 100 mg/*l* uniconazole was almost the same. Growth retardation by uniconazole was alleviated by the application of gibberellic acid at higher internodes. In petunia, impatiens, salvia and marigold, foliar spray application of uniconazole at concentrations from 10 to 160 mg/*l* produced smaller plants than untreated control plants[1] and spraying of uniconazole at 5 and 10 mg/*l* also reduced the height of lisianthus[12]. As a result, variation in the length of the hypocotyl and internodes was obtained by the combined application of uniconazole and gibberellic acid.

Morphology of figleaf gourd whose seeds were immersed in various concentrations of uniconazole and sprayed or not sprayed with

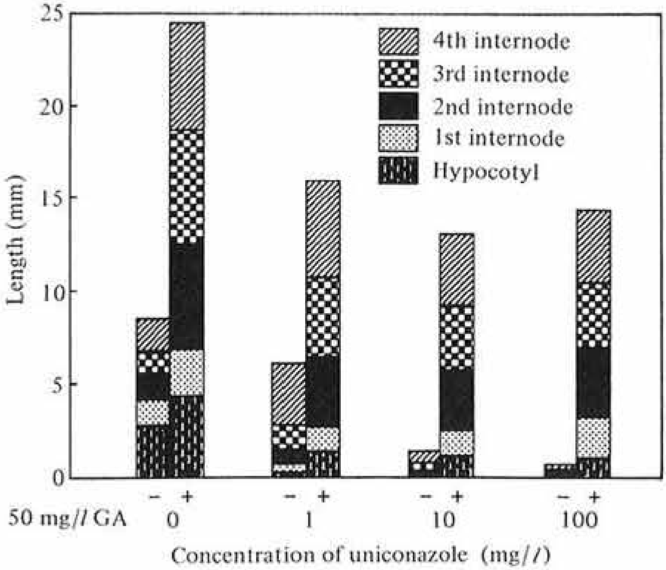

Fig. 1. Length of hypocotyl and internodes of figleaf gourd whose seeds were immersed in various concentrations of uniconazole (0 - 100 mg/l) for 20 hr
(+): Sprayed with 50 mg/l gibberellic acid when cotyledons unfolded.
(−): Not sprayed.
Length was measured 21 days after sowing.

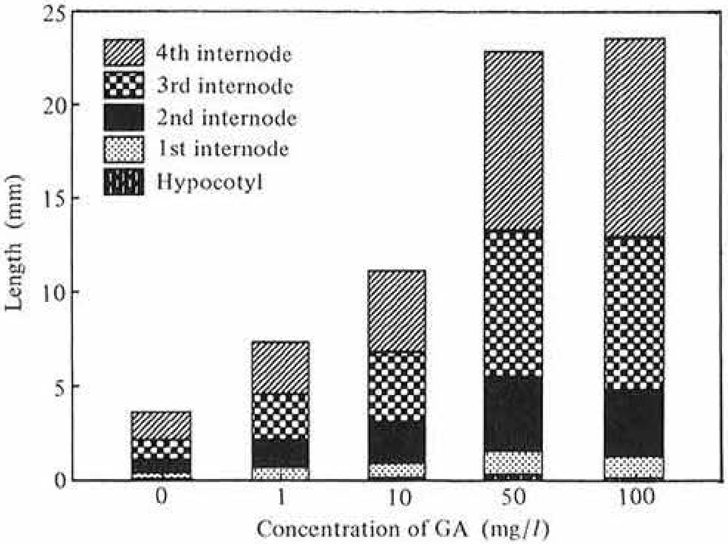

Fig. 2. Length of hypocotyl and internodes of figleaf gourd 9 days after spraying of gibberellic acid on the seedlings at 1.3-leaf stage
Seeds were immersed in 1 mg/l uniconazole for 20 hr and sown.

50 mg/*l* gibberellic acid when the cotyledons had unfolded is shown in Plate 1. Seed immersion in uniconazole resulted in the reduction of the size of the leaf and petiole, whereas the effect of gibberellic acid was opposite. Changes in the plant morphology were clearly apparent 5 days after spraying of gibberellic acid. Leaf size and petiole were larger than those of untreated control plants. However, the shape of the plants treated with 100 mg/*l* uniconazole and 50 mg/*l* gibberellic acid was similar to that of untreated control plants, except for the ratio of hypocotyl and internode length.

Length of hypocotyl and internodes of figleaf gourd 9 days after spraying of gibberellic acid on the seedlings at the 1.3-leaf stage following seed immersion in 1 mg/*l* uniconazole is shown

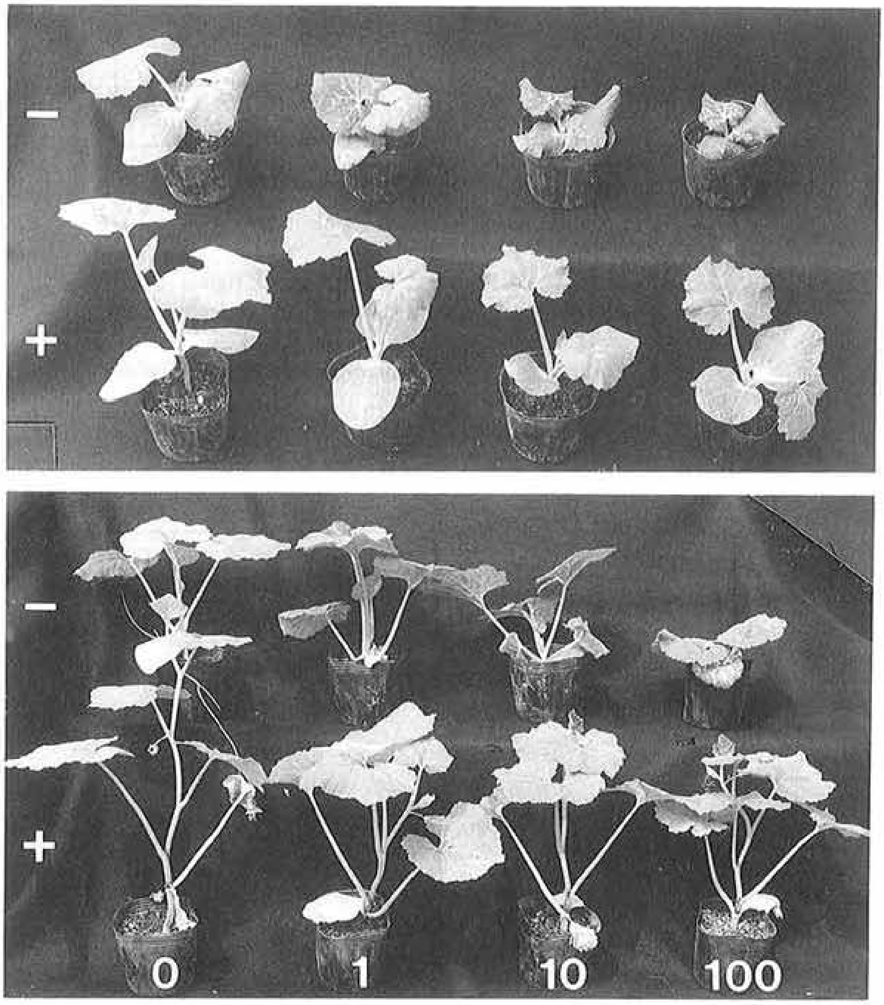

Plate 1. Morphology of figleaf gourd whose seeds were immersed in various concentrations of uniconazole (0 – 100 mg/*l*) for 20 hr
(+): Sprayed with 50 mg/*l* gibberellic acid 7 days after sowing when cotyledons unfolded.
(−): Not sprayed.
Pictures were taken at 12 days (top) and 21 days (bottom) after sowing.

in Fig. 2. The application of gibberellic acid resulted in the elongation of the internodes of the plants whose seeds had been immersed in 1 mg/*l* uniconazole but not in that of the hypocotyl. The length of the hypocotyl and internodes increased with increasing concentration of gibberellic acid up to 50 mg/*l*, while the values at 100 mg/*l* were almost the same as those at 50 mg/*l*. In hibiscus, the application of gibberellic acid at a concentration of 50 mg/*l* was effective in promoting the elongation of shoots previously delayed by the application of uniconazole while at 25 mg/*l* the growth retardation of rice[14] associated with the application of uniconazole was alleviated. In the present experiment, leaf size, petiole and height of plants increased with increasing concentration of gibberellic acid up to 50 mg/*l*.

Based on these results, it is concluded that the length of the stem and internodes of figleaf gourd for rootstock can be controlled by treatment with uniconazole and gibberellic acid. Plants with a shorter hypocotyl and longer internodes but with a similar height to that of untreated control plants can be obtained by immersing seeds in 1 mg/*l* uniconazole and spraying of 50 mg/*l* gibberellic acid at the cotyledon-unfolded stage.

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