Comparison of Staminate Flower Production on Gynoecious Strains of Cucumbers, *Cucumis sativus* L., by Pure Gibberellins (A_3, A_4, A_7, A_{13}) and Mixtures[1]

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Abstract. The mixture of GA_4 and GA_7 was effective in staminate flower production in gynoecious cucumbers and was nearly equal to pure GA_7. Although GA_{13} produced male flowers on gynoecious cucumbers, it is much less active than GA_7 or the mixture of GA_4 and GA_7.

Introduction

WITH the advent of mechanical harvesting of cucumbers, new hybrids involving gynoecious lines are becoming more and more important. However, the maintenance and production of the gynoecious line is a problem due to insufficient male flowers and viable pollen.

In 1960, Peterson (6) reported that gibberellin A_3 (GA_3) at a concentration of 1000 ppm and above, stimulated male flower production on gynoecious cucumbers. As other gibberellins became available, Bukovac and Wittwer (2, 3) and Brian (4) showed gibberellin A_7 (GA_7) and gibberellin A_4 (GA_4) were more active respectively in the cucumber hypocotyl elongation test than GA_3. In 1962, Wittwer and Bukovac (5) related this increased activity to staminate flower production. For the structures of the various gibberellins see Fig. 1.

Up to 1967, only milligram quantities of GA_4 and GA_7 were available. In that year, a mixture of GA_4 and GA_7 of approximately equal parts was made available in quantities. This new product was made by the deep aerated fermentation of *Gibberella fujikori*. If this mixture is found to behave in the same manner as either pure GA_4 or GA_7, certain economic advantages would accrue. As in the case of other antibiotics fermentation products, it is rather difficult to control consistently the exact ratio of GA_4 and GA_7 in the final product. Also if it were necessary to produce either component in pure form, the cost would be many times that of a mixture. Thus, if this mixture of GA_4 and GA_7 could be substituted for either pure component, it could be done at a greatly reduced cost.

GA_4 and GA_7 belong to the deoxygibberellin series. These gibberellins have been found to be naturally occurring in the cucurbit and pome fruit families (5). This group of gibberellins differs from GA_3, the gibberellin of commerce, in that it lacks a hydroxyl group in the seven position. Recently, gibberellin A_{13} (GA_{13}) became available in commercial quantities. It also belongs to the 7-deoxygibberellin series. Recently, Bukovac (4) reported that GA_{13} increased fruit set on apples. Since this new gibberellin is also a member of the 7-deoxygibberellin series, it could have superior properties in staminate flower production.

In 1968, Pike and Peterson (7) reported on a gynoecious cucumber field trial comparing treatments of 1000 ppm GA_3 and 50 ppm of a mixture of GA_4 and GA_7. They concluded that the GA_4-GA_7 mixture at 50 ppm applied 3 times was more effective than GA_3 applied 3 times at 1000 ppm in production of staminate flowers. Not only did the GA_4-GA_7 mixture produce more male flowers but for a greater period of time.

The objective of this investigation was to determine the relative efficacy of pure GA_7, GA_4, GA_{13} and mixtures of GA_4-GA_7 with pure GA_3 under controlled conditions.

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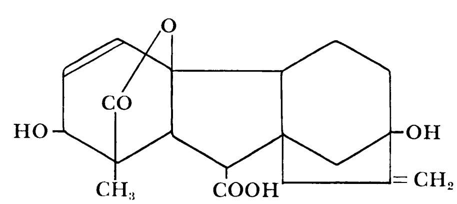
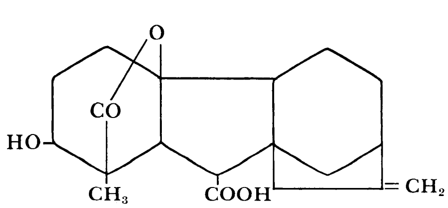
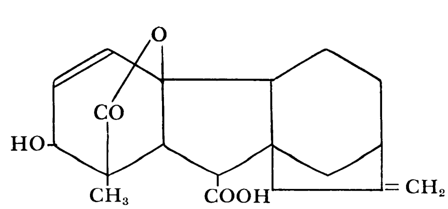


GA_3

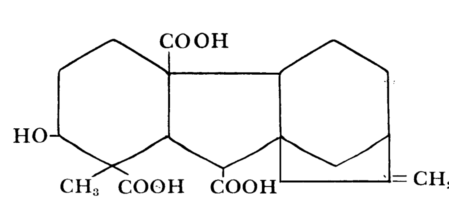
7-Deoxygibberellins



GA_4



GA_7



GA_{13}

Fig. 1. Comparison of the deoxygibberellins structures to gibberellic acid.

Materials and Methods

Seeds of the gynoecious cucumber MSU-713-5 were germinated in soil at 28° C for 72 hr and the seedlings were transplanted to steamed soil in 6 inch clay pots and grown under ambient greenhouse conditions. The period of time was during the summer and the temperatures ranged from 70° to 90° F. At the time when the first true leaf of most plants was 5–7 cm in width, the plants were selected for testing. Plants were selected for uniformity of size and vigor and were randomly assigned to test groups, 10 plants per group. Plants were sprayed with the appropriate gibberellin formulation. The first treatment was made when the first true leaf reached 5–7 cm, the second was one week later and the third 2 weeks after the initial application. All plants were sprayed individually, until uniformly wet, with a stainless steel atomizer (Standard Safety Equipment Co.), at 15 psi.

The formulations were prepared as 1000 ppm stocks in 95% isopropyl alcohol and 5% X-77 (Colloidal Products Corp.) and diluted with tap water to the desired concentration. The group identification and spray concentrations are given in Table 1.

Table 1. Gibberellin formulations and concentrations applied to seedlings of gynoecious cucumber MSU 713-5.

Treatment number	Gibberellin	Concentration (ppm) and number of applications[a]		
		1	2	3
I.........	Check, no GA	0	0	0
II.........	A_3	1000	1000	1000
III.........	A_4	50	50	50
IV.........	A_7	50	50	50
V.........	A_{13}	50	50	50
VI.........	A_4 (45%)-A_7 (55%)	50	50	50
VII.........	A_4 (45%)-A_7 (55%)	25	50	100

[a]First application when first true leaf reached 5–7 cm width; second, one week later and third, 2 weeks after initial treatment.

The sex of the flowers produced at each node was recorded at weekly intervals beginning 2 weeks after the final spray. At each weekly recording, all nodes were examined so that multiple flower production per node could be recorded. The experiment was terminated when at least 6 nodes had been produced above the last staminate flower.

Results and Discussion

The results obtained are tabulated in Table 2.

All treatments were effective in altering sex expression of the gynoecious cucumber used in this experiment. The relative activities of GA_7, GA_4 and GA_3 confirm the earlier work of Bukovac and Wittwer (2, 3) and Brian (4). The mixture of GA_7 and GA_4 is active and compares favorably with pure GA_7, especially when one considers the cost factor. It appears that GA_{13} is less active than GA_7 or the GA_4-GA_7 mixture. Further experiments are necessary to rank its activity along with GA_3 and GA_4.

Although no measurements were made, the elongation of the internodes was greatest with GA_3 followed by GA_4, GA_7 and the mixture and least by GA_{13}. The latter was hardly distinguishable from the controls.

Table 2. Effect of various gibberellins on production of staminate flowers on gynoecious cucumbers.

Treatment no. and GA formulation		Applications and concentration	Sex expression response[a]	
			Staminate flowers per plant (no.)	Last node producing staminate flower[b]
		No *ppm*		
I	Check	3 × 0	—	—
II	A_3	3 × 1000	22.4 d (6–40)[c]	11.4 cd (5–16)[c]
III	A_4	3 × 50	6.6 b (3–13)	10.1 c (4–14)
IV	A_7	3 × 50	25.2 d (7–45)	12.1 cd (6–16)
V	A_{13}	3 × 50	1.3 b (0– 3)	4.1 b (3– 6)
VI	A_4 A_7	3 × 50	14.6 c (5–23)	12.7 cd (5–16)
VII	A_4 A_7	1st at 25		
		2nd at 50		
		3rd at 100	21.7 d (10–34)	14.9 d (10–18)

[a]Means followed by the same letter are not significantly different at the 5% level by Duncan's multiple range test.
[b]Average node, counting out from crown.
[c]Range of response.

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Fertility Levels in Soil-Substitute Media: Their Influence on Transplant Development, Macro-Nutrient Content, and Yield in Tomato[1]

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Abstract. Tomato transplants were grown in soil-substitutes of peat moss-Turface and peat moss-perlite. Nutrients were added to the mixtures in factorial combinations by varying the levels of N, P, K, and dolomite. Plants grown in peat-Turface were taller and heavier than those grown in peat-perlite. In either medium, plants grown with the high level (10 lb./yd³) of dolomite were taller than the plants grown with the low level (5 lb./yd³) of dolomite. Plants grown in peat-Turface contained more N, K, and Ca than did the plants grown in peat-perlite. Plants grown in peat-perlite contained more P than plants grown in peat-Turface. The growing medium had no influence on Mg content of plant tops. The highest and earliest yielding plants were those grown in peat-Turface. The 10-lb. rate of dolomite was essential for high early yields in peat-Turface, but the additional increment of dolomite had no effect on early yields for plants grown in peat-perlite. Interactions existed between media and nutrient levels for growth, nutrient uptake, and early yields.

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Introduction

DEVELOPMENT of plants in soil and other media containing soil is variable and unpredictable. Besides temperature, humidity, solar energy, and watering practices, variability can be attributed to different kinds and amounts of nutrients present, degree of weathering, and physical properties of different soils. These factors can result in variable drainage, aeration, soil-water-nutrient interrelationships, and growth.

Use of standardized mixtures of soil-substitute materials, with the addition of known amounts of specific nutrients, offers promise as a means of

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