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Gibberellin-Induced Systemic Fruit Set in a Male-Sterile Tomato

Although recent reports (*1–3*) suggest that gibberellin or gibberellin-like substances (hereafter referred to as gibberellin) occur naturally in plants, investigators differ in their opinions regarding the movement of these compounds. The probability that gibberellin, like auxin, produces physiological effects distal from the site of synthesis indicates the need for further investigations of its movement in plants (*4, 5*). Hitchcock and Zimmerman (*6*) and Ferri (*7*) have demonstrated the movement of auxin through the plant by application to the soil, to roots, or to cuttings.

In the present study (*8*) the ability of gibberellin, applied as flower sprays, to set fruit parthenocarpically (*9, 10*) or to increase the growth of "dormant" tomato fruit (*11*) was regarded as a biological assay of its systemic movement.

The technique was refined by using male-sterile tomato plants (*Lycopersicon esculentum*) of the variety Earlypak (*12*) which were identified and selected at anthesis from a segregating backcross generation. These plants were normal in every respect except that the pollen grains were aborted (as indicated by an acetocarmine test). A few parthenocarpic fruit may set naturally on this mutant, but any appreciable increase in numbers of fruit under isolated greenhouse conditions could be attributed to applied gibberellin.

Table 1. Effect of gibberellin applied both to the foliage and soil on induction of fruit set in male-sterile Earlypak tomato.

Gibberellin per plant	Place of application	Average per plant			
		Total No. of clusters with fruits	Total No. of fruits	No. of fruits on treated lateral	No. of fruits on untreated lateral
100 μg	Expanded leaves	6.4	14.8	10.8	4.8
100 μg	Stem apices	7.0	12.0	7.0	5.0
100 μg	Flower peduncles	2.0	5.0	5.0	0.0
100 mg	Soil	8.0	36.0		
0	Control (untreated)	0.3	0.7		

Immediately preceding anthesis of the first flower cluster, the main stems of the tomato plants were pruned in order to stimulate the growth of two lateral branches from the cotyledonary axils. These branches were nearly alike with regard to time of flowering, number of flowers per cluster, and number and length of internodes. Basipetal and acropetal movement from a treated lateral would be reflected in a stimulation of fruit set on an untreated lateral. The plants were grown during the spring and summer in a greenhouse held at approximately 65°F at night. Day temperatures were held between 65° and 85°F.

In preliminary experiments to confirm previous results (*13*), floral sprays containing 500 μg of gibberellin per milliliter resulted in characteristic parthenocarpic fruit development. Subsequently, the effect of gibberellin (*14*) on inducing systemic fruit set was evaluated (i) by applying, with a micropipette, 100 μg per plant to the first or second fully expanded leaf above the second open flower cluster, to stem apices, and to the peduncle of a single inflorescence (*15*) and (ii) by applying 100 ml of a solution containing 1000 μg/ml (100 mg) to the soil (Table 1). An excess of gibberellin was applied in order to compensate for the rapid degradation in the soil reported by Brian *et al.* (*16*). One milliliter of polyoxyethylene sorbitan monolaurate (Tween-20) per 100 ml of solution was added as a wetting agent for both plant and soil treatments.

Increased parthenocarpic fruit set on both treated and untreated laterals was induced by applying gibberellin to the foliage, but not by treating peduncles (Table 1). Greatest fruit set resulted from the soil application. Fruit from these treatments in every way resembled that resulting from direct floral sprays. All treatments, in addition to floral sprays, resulted in significant increases in size of "dormant" fruits. Johnson and Liverman (*11*) reported that a "dormancy" of developing fruits induced by high temperature or by far red irradiation could be overcome by spraying them with gibberellin. No quantitative studies were made to determine whether promotion of fruit growth in our experiments was comparable to that reported by Johnson and Liverman.

The marked increase in fruit set on an untreated lateral of a male-sterile plant indicates that gibberellin initiates a physiological response distant from the point of treatment. The results do not necessarily imply that gibberellin per se is directly responsible for systemic induction of fruit set. The use of male-sterile plants to assay for systemic fruit setting may have application for evaluating other growth-regulating substances.

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