

Comparative Potency of Gibberellins in Inducing Parthenocarpic Fruit Growth in *Malus sylvestris* Mill.

Induction of parthenocarpy in the apple with auxins has met with limited success^{1,2}. The gibberellins, however, are now established as potent fruit-setting agents³. Fruit enlargement and continued development to maturity has been achieved in a number of apple cultivars with gibberellin A₃^{4,5}. Fruit size at maturity, depending on variety, may equal that of seeded fruits and specificity among cultivars and gibberellins is apparent^{6,7}. The comparative effectiveness of gibberellins A₁₋₁₀, A₁₃ and A₁₄ in promoting parthenocarpic fruit growth in the apple, in the absence of pollination, is the subject of this report⁸.

Ten to fifteen flower clusters were selected for uniformity on fruiting wood of comparable vigor and potential leaf area on apple (*Malus sylvestris* Mill. cv. Wealthy) trees. Each cluster was thinned to a single lateral flower and the flower was emasculated in the early balloon stage. Gibberellins (GA) A₁ through A₁₀, A₁₃ and A₁₄, in lanolin paste at $5 \times 10^{-3}M$, were applied to the cut style and adjacent receptacle tissue. Flowers similarly treated with lanolin alone and another group hand-pollinated at anthesis served as control comparisons. Each treatment was assigned to a single branch and replicated 4 times on different trees.

Fruit enlargement and number of persisting fruits were recorded at weekly intervals. Analysis of variance and comparison among treatment means were performed on fruit diameter data.

Fruit swelling was apparent with all gibberellins within 2 weeks (Table). All non-pollinated controls failed to enlarge and abscised between 2 and 3 weeks after treatment. Pronounced differences between the gibberellins were apparent 4 weeks after treatment. GA₄ and GA₇ were most active; fruit growth was equal to the pollinated control. GA₅, GA₆ and GA₈ were least active and fruit size approximated 50% of the pollinated control. GA₁, GA₂, GA₃, GA₉, GA₁₀, GA₁₃ and GA₁₄ were intermediate (Table). At maturity, size of all persisting parthenocarpic

fruits was similar to that of seeded fruits, with the exception of those induced with GA₅ and GA₁₄.

Sustaining fruit growth to maturity is equally important to initiation of fruit development. The greatest number (82%) of fruits persisted with GA₄. 15-35% of fruits persisted with GA₂, GA₇, GA₁₃ and GA₁₄, and 3-5% when treated with GA₁, GA₃, GA₅ and GA₁₀. All fruits induced with GA₆, GA₈ and GA₉ abscised within 5 or 6 weeks after treatment.

It is pertinent that in those treatments where a low percentage of the fruits matured, a greater leaf to fruit ratio developed as the number of persisting fruits decreased. Thus, final fruit size may not be the best index of relative gibberellin activity. We considered fruit size after 4 weeks and the number of fruits persisting to maturity as more acceptable indices.

Similar studies on an unnamed apple seedling, prone to frost-induced parthenocarpy, using GA₁ through GA₁₀ (except GA₈) revealed that GA₄, GA₇, and GA₉ were most active. GA₃, GA₅ and GA₈ were least active and GA₁, GA₂ and GA₁₀ intermediate. Only fruits induced by GA₄, GA₇, GA₂, GA₁ and GA₉ (decreasing order of activity) persisted to maturity.

Mature GA-induced parthenocarpic fruits had a smaller width to length ratio than the seeded control, except for GA₅, where it was larger.

Our data provide additional evidence for specificity among the gibberellins in promotion of parthenocarpy. The more active gibberellins, from the standpoint of molecular structure, do not have an OH group at position 7. The marked activity of GA₄ and GA₇ is of particular interest for they have been detected in immature apple seeds⁹. Although the role of gibberellins in fruit growth has not been established, the dependence of fruit enlargement on the presence and development of seeds may be related to endogenous seed gibberellins¹⁰.

Zusammenfassung. Die biologische Wirksamkeit der Gibberelline A₁ bis A₁₀, A₁₃ und A₁₄ wurde bei der Einsetzung von Parthenokarpie in *Malus sylvestris* Mill. festgestellt. Die Gibberelline A₄ und A₇ waren sehr wirksam, A₁, A₂, A₃, A₉, A₁₀, A₁₃ und A₁₄ waren von mittelmässiger Wirksamkeit, während A₅, A₆ und A₈ waren unwirksam. Die mehr wirksamen Gibberelline besitzen, vom molekularen Standpunkt betrachtet, in der Stellung 7 keine OH-Gruppe.

M. J. BUKOVAC and S. NAKAGAWA¹¹

Michigan State University Department of Horticulture, East Lansing (Michigan 48823, USA), 12th April 1967.

Comparative activity of gibberellins in inducing parthenocarpic growth of apple fruits

Gibberellin	Fruit diameter weeks after treatment			Fruits persisting at maturity
	2	4	13	
	% of pollinated control			% of flowers treated
A ₁	93bcd	77b	92a	5
A ₂	90cde	70b	90ab	15
A ₃	87de	64bc	96a	5
A ₄	101ab	96a	99a	82
A ₅	65f	45cd	82b	4
A ₆	62f	38d	—	0
A ₇	103a	94a	93a	23
A ₈	56f	44cd	—	0
A ₉	97abc	78b	—	0
A ₁₀	81e	58bc	98a	3
A ₁₃	64f	69b	93a	33
A ₁₄	62f	64bc	83b	34

^{*} Means followed by different letters are significantly different at $P = 0.05$.

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¹¹ On leave from Osaka Prefecture University, Osaka, Japan.