

Effect of gibberellins GA₃, GA₄₊₇ and GA₁₃ on seed germination and subsequent seedling growth in Early Muscat grape (*Vitis vinifera*)

by

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Der Einfluß der Gibberelline GA₃, GA₄₊₇ und GA₁₃ auf die Samenkeimung und das anschließende Sämlingswachstum bei der Rebensorte Early Muscat (*Vitis vinifera*)

Zusammenfassung. — Bei der Rebensorte Early Muscat wurde der Einfluß einiger Gibberelline (GA₃, GA₄₊₇ und GA₁₃) auf die Samenkeimung und das anschließende Wachstum der Sämlinge untersucht. Die nachgereiften Samen wurden jeweils mit Gibberellinkonzentrationen von 0, 50, 100, 250, 500 und 1000 ppm behandelt. Alle Gibberelline, mit Ausnahme von GA₄₊₇, förderten bei Konzentrationen über 50 ppm die Samenkeimung. Im allgemeinen erwiesen sich niedrigere Konzentrationen hierbei als wirksamer. 1000 ppm GA₄₊₇ hemmten die Keimung vollkommen. Die Wirkungskurve des GA₃ in Abhängigkeit von der Konzentration verlief stetig und ausgeglichen, während sie bei GA₄₊₇ und GA₁₃ einen raschen Anstieg mit einem schmalen keimungsfördernden Konzentrationsbereich zeigte. Auch beim Wachstum der Sämlinge wurde der unterschiedliche Einfluß der Gibberelline beobachtet.

Introduction

The germinability of grape seeds is very poor if inductive influences, such as stratification, chilling, growth regulators, etc., are not applied. Usually, the fresh seeds require an after-ripening or chilling treatment (0—4 °C) for about 2—3 months for good germination.

The aid of gibberellic acid (GA₃) in achieving enhanced germination in after-ripened grape seeds has been recognized by many workers (RANDHAWA and NEGI 1964; RANDHAWA and PAL 1968). Also more striking results have been reported by YEOU-DER *et al.* (1968) who claimed that GA rapidly terminated rest of Tokay grape seeds which had received no after-ripening. On the other hand, instances are reported which indicate that the activity of different gibberellins varies in different plant systems (BRIAN *et al.* 1964; RAI and LALORAYA 1967). The present studies were projected to investigate the differential influence of some of the gibberellins on seed germination in Early Muscat grape. Subsequent effect of the treatments on seedling growth was also noted.

Materials and Methods

Seeds of Early Muscat cultivar were extracted from the matured berries. These were gently and thoroughly washed with tap water and then in distilled water. The floating seeds were discarded and only those which settled down in water were used in the present studies. Prior to the gibberellin treatments, the seeds were stored in moist sand at a temperature ranging between 0 and 4 °C in a refrigerator for 80 days. The gibberellins employed were: GA₃, GA₁₃, and a mixture of approximately equal amounts of GA₄ and GA₇. The concentrations were 0, 50, 100, 250, 500 and 1000 ppm in each case. Seeds were soaked in various solutions for 24 hours

and, thereafter, were sown in pots. Twenty seeds were sown in each pot as one experimental unit and each treatment was repeated five times. The data on germination were recorded through the period till no more hypocotyls emerged. The height of the seedlings was measured up to growing apex, about three and a half months after sowing.

Results and Discussion

1. Effect on seed germination

The effect of different gibberellins on seed germination is depicted in Table 1. All gibberellins, except GA_{4+7} at concentrations beyond 50 ppm, promoted germination as compared to the control (0 ppm) which gave 58% germination. Maximum germination percentage (76%) was achieved with GA_{13} (100 ppm) closely followed by GA_3 (250 ppm) and GA_{4+7} (50 ppm) which resulted in 74 and 71% germination, respectively. Generally, the lower concentrations were found more efficacious for enhancing the germination. RANDHAWA and PAL (1968) also reported similar results. They observed that germination of Black Hamburg grape seeds went down from 52 to 5% when the concentration of GA_3 was increased from 500 to 2000 ppm.

Table 1

Effect of different gibberellins on the germination (%) of grape seeds cv. Early Muscat
Einfluß verschiedener Gibberelline auf die Keimung (%) von Samen der Rebensorte
Early Muscat

Gibberellins	Concentration (ppm)					
	0	50	100	250	500	1000
GA_3	58 ± 20.00	62 ± 32.50	67 ± 32.50	74 ± 17.50	69 ± 17.50	65 ± 12.50
GA_{4+7}	58 ± 20.00	71 ± 17.50	56 ± 30.00	56 ± 42.50	64 ± 17.50	0.0 ± 0.00
GA_{13}	58 ± 20.00	56 ± 42.50	76 ± 30.00	60 ± 12.50	60 ± 37.50	60 ± 25.00
Mean	= 63.6%					
S.E. (m)	= 2.273					
C.V.	= 7.99%					
C.D. at 5%	= 6.428					
1%	= 8.549					

It is amply demonstrated in Table 1 that the activity of gibberellins differed widely regarding their effect on seed germination. GA_3 markedly promoted the germination as its concentration was elevated to 250 ppm, beyond which the response diminished. In case of GA_{13} , a slow promotion in germination was observed at 50 ppm which registered a steep rise at 100 ppm application. A fall, almost of the same magnitude, occurred at its 250 ppm concentration. There was, however, very little difference in germination with 250, 500 or 1000 ppm GA_{13} . The activity of GA_{4+7} was found most striking. It could promote germination only at 50 ppm and it is interesting to note that the higher concentrations progressively inhibited the process of germination. A complete inhibition was recorded at 1000 ppm concentration.

From the results of the present studies it is enunciated that the activity of GA_3 was gradual and regular, i.e. it did not increase or decrease swiftly. On the other hand, GA_{13} and GA_{4+7} showed very narrow germination-promotive-concentration-range. GA_{4+7} was more critical in this regard. While studying the effects of different gibberellins on the hypocotyl growth of cucumbers, BRIAN *et al.* (1964) found that GA_7 and GA_4 were more active than GA_3 . FRANKLAND and WAREING (1960) and RAI and LALORAYA (1967) also documented that different gibberellins exhibit dif-

ferent growth-promoting activity. The latter workers also suggested three possibilities which were considered responsible for differential gibberellin response. According to them, the difference may be due to either (i) different levels of the endogenous growth regulators in different plant species, or (ii) to the presence of endogenous inhibitors of gibberellins, or (iii) to the requirement of some specific gibberellin other than gibberellic acid.

2. Effect on seedling growth

A reference to Table 2 indicates that the subsequent seedling growth was also influenced to a varied degree with different gibberellins. However, all the gibberellin treatments resulted in more seedling growth as compared to the control.

Table 2

Effect of different gibberellins on the seedling growth (cm) of the grape cv. Early Muscat
Einfluß verschiedener Gibberelline auf das Wachstum (cm) von Sämlingen der Rebensorte Early Muscat

Gibberellins	Concentration (ppm)					
	0	50	100	250	500	1000
GA ₃	2.8 ± 0.025	3.3 ± 0.040	3.6 ± 0.025	4.0 ± 0.025	4.6 ± 0.025	4.5 ± 0.075
GA ₄₊₇	2.8 ± 0.025	3.3 ± 0.025	4.5 ± 0.060	4.1 ± 0.025	3.6 ± 0.015	0.0 ± 0.000
GA ₁₃	2.8 ± 0.025	3.3 ± 0.025	3.9 ± 0.025	3.6 ± 0.025	3.0 ± 0.025	3.4 ± 0.025
Mean	= 3.7 cm					
S.E. (m)	= 0.0787					
C.V.	= 4.75%					
C.D. at 5%	= 0.2226					
1%	= 0.2960					

A critical appraisal of the data depicted in Table 2 reveals that increase in seedling height was observed with the increase of gibberellin concentration to 100 ppm in case of GA₄₊₇ and GA₁₃, and to 500 ppm in GA₃. The magnitude of growth increase started diminishing progressively with the application of super-optimal concentration of gibberellins. The studies on Bhokri grapes by RANDHAWA and PAL (1968) also showed that beneficial response of GA₃ gradually increased with its increasing concentration up to 500 ppm, beyond which the growth of the seedlings slowly decreased. Similar results were reported by RANDHAWA and NEGI (1964) on Bangalore Blue grape. The differential activity of various gibberellins has already been discussed.

Summary

The effect of some of the gibberellins (GA₃, GA₄₊₇ and GA₁₃) on seed germination and subsequent seedling growth of Early Muscat grape was investigated. The after-ripened seeds were treated with 0, 50, 100, 250, 500 and 1000 ppm concentrations of each gibberellin. All gibberellins, except GA₄₊₇, at concentrations beyond 50 ppm promoted germination. Generally, the lower concentrations were found more efficacious for enhancing the germination. GA₄₊₇ at 1000 ppm completely inhibited the germination. The activity of GA₃ was gradual and regular, whereas GA₄₊₇ and GA₁₃ showed swift activity with a narrow germination-promotive-concentration-range. The variable influence of gibberellins on seedling growth was also observed.

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