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Differential response of some seeded grape cultivars of Vitis vinifera to gibberellin application*)

by

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Introduction

All seedless cultivars of *Vitis vinifera* respond to gibberellin application in increasing their berry size (Coombe 1960, and Weaver 1960). In case of seeded cultivars of *Vitis vinifera*, however, varietal differences in sensitivity to gibberellin application have been observed. Application of gibberellin to seeded grapes like Carignane, Zinfandel, Tokay, Ribier and Red Malaga at various stages of cluster development did not increase the berry size but rather toxic effects like shot berry formation and reduced crop weights were observed (Weaver and McCune 1959 a, b). Similar toxic effects of gibberellin treatment have been noted in White Riesling and Pinot Blanc cultivars (Blaha 1963) and also in Black Hamburg, Bharat Early and Black Muscat grapes (Dass 1965).

Recent experience with other seeded cultivars of *Vitis vinifera*, however, has been different. Size and weight of the berries have been increased by GA application in a number of seeded cultivars like Queen of Victoria (Lavee 1960), Anab-e-Shahi (Dass 1965, Venkataratnam 1964, and Rao *et al.* 1962), Gulabi (Gopalkrishna and Kerawala 1962), Bhokri (Anon. 1962, and Dass 1965) and Black Queen and Koshu cultivars (Oohata and Yoshida 1960). Likewise, a very high percentage of seedless berries were induced by GA application in Delaware grape (Kishi and Tasaki 1960, Inoue *et al.* 1961, and Kajiura 1962) and Bhokri cultivar (Rao *et al.* 1962, and Dass 1965) but in other seeded grapes like Black Hamburg, Bharat Early and Black Muscat, GA application failed to induce seedlessness (Dass 1965).

It shows that some seeded grapes of *Vitis vinifera* respond to gibberellin application by increasing berry size or by formation of seedless berries, whereas other seeded grapes show rather toxic effects even at low concentration of GA. In the work reported here, an attempt was made to determine the cell size, seed number and seed index number in some of the seeded cultivars in order to elucidate the causes of this variation in response to gibberellin application.

Material and Methods

Ten year old vines trained on kniffin system of Bharat Early, Black Hamburg, Black Muscat, Anab-e-Shahi, Bhokri, Gros Colman (Pusa) and Alamwick were utilized for this experiment. Gibberellic acid (GA) was sprayed with a hand sprayer to uniform clusters of these cultivars. Triton was used as a wetting agent. At pre-bloom stage, GA was applied at 7—10 days before full bloom at the rate of 75 ppm on Bharat Early, Black Hamburg and Black Muscat grapes, at 50 ppm to Anab-e-Shahi and 100 ppm on Bhokri, Gros Colman (Pusa) and Alamwick cultivars. At post

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Table 1

Relation of seed number and seed index number with berry weight and seedlessness as affected by GA in different seeded cultivars of *Vitis vinifera* L.

Cultivars	Average seed number per berry	Weight of 100 berries	Wt. of fresh seeds extracted from 100 berries	Seed index number	Increase in berry weight with GA applied at postbloom stage		Seedless berries induced with GA applied at prebloom stage	
					GA	Increase in berry weight	GA	Seedless berries
		gm	gm		ppm	%	ppm	%
Bharat Early	2.792	193.52	10.06	19.33	100	8.33	75	2.00
Black Hamburg	2.690	286.00	17.42	16.42	100	3.03	75	3.20
Black Muscat	2.390	229.65	14.34	16.04	100	6.36	75	1.20
Anab-e-shahi	1.910	394.30	16.26	24.26	100	25.23	50	29.60
Bhokri	1.577	299.15	10.10	29.67	100	34.59	100	97.52
Gros Colman (Pusa)	1.475	286.40	10.32	27.76	100	30.33	100	80.00
Alamwick	1.970	447.75	16.48	27.16	100	0.00	100	32.60

bloom stage, GA was sprayed at 100 ppm in all the cultivars at 20—21 days after full bloom. For each treatment at least nine clusters were used.

The number of seeds per berry, berry weight and fresh seed weight were taken of the above seeded cultivars during the years 1963 and 1964 and averaged figures for the two years have been presented in Table 1. For calculating all these indices at least six representative bunches from different vines were selected and the berries of the clusters were removed and mixed thoroughly. A random sample of 100 berries was then taken and weighed and from these 100 berries also fresh seeds were extracted and weighed. Seed index number was calculated by dividing the berry weight by seed weight as suggested by Olmo (1946), which gives the approximate number of units of berry flesh produced per unit of seed.

The seed number per berry was recorded by cutting the berries open from at least 100 berries taken at random. For cell size, samples of Bhokri and Bharat Early grapes were taken on May 8, 1964, about five weeks after full bloom. A portion of the mesocarp from epicarp to the centre was taken from the middle of each fruit. The material thus collected was fixed in formalin-acetic acid-alcohol and was dehydrated, cleared and infiltered as usual. Radial microtome sections 20—30 μ thick from several samples were cut and stained with fast green alone. The length and breadth of at least fifty cells from each slide were measured by ocular micrometer and observations were standardized by stage micrometer.

Observations

Prebloom application of GA to Bharat Early, Black Hamburg and Black Muscat grapes at even low concentrations showed toxic effects like abnormal elongation of clusters ,cracking of rachis, shot berry formation and reduced crop weights. However, in case of other cultivars such as Anab-e-Shahi, Alamwick, Bhokri and Gros Colman

(Pusa), even higher concentrations of GA applied at prebloom stage did not result in such toxic effects as wiry condition of clusters, shot berry formation and cracking of rachis but induced seedless berries.

Data for average number of seeds per berry, berry weight, seed weight, seed index number, percent increase in berry weight and percent seedless berries induced by GA application in different seeded cultivars of *Vitis vinifera* are summarized in Table 1.

In Anab-e-Shahi, Bhokri, Gros Colman (Pusa) and Alamwick grapes, the average seed content per berry was lower and seed index number was higher as compared to Bharat Early, Black Hamburg and Black Muscat cultivars. A further perusal of Table 1 shows that the number of seedless berries were appreciable induced by GA application only in grapes having a comparatively high seed index number. Except in case of Alamwick, high seed index number and low seed content per berry in Anab-e-Shahi, Bhokri and Gros Colman (Pusa) grapes, was associated also with increased berry weight in response to application of GA. On the other hand, Bharat Early, Black Hamburg and Black Muscat grapes having high seed content per berry and low seed index number did not respond to prebloom GA application for inducing seedlessness but rather showed toxic effects and only a nominal increase in weight could be recorded by post bloom application of GA.

Anatomical studies of Bhokri and Bharat Early grapes were done to see if the initial cell size in a particular cultivar has any effect on its response to GA application.

It is evident from Table 2 that both the length and width of mesocarp cells were larger in Bharat Early than in Bhokri grape.

Table 2

Mean length and breadth of parenchyma cells in mesocarp of Bharat Early and Bhokri cultivars

Cultivars	Mean cell length (microns)	Mean breadth of cells (microns)
Bharat Early	204.75	177.58
Bhokri	160.16	156.05

Discussion

Examination of mean cell size of Bharat Early and Bhokri grapes showed that cell size in Bharat Early was larger than in Bhokri. The fact that Bharat Early, Black Hamburg, Black Muscat and Alamwick cultivars do not respond to GA application by increasing their berry weight, suggests that these cultivars probably have already attained an optimum cell size and beyond that there is no effect of GA application. However, formation of quite a large number of seedless berries in Alamwick, Bhokri, Anab-e-Shahi and Gros Colman (Pusa) and a very few or almost none in Bharat Early, Black Hamburg and Black Muscat indicates that apart from cell size there are some other differences in these two groups of cultivars which may be responsible for differential behaviour of these grapes to exogenous GA.

When comparison of seed index number of different seeded cultivars is made, it is clear that cultivars with high seed index number respond to GA application by inducing seedless berries and by increasing berry weight. Alamwick grape alone

inspite of its high seed index number did not respond to GA by increasing berry weight, but it responded to GA in that more seedless berries were induced. On the other hand, Bharat Early, Black Hamburg and Black Muscat grapes have high seed content per berry and comparatively low seed index number and thus do not respond to GA by increasing berry weight or induction of seedlessness. This suggests that there are some physiological differences in these two groups of grape cultivars.

In one group comprising Bhokri, Anab-e-Shahi, Gros Colman (Pusa) and Alamwick grapes, one unit of seed is associated with a large amount of berry flesh compared to the other group composed of Bharat Early, Black Hamburg and Black Muscat. High amounts of gibberellin-like activity have been found in seeded Tokay and Carignane grapes compared to seedless Tokay (Weaver and Pool 1965). It seems that this variation in berry size compared to seed content in these two groups of cultivars is not due to critical level of cell enlargement factors, but due to cell division factors. In Bharat Early grape, the cell size was found to be larger than in Bhokri, which, however, had a larger berry size and lower average seed content than Bharat Early. The reason for this may be that in this cultivar, the initial cell number is very low to start with and cell enlargement reaches the maximum with a limited number of cells. The differential response to GA may be explained on the assumption that some factors opposing the action of exogenous GA, are produced in addition to gibberellin like factors. Such factors opposing the action of exogenous GA are probably produced in proportion to the high seed content in cultivars which do not respond to application of GA.

Field observations also showed that the group which responds to GA, consisting of Bhokri, Anab-e-Shahi, Gros Colman (Pusa) and Alamwick is more vigorous in vine spread, cane length and leaf size compared to the group of Bharat Early, Black Hamburg and Black Muscat which does not respond to GA. It is likely that the whole physiology of the vine may be different in these two groups of grape cultivars.

Summary

Several seeded cultivars of *Vitis vinifera* varying in seed content and berry size were tested to see their response to GA application. Cultivars with high seed index number and low seed content like Bhokri, Anab-e-Shahi, Gros Colman (Pusa) and Alamwick did not show any toxic effects due to GA application but responded by producing seedless berries and increasing berry weight with prebloom and postbloom application respectively. Alamwick alone, with high seed index number did not respond to GA by increasing the berry weight but it responded by forming seedless berries. Cultivars like Bharat Early, Black Hamburg and Black Muscat with high seed content per berry and low seed index number did not respond to GA by producing seedless berries and increasing berry weight. This differential response of cultivars to exogenous GA is discussed on the basis of physiological differences in the two groups of cultivars.

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Literature Cited

1. Anonymous: Sixth annual report of coordinated scheme to study the application of growth regulating substances in horticulture. Andhra Pradesh, India, 1961—1962 (1962).
2. Blaha, J.: Influence of gibberellic acid on the grape vine and its fruit in Czechoslavakia. Amer. J. Enol. Vitic. **14**, 161—163 (1963).
3. Coombe, B. G.: Relationship of growth and development to changes in sugars, auxins and gibberellins in fruit of seeded and seedless varieties of *Vitis vinifera*. Plant Physiol. **35**, 241—250 (1960).
4. Dass, H. C.: Response of seedless and seeded grapes (*Vitis spp.*) to gibberellin. Thesis submitted for Ph.D to Post Graduate School, Indian Agricultural Research Institute, New Delhi, India (1965).
5. Gopalkrishna, N. and D. N. Kerawala: Pre and post blossom sprays of gibberellin and its effect on fruit set, bunch compactness and quality of Gulabi (*Vitis vinifera*) grapes. Proc. 16th. International Hort. Cong. (Brussels). **1**, 288 (1962).
6. Inoue, S., Y. Nageno and Y. Fujiwara: Effects of gibberellin on grape varieties. Abstr. 4th. Meet. Jap. Gibb. Res. Assoc. 64—65 (1961).
7. Kajiura, M.: Gibberellin application for seedless Delaware production in commercial vineyards in Japan. Proc. 16th. International Hort. Cong. (Brussels). **1**, 286 (1962).
8. Kishi, T. and M. Tasaki: The effect of gibberellin on grape varieties. I. On Delaware grape. Abstr. 3rd Meet. Jap. Gibb. Res. Assoc. 65—66 (1960).
9. Lavee, S.: Effect of gibberellic acid on seeded grapes. Nature **185**, 395 (1960).
10. Olmo, H. P.: Correlations between seed and berry development in some seeded varieties of *Vitis vinifera*. Proc. Amer. Soc. Hort. Sci. **48**, 291—297 (1946).
11. Oohata, T. and M. Yoshida: Gibberellin effect on peaches and grapes. Abstr. 3rd Meet. Jap. Gibb. Res. Assoc. 66—67 (1960).
12. Rao, S. N., R. N. Reddy and P. Sreeramulu: Studies on the effects of gibberellic acid on fruit set, size, weight, seed content and quality of grapes. Andhra Agric. J. **9**, 166—174 (1962).
13. Venkataratnam, L.: Effect of gibberellic acid on Anab-e-Shahi grape (*Vitis vinifera*). Proc. Amer. Soc. Hort. Sci. **84**, 255—258 (1964).
14. Weaver, R. J.: Growth of grapes in relation to gibberellin. In Gibberellins. Adv. in Chem. Series **28**, 89—108 (1960).
15. — — and S. B. McCune: Response of certain varieties of *Vitis vinifera* to gibberellin. Hilgardia **28**, 297—350 (1959 a).
16. — — and — — : Effect of gibberellin on seeded *Vitis vinifera* and its translocation within the vine. Hilgardia **28**, 625—645 (1959 b).
17. — — and R. M. Pool: Gibberellin-like activity in seeded fruit of *Vitis vinifera* L. Naturwiss. **5**, 111—112 (1965).

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