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Studies on the Effect of Plant Growth Regulators on Certain Varieties of Grapes (*Vitis vinifera* L.)

by

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Introduction: Plant growth regulators are widely employed to secure good fruitset and development in many horticultural crops. They are now widely used in grape production for varied uses such as thinning of berries, improving the fruitset, hastening or delaying maturity of fruits (Weaver, 1956), increasing the size of berries (Weaver and Mc Cune, 1959 a), increasing the quality of berries (Weaver and Mc Cune 1959 a, b and c, Venkataratnam, 1964) and for inducing seedlessness in berries (Celestre, 1963, Blaha, 1963 and Coombe, 1965). The compounds of plant growth regulators like naphthalene compounds, phenoxy compounds and gibberellins are commercially used for such purposes. In India Krishnamurthi *et al* (1959) found the usefulness of gibberellic acid for improving the size and quality of Pusa Seedless variety of grape. In the light of the above findings, investigations were undertaken, to study the effect of plant growth regulators on some of the important varieties of grapes.

Materials and Methods: Vines of four varieties of grapes *viz.*, Seedless, Pachadraksha, Khandari and Anab-E-Shahi of the same age group grown at the College Orchard, Agricultural College and Research Institute, Coimbatore-3 were selected for the study. The growth regulators employed were gibberellic acid (G. A.), naphthalene acetic acid (NAA), naphthoxy acetic acid (NOA) 2-4-5-trichlorophenoxy acetic acid (2-4-5-T) and 2, 4-dichlorophenoxy acetic acid (2, 4-D). The aqueous preparations of the above growth regulators were prepared and mixed with wetting agent Tepal. The concentrations used ranged from 2 to 100 ppm. The flower clusters of the above four varieties just before flower opening were dipped in the growth regulator solutions for two minutes. The experiments were conducted for three seasons during 1965 and 1966. Five clusters were treated under each treatment and concentration. Observations on the percentage of berryset, time taken for maturity and quality of berries in terms of total soluble solids (T.S.S.) and acidity, were recorded and the mean values of the data for the period of study were statistically analysed whenever feasible and tabulated.

Results: The data on the effect of growth regulators on fruitset and time taken for maturity are presented in Table 1.

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TABLE 1. *Effect of plant growth regulators on berryset and maturity of grapes*

Growth regulator Concentration in ppm	Seedless		Pachadraksha		Khandari		Anab-E-Shahi	
	Fruitset in percentage	No. of days taken for maturity	Fruitset in percentage	No. of days taken for maturity	Fruitset in percentage	No. of days taken for maturity	Fruitset in percentage	No. of days taken for maturity
G.A.								
10	53.5	58	62.1	55	51.8	53	63.3	53
25	65.9	58	71.8	54	58.7	58	59.5	54
50	55.8	56	66.9	55	55.9	51	54.3	53
100	59.7	54	62.3	53	59.6	49	48.2	50
NAA								
10	41.9	60	53.2	56	45.6	53	55.5	54
25	52.2	59	49.4	56	36.9	55	51.2	55
50	33.3	60	47.1	57	35.9	54	48.5	56
100	35.4	60	44.1	56	31.7	55	45.9	56
NOA								
10	73.6	57	76.3	58	57.5	54	73.5	57
25	77.9	57	73.9	59	62.9	53	75.7	55
50	72.9	59	73.9	59	58.7	58	64.8	56
100	76.4	60	69.9	57	61.5	56	74.9	57
2, 4-D								
2	60.7	57	64.9	57	62.1	53	60.2	50
5	50.2	57	63.8	54	55.2	49	59.2	54
10	46.4	49	50.9	52	54.3	48	38.5	49
2, 4, 5-T								
2	57.2	58	60.9	55	43.9	52	44.1	56
5	54.4	57	58.2	54	43.3	51	43.7	51
10	35.2	58	49.9	57	31.7	51	47.5	50
Control	64.6	61	62.9	60	45.1	56	62.4	56
CD at 5% level	7.31	2.72	6.92	2.17	5.71	2.61	7.12	2.48

1. *Effect on fruitset:* In Khandari, G.A. at all concentrations improved the fruitset ranging from 14.9 to 32% maximum being at 100 ppm. But in other varieties there was thinning effect due to G. A. at 100 ppm. In seedless, G. A. at 25 ppm induced only two percent increase in fruitset than the control whereas thinning effect was ranging from 7.6 to 17.2% in other concentrations. In Pachadraksha, G. A. at 25 and 50 ppm had increased the fruitset by 14.1 and 6.4% respectively. In Anab-E-Shahi an increase of 1.5% in the fruitset was noticed at 10 ppm of G. A. and in other concentrations there was only reduction in the percentage of fruitset. NAA did not influence the fruitset in any of the concentrations and it only reduced the fruitset ranging from 11.0 to 48.4% in the four varieties thereby causing thinning effect. The reduction in fruitset was more in Seedless *i. e.*, 45.2 and 48.4% when treated with NAA at 50 and 100 ppm respectively.

Among the growth regulators tried, NOA was found promising to promote the fruitset in all the varieties. In Khandari, where the normal percentage of fruitset was only 45.10% there was increase in the fruitset by 27.5 to 39.5% due to NOA treatment. NOA at 25 ppm recorded higher percentage of fruitset in all the four varieties tried. In Khandari, 2, 4-D in all the concentrations increased the fruitset, the maximum being 37.7% at 2 ppm. In other varieties 2, 4-D and 2, 4, 5-T did not improve the fruit set remarkably. On the contrary they caused reduction in fruit set in Anab-E-Shahi and Seedless. 2, 4-D and 2, 4, 5-T at higher concentrations showed epinastic symptoms like splitting, curling and twisting of the stalks and the buds did not open at all.

2. *Effect on fruit maturity:* In general, the growth regulators had induced earlier fruit maturity. The maximum effect in this direction was observed in Khandari with GA at 10 ppm (7 days earlier) and 2, 4-D at 5 and 10 ppm (7 to 8 days earlier). In Pachadraksha, the maturity was 7 days earlier at 100 ppm of GA and 8 days earlier at 10 ppm of 2, 4-D. In the variety Seedless the berries matured earlier by 7 days at 100 ppm of GA and 12 days at 10 ppm of 2, 4-D. In Anab-E-Shahi the maximum effect of earlier maturity was observed at 100 ppm of GA and 10 ppm of 2, 4-D. In general GA and 2, 4-D had induced earlier maturity in all the four varieties studied. NOA did not influence on the maturity of the berries due obviously to the higher percentage of fruit set induced by it. NAA also had no effect on the maturity of berries appreciably, though it produced thinning effect on the clusters.

3. *Effect on fruit quality*: The effect of growth regulators on the T.S.S. content and acidity of berries is depicted in figure 1. It could be seen that GA at 50 and 100 ppm and 2, 4-D at 2 and 5 ppm increased the quality of berries considerably when compared to the respective control. The effect of GA was more marked. It is also interesting to note that the application of growth regulators in general reduced the acidity of berries and this was more pronounced due to GA treatment in all the varieties.

4. *Effect of GA on berry size and seedlessness:* The data on the effect of GA on berry size and seedlessness are furnished in Table 2. The increase in size of berries was remarkable particularly at higher concentrations. This was even more marked in the Seedless variety. In the seeded varieties of Anab-E-Shahi and Pachadraksha complete seedlessness was obtained in the three higher concentrations in one and in all the concentrations in the other. But it may also be seen from the Table 2. that the undesirable effect of more quantum of shot berries has also been evident to varying degrees at different concentrations. The effect was more pronounced in Anab-E-Shahi. Elongation

TABLE 2. *Effect of G.A. on size, seededness of berries and production of shot berries*

Variety/ Concentration (ppm)	Length of berry (cm)	Percent increase over control	Girth of berry (cm)	Percent increase over control	No. of seeds per berry	Percent shot berries
Anab-E-shahi						
10	2.3	109.5	1.8	112.5	2	19.6
25	2.6	123.8	1.9	118.8	Nil	15.3
50	2.6	123.8	1.9	118.8	Nil	18.7
100	2.6	123.8	1.9	118.8	Nil	20.2
Control	2.1	100.0	1.6	100.0	3	Nil
Pachadraksha						
10	2.2	122.2	1.3	92.8	Nil	6.4
25	2.3	127.8	1.3	92.8	Nil	10.1
50	2.6	144.4	1.3	92.8	Nil	7.7
100	2.6	144.4	1.3	92.8	Nil	8.1
Control	1 8	100.0	1.4	100.0	2	Nil
Seedless						
10	2.0	125.0	1.2	92.3	Nil	7.3
25	2.1	131.3	1.2	92.3	Nil	9.0
50	2.4	150.0	1.2	92.3	Nil	5.4
100	2,4	150.0	1.2	92.3	Nil	9.5
Control	1.6	100.0	1.3	100.0	Nil	Nil
Khandari						
10	1.7	100.0	1.4	100.0	2	12.5
25	1.7	100.0	1.4	100.0	2	10.1
50	1.7	100.0	1.4	100.0	2	8.1
100	1.7	100.0	1.4	100.0	2	5.4
Control	1.7	100.0	1.4	100.0	2	6.4

of clusters was also noticed in Anab-E-Shahi and Pachadraksha due to GA treatment. In Khandari no response was observed either in the berry size or seedlessness.

Discussion: The response due to the treatment of plant growth regulators on the clusters of four varieties *viz.*, Seedless, Pachadraksha, Khandari and Anab-E-Shahi varied with the chemicals and the concentrations employed.

Among the growth regulators NOA induced the maximum percentage of fruitset than the other growth regulators in all the four varieties, while GA at higher concentrations produced thinning effect. NAA also in almost all the concentrations produced thinning effect in all the varieties tried as reported by Weaver (1954), Farrag (1955), Lavees (1960) and Tripathi (1967). Clusters treated with 2, 4–D at lower concentrations increased the berryset. Similar results were obtained by Weaver *et al* (1961). But 2, 4–D and 2, 4, 5–T at higher concentrations caused epinastic effects and failure of buds to open and set fruits.

The growth regulators GA and 2, 4-D hastened the maturity of the berries of all the varieties considerably. Shing (1961) has also reported that application of GA hastened the maturity of the berries. However, Krishnamurthi *et al* (1959) and Tripathi (1967) have reported that application of GA delayed the maturity of berries.

With regard to the quality of berries, gibberellic acid has remarkably enhanced the quality of the grapes by increasing the T.S.S. content. Similar results were reported by Nijjar and Bhatia (1969) who found that GA at 25 and 50 ppm gave significantly higher T.S.S. in Anab-E-Shahi than the control. (Fig. 1)

It is interesting to note that GA induced complete seedlessness in the seeded varieties of Anab-E-Shahi and Pachadraksha. But a certain amount of shot berries was produced due to GA treatment. These findings are in agreement with the results obtained by Stewart *et al* (1958) Weaver and McCune (1959 a and 1962) Hidalgo and Candela (1962), Venkatratnam (1962) Blaha (1963), Celestre (1963) Coombe (1965), Cankov and Brajkov (1965), Clore (1965) and Shanmugavelu and Sundararaj (1968).

Enlargement of berries in the variety Seedless, as well as in the seeded varieties like Anab-E-Shahi and Pachadraksha was noticed and it is one of the significant responses of grapes due to GA. However, the previous workers (Weaver and McCune 1959 and Krishnamurthi *et al* 1959) have recorded the elongation of berries only in the seedless varieties. They have also reported that the response of the seeded varieties was much less than that of seedless. The reason attributed to this response is that perhaps seeds produce sufficient gibberellin or related compounds to result in berry enlargement. In the present studies, the pronounced effect due to GA in the seeded varieties is attributable to the fact the seeded varieties Anab-E-Shahi and Pachadraksha may not contain endogenous gibberellin or its related compounds, because they responded well to the exogenous application of GA. The variety Khandari did not show any significant response to GA treatment in the berry size or its development, which may be due to that the berries of variety Khandari may contain GA or its related compounds endogenously. Phinney *et al* (1957) and Weaver and Pool (1965) have demonstrated the presence of "gibberellin like" substances in several seeds including grapes. Weaver *et al* (1962) reported that there was no increase in the size of seeded varieties due to GA treatment and they have attributed the above mentioned reason for such kind of response.

Thus the response of the growth regulators varied with the variety and the concentration of the chemical. However, GA could be advantageously used to induce seedlessness and to improve the quality of berries. NOA for

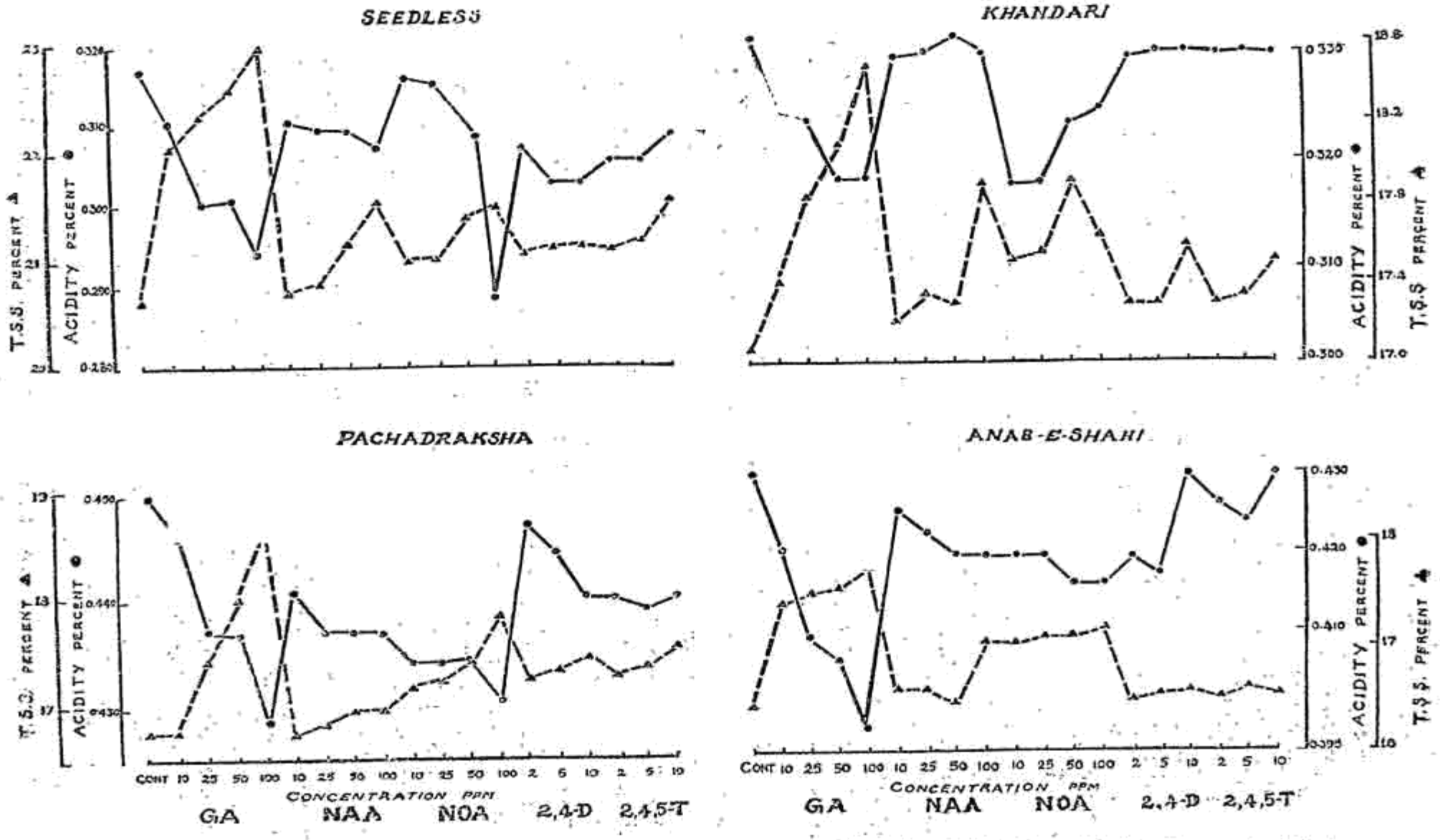

FIG. EFFECT OF PLANT GROWTH REGULATORS ON QUALITY OF GRAPES

increasing the fruitset, NAA for thinning the berries and 2, 4-D and 2, 4, 5-T at lower concentrations to hasten the maturity of the berries may be employed with advantage in viticulture.

Summary: The studies on the effect of plant growth regulators on four varieties of grapes *viz.*, Seedless, Pachadraksha, Khandari and Anab-E-Shahi have indicated that

i) the application of gibberellic acid resulted in complete seedlessness in Anab-e-Shahi and Pachadraksha; produced elongated berries in all the varieties except Khandari; improved the fruitset and quality and induced early maturity.

ii) NOA improved the percentage of fruitset but did not influence the ripening of berries.

iii) NAA caused thinning effect in grapes but did not influence the maturity of the berries.

iv) 2, 4-D at lower concentrations improved the fruitset and quality and hastened the maturity of berries. But at higher concentrations produced formative effects due to toxicity.

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