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Regional Fruit Research Station, Punjab Agricultural University, Abohar, India

Effect of growth regulators on floral bud drop, fruit characters and quality of Thompson Seedless grape (Vitis vinifera L.).

by

J. S. Jawanda, Raghbir Singh and R. N. Pal

Einfluß von Wachstumsregulatoren auf das Durchrieseln der Blütenknospen sowie auf Traubenmerkmale und Qualität von Thompson Seedless (Vitis vinifera L.)

Zusammenfassung. — Der Einfluß von drei Wachstumsregulatoren auf das Abfallen der Blütenknospen sowie auf Merkmale und Qualität der Beeren und Trauben bei der Sorte Thompson Seedles wurde untersucht. Die Infloreszenzen wurden 18 und 10 Tage vor der Anthese (Stadien S_1 und S_2) mit GS_3 (5, 10, 20, 50 ppm), IES und PCPA (je 2,5, 5, 10, 20 ppm) besprüht. Alle Behandlungen verringerten das Durchrieseln im Vergleich zur Kontrolle. Bei Anwendung von GS_3 (20 und 50 ppm), IES (10 und 20 ppm) und PCPA (20 ppm) war das Verrieseln jedoch signifikant verringert (ca. 22—41%). Ein deutlich verbessertes, allerdings nicht statistisch abzusicherndes Ergebnis zeigte sich, wenn die Infloreszenzen in dem früheren Vorblütenstadium (S_1) behandelt wurden. Trauben- und Beerengewicht waren gleichfalls signifikant erhöht. GS_3 (bei allen Konzentrationen) und IES (bei 20 ppm) hatten eine signifikante Verlängerung der Trauben zur Folge. PCPA-Behandlungen bewirkten eine schwache Erhöhung der TSS und eine geringfügige Erniedrigung der Säuren, während GS_3 und IES darauf keinen merklichen Einfluß hatten.

Introduction

Of late, the problem of abnormal floral bud drop in grapes, particularly in the commercially grown cultivar — Thompson Seedless, has assumed alarming proportions in the vineyards in the arid regions of north India. The trouble was first noticed at the Regional Fruit Research Station, Abohar, Punjab, during the flowering season of 1971. Contemporary reports of similar disorders were also received from several growers' fields. Preliminary observations revealed that shedding of flower buds initiated when the clusters were still at a pre-bloom stage and reached the maximum severity just near anthesis, continuing thereafter until the shatter stage. As a consequence of this trouble, the fruit-set is greatly reduced, clusters remain poorly filled up and yields dwindle down significantly.

The specific causes of the floral bud drop trouble are yet to be investigated fully. The present studies were mainly designed to explore the efficacy of three important growth regulators, viz. GA_3 (Gibberellic acid), IAA (Indole-3-acetic acid) and PCPA (Para chlorophenoxyacetic acid) for checking the malady in grapes. These growth regulants are well known for producing vast range of effects in grapes, as reviewed by Wittwer (1968, 1970) and Randhawa (1971).

Materials and Methods

The work was carried out in the vineyard of the Regional Fruit Research Station, Abohar during 1972. Eight-year old vines of Thompson Seedless, trained on 4-arm Kniffin system, were employed. The following four concentrations each of three growth regulators (in aqueous solutions), were sprayed on clusters with a hand atomizer.

GA_3 at 5, 10, 20 and 50 ppm
IAA at 2.5, 5, 10 and 20 ppm
PCPA at 2.5, 5, 10 and 20 ppm

Clusters under control were sprayed with distilled water only. The treatments were applied at two stages of cluster development, i. e., according to observations taken by us, 18 days and 10 days before anthesis. The clusters measured approximately 5 cm and 10 cm and these two stages designated as S_1 and S_2 respectively. To ensure uniformity, only one treated cluster per shoot, of normal size, was retained. Different clusters on a vine were treated with different concentrations of the same regulator. These clusters attained full bloom period by April 26. Each treatment was given to six clusters with three repeats employing split plot technique.

For floral bud drop studies, the flower buds were counted on 2 to 4 basal laterals at the time of treatments. The percentage of bud drop was calculated after counting the number of berries on the same laterals when the clusters reached shatter stage.

For assessing the influence of treatments on the fruit quality, physico-chemical analyses were carried out on June 30. The data on physical characters, viz. cluster length, cluster weight and number of berries were recorded. The weight per berry was found by subtracting the weight of rachis from that of cluster and dividing it by the total number of berries. Total soluble solids (TSS) per cent was determined by using a hand refractometer. Acidity was estimated as per cent tartaric acid by titrating 10 ml juice against 0.1 N sodium hydroxide.

Table 1

Effect of growth regulators on floral bud drop in Thompson Seedless grape
Einfluß von Wachstumsregulatoren auf das Durchrieseln von Blütenknospen bei Thompson Seedless

Concentration (ppm)		Floral bud drop (%)		
		S_1	S_2	Mean
GA_3	5	64.10	69.58	66.84
	10	61.79	68.17	64.98
	20	46.91	57.45	52.18
	50	55.28	61.94	58.61
IAA	2.5	62.58	73.67	68.12
	5	61.16	68.18	64.67
	10	56.32	64.30	60.31
	20	42.40	49.72	46.06
PCPA	2.5	71.26	73.62	72.44
	5	68.33	72.94	70.63
	10	65.87	71.65	68.76
	20	55.25	63.98	59.61
Control		78.02	77.33	77.67
Mean		60.71	67.12	—

C. D. at 5%: Concentrations = 16.26
stages = NS
Interaction = NS

Results

1. Effect on floral bud drop

The data in Table 1 show that the floral bud drop was markedly reduced by all the treatments as compared to control. However, GA_3 (20 and 50 ppm), IAA (10 and 20 ppm) and PCPA (20 ppm) brought about a significant reduction. In comparison to control, about 22 to 41 per cent less drop occurred under the afore-mentioned five treatments.

All concentrations of GA_3, IAA and PCPA invariably brought about greater reduction in bud drop when applied at earlier stage of cluster development (S_1), although the results were non-significant.

2. Effect on cluster length

All the four concentrations of GA_3 as well as IAA at 20 ppm induced the clusters to grow significantly longer than those under control (Table 2). The increment of cluster elongation with the successive higher concentration of GA_3 was highly significant in all cases except between 10 and 20 ppm. Various concentrations of IAA and PCPA, except 20 ppm IAA, were on a par.

The length of clusters treated at two stages, i. e., S_1 and S_2, did not register any significant difference.

3. Effect on cluster weight

A significant increase in cluster weight was observed in all treatments except PCPA — 2.5 ppm (Table 2). A progressive increase in weight, significant in a number of cases, occurred with increased concentrations of GA_3 and IAA. But in case of PCPA, increase in cluster weight by different concentrations was non-significant. Its highest concentration actually reduced the cluster weight. The clusters from IAA treatments weighed usually significantly more than those from the corresponding concentrations of PCPA.

It is also interesting to note (Table 2) that applications given at earlier stage (S_1) produced significantly more heavy clusters than the delayed applications (S_2). The same was true for the individual concentration of GA_3 and IAA when compared at different stages. PCPA, however, could give significant response at 10 ppm only, whereas other concentrations were found on a par.

Further examination of the data in Table 2 shows that 20 ppm GA_3 applied at S_1 resulted in maximum cluster weight and was closely followed by 50 ppm GA_3 at the same stage. Both these treatments were at par but were significantly superior to all others.

4. Effect on berry weight

All treatments brought about a marked increase in berry weight as compared to control, but a significant effect was noted with GA_3 (all four concentrations) and IAA (10 and 20 ppm) treatments only (Table 2). Another notable feature of the data is that an increase in concentration of GA_3 and IAA resulted in the progressive increase in berry weight. On the contrary, a rise in concentration of PCPA beyond 5 ppm resulted actually in a decrease in berry weight. The berries from the clusters treated at S_2 were significantly heavier than those from clusters of S_1. The maximum berry weight was recorded with 50 ppm GA_3 applied at S_2, closely followed by same concentration of GA_3 applied at S_1.

Table 2

Effect of growth regulators on cluster length, cluster weight and berry weight
Einfluß von Wachstumsregulatoren auf Traubenlänge und -gewicht sowie Beerengewicht

Concentration (ppm)		Cluster length (cm)			Cluster weight (g)			Berry weigth (g)		
		S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
GA_3	5	20.2	21.2	20.7	314.7	252.7	283.7	1.259	1.263	1.261
	10	25.2	24.8	25.0	414.7	353.3	384.0	1.312	1.224	1.268
	20	26.7	24.8	25.8	554.3	400.3	477.3	1.375	1.396	1.385
	50	27.8	29.2	28.5	536.3	452.7	494.5	1.517	1.565	1.541
IAA	2.5	19.2	17.5	18.3	313.3	199.0	256.1	1.071	1.103	1.087
	5	20.3	20.0	20.1	350.7	241.0	295.9	1.146	1.197	1.171
	10	20.2	19.7	20.0	395.0	304.7	349.9	1.173	1.250	1.211
	20	21.0	21.8	21.4	446.6	365.7	406.1	1.230	1.259	1.244
PCPA	2.5	17.3	19.2	18.2	209.7	228.3	219.0	1.056	1.073	1.064
	5	17.8	19.5	18.6	249.0	235.7	242.3	1.167	1.198	1.182
	10	18.3	18.0	18.1	333.0	262.7	297.9	1.077	1.083	1.080
	20	19.3	19.2	19.3	283.7	276.7	280.2	1.029	1.070	1.050
Control		17.2	17.5	17.4	173.0	182.3	177.7	0.972	0.999	0.985
Mean		20.8	21.0	—	351.8	288.0	—	1.183	1.206	—

C. D. at 5%:	Cluster length	Cluster weight	Berry weight
Stages	NS	9.5	0.014
Concentrations	2.8	44.3	0.206
One stage X variable concentrations	NS	62.7	NS
One concentration X variable stages	NS	61.0	NS

5. Effect on fruit quality

A close scrutiny of data in Table 3 indicates that various treatments failed to affect TSS and acidity contents significantly. However, PCPA treatments given at S_2 stage, brought about suggestively higher TSS and lower acidity. Similar but less marked effects were also noticed in case of GA_3 and IAA treatments.

Discussion

The present studies reveal that as high as 78 per cent of floral buds dropped before setting fruits in Thompson Seedless. Although the bud drop was observed to be initiating about a week before bloom stage, yet period just near anthesis was found to be the most critical for its occurrence. These findings support the observations of TODOROV and GEORGIEV (1970) from Bulgaria.

Furthermore, it was observed that Thompson Seedless, which ripens in the mid-season, was affected with acute floral bud drop while Perlette and Beauty Seedless (early season cultivars) escaped undamaged. The specific reasons for variable varietal susceptibility to the trouble are yet to be known. However, the rapid change in weather coupled with wide difference between day and night temperatures, in this region, during the blooming period of grapes could be considered one of the contributory factors. To lend further support to this belief, it might be revealed that the above cultivars reach bloom stage (critical period for floral bud drop) at periods falling under unidentical weather conditions, hence they could be affected differently. Certain inherent variations, particularly in regard to the level of endogenous regulators, among these cultivars might be attributing towards variable varietal behaviour. The bioassay tests for various endogenous growth regulating substances during flower bud development may prove to be helpful in further understanding the problem.

The floral bud drop was effectively reduced by various treatments of GA_3, IAA and PCPA and higher concentrations of these growth regulants produced significant response. Many earlier workers have reported that higher fruit-set was induced with GA (WEAVER 1958, KRISHNAMURTHI *et al.* 1959, RANDHAWA and SINGH 1962) and PCPA (COOMBE 1953, WEAVER 1956). SRIVASTVA and BISHT (1969) claimed that berry drop was reduced from 41.13 to 8.39 per cent with GA in seedless grapes.

A greater reduction in bud drop was brought about when the clusters were treated at the earlier pre-bloom stage (S_1). Probably the endogenous availability of growth regulants decreased as the floral buds grew older. This inferrence is further supported by the data in Table 1 which indicate that in comparison to S_1, higher concentration of a growth regulant was required to produce similar quantum of effect at S_2.

GA_3 treatments resulted in significant elongation of clusters. A suggestive increase in cluster length was also observed with IAA and PCPA applications, response being much more conspicuous in the former case. The elongation of clusters is one of the most striking responses of grapes to GA and has been reported by several earlier workers (WEAVER 1958, JAWANDA *et al.* 1972).

GA_3 was observed to be the most effective growth regulant in increasing the cluster weight and berry weight, whereas IAA and PCPA were next in order of efficacy. WEAVER and MCCUNE (1959), ANTCLIFF (1967) and DASS and RANDHAWA (1968) have also reported similar supremacy of GA over PCPA. In these studies, the production of heavier clusters seemed to be a result of the reduction in floral bud-

Table 3

Effect of growth regulators on fruit quality of Thompson Seedless grape
Einfluß von Wachstumsregulatoren auf die Fruchtqualität bei Thompson Seedless

Concentration (ppm)		Total soluble solids (%)			Acidity (%)		
		S_1	S_2	Mean	S_1	S_2	Mean
GA_3	5	16.4	17.2	16.8	0.69	0.60	0.64
	10	16.0	18.0	17.0	0.58	0.61	0.60
	20	17.4	19.2	18.3	0.73	0.67	0.70
	50	18.0	18.0	18.0	0.67	0.64	0.65
IAA	2.5	15.0	19.6	17.3	0.61	0.67	0.64
	5	19.0	19.4	19.2	0.81	0.72	0.76
	10	19.2	17.8	18.5	0.78	0.72	0.75
	20	16.4	16.0	16.2	0.73	0.61	0.67
PCPA	2.5	19.0	19.0	19.0	0.67	0.66	0.66
	5	17.8	19.6	18.7	0.70	0.54	0.62
	10	18.0	19.0	18.5	0.69	0.57	0.63
	20	17.4	19.2	18.3	0.66	0.60	0.63
Control		17.0	16.2	16.6	0.75	0.67	0.71
Mean		17.4	18.3	—	0.70	0.64	—

The results are NS

-drop with the use of growth regulants. The effect of GA_3 was more pronounced because in addition to lowering the floral bud drop, it resulted in heavier berries.

The clusters treated at earlier stage (S_1) were significantly greater in weight than those obtained from delayed application (S_2). On the other hand, weight per berry was significantly more in the latter case. It could thus be inferred that comparatively less floral bud drop and higher fruit-set in the S_1-treated clusters must have been responsible for their significantly greater weight.

Though not significant, yet a suggestively higher TSS and lower acidity were recorded with PCPA applications at S_2. Observations of DASS and RANDHAWA (1968) that PCPA increased TSS in Pusa Seedless are in accord with these findings.

Summary

Effect of three growth regulators on the floral bud drop, cluster, and berry characters as well as fruit quality in Thompson Seedless grape was studied. The clusters were sprayed 18 and 10 days before anthesis (S_1 and S_2 stages) with GA_3 (5, 10, 20, 50 ppm) and IAA and PCPA (2.5, 5, 10, 20 ppm each). All treatments reduced floral bud drop in comparison to control. However, significantly less drop (about 22 to 41 per cent) occurred when GA_3 (20 and 50 ppm), IAA (10 and 20 ppm) and PCPA (20 ppm) were applied. A better response, though non-significant, was clearly demonstrated when the clusters were treated at the earlier pre-bloom stage (S_1). Cluster weight and the berry weight were also significantly increased. GA_3 at all concentrations and IAA (20 ppm) resulted in significant elongation of clusters. PCPA treatments suggestively increased TSS and lowered the acidity level, whereas GA_3 and IAA did not have any appreciable effect on these attributes.

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Dr. J. S. Jawanda
Senior Horticulturist
Regional Fruit Research Station
Punjab Agricult. University
Abohar 152116
India