Vitis 6, 14—20 (1967)

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A Field Trial with Growth Regulators on the Zante Currant (Vitis vinifera var.)

by

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Introduction

Plant growth regulators have been extensively tested in viticulture and their uses have been discussed by WINKLER (1962, p. 302). In particular growth regulator sprays have found a wide acceptance as a substitute for the cincturing (girdling) formerly used to produce a satisfactory crop on the parthenocarpic Zante currant variety.

This paper reports a trial in which growth regulator sprays were tested in a new planting of Zante currant with no previous history of cincturing. In addition to yield and yield components the occurrence of hard seeds in the fruit was studied, since these have sometimes been induced by growth regulator sprays (WEAVER, 1956), and seedlessness is one of the most important commercial attributes of this variety.

Materials and Methods

Rooted Zante currant vines from normal commercial sources were planted 2.75 metres apart in rows 3.35 metres apart running north and south on an area of Barmera sand (PENMAN *et al.* 1939) at the Horticultural Research Section, Merbein. Planting was completed in spring 1955 and the first treatments were applied in spring 1958*. A randomised block design was used which allowed for eight replications of seven treatments. Plots were of six vines, three in each of two adjacent rows, in blocks across the rows. Thus, as no guard vines were left between the plots, 14 rows of 24 vines were needed for the trial itself. In addition an extra row was planted on each side of the trial, as well as three vines at the top and two vines at the bottom of each row. Vines were trained with four permanent arms on a T-trellis and were spur pruned each year. Growth was very vigorous each season throughout the experiment.

As far as possible treatments were applied at about 90% cap fall each year. By the time flowering had reached this stage appreciable berry enlargement was occurring on the earliest flowering bunches. In the first two years the spray treatments were applied with a 15-litre knapsack spray. In later years a tractor driven nylon roller pump was used. In all cases about 750 ml of spray were applied to each vine. In all years except the first all vines were topped (20—50 cm cut from the ends of the shoots) a day or two before the treatments were applied.

In spring 1958 the treatments were 2,4-dichlorophenoxyacetic acid at 5 parts per million (2,4-D), p-chlorophenoxyacetic acid at 20 parts per million (PCPA), 2,3,4-trichlorophenoxyacetic acid at 50 parts per million (2,3,4-T), gibberellic acid at 5 parts per million (GA5) and 20 parts per million (GA20), cincture and control. In the next

* In the Southern Hemisphere treatments applied in spring 1958 relate to the 1959 harvest and so on.

season 2,3,4-T was replaced by a combined treatment of gibberellic acid at 10 parts per million and cincture (GA10 + cinct) and GA5 by GA10. The treatments were then continued unchanged for a further four seasons.

Commercial spray formulations were used as far as possible. In the early seasons before commercial gibberellic acid was available the pure chemical was dissolved in a small quantitiy of ethanol before making up the spray with water and 0.02% "Agral LN" added as a wetter. Cincturing was a single knife cut around the trunk for the first two or three seasons while the trunks were of small diameter and then a double cut around the trunk with the removal of a strip of bark about 3 mm wide.

Observations and Results

At the 1959 harvest the fresh fruit from each plot was weighed, the sugar concentration in the juice from a sample from each plot was determined with a refractometer, and the fruit from each plot dried in a tunnel dehydrator and reweighed. Figure 1 shows for each treatment the mean weight of fresh fruit per plot, the expected weight of dried fruit per plot calculated from the fresh weight and sugar concentration according to the relation described by Lyon and Walters (1941), and the actual weight of dried fruit per plot.

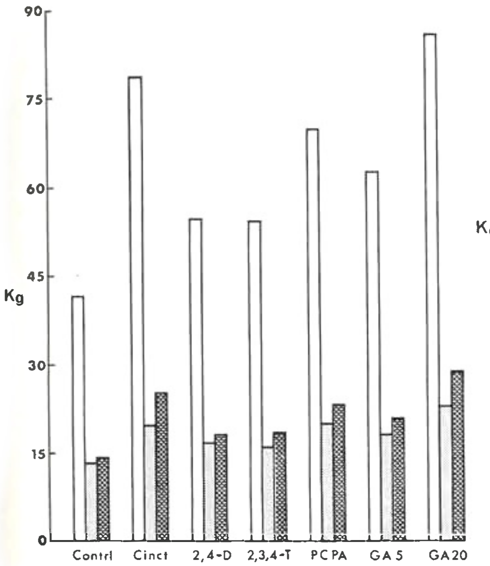

Fig. 1

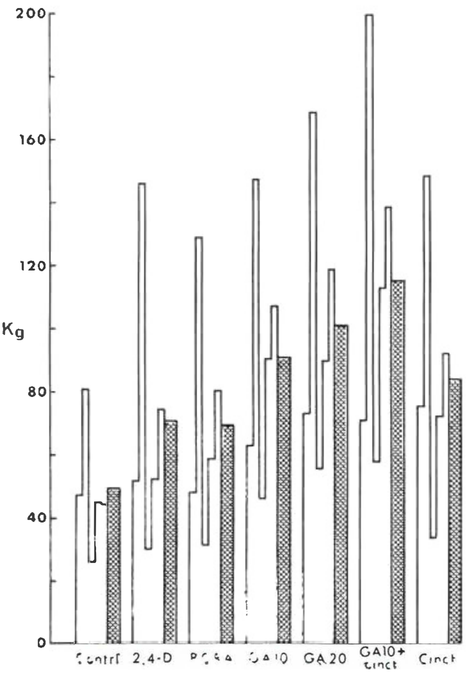

Fig. 2

Fig. 1: Mean weight of fresh fruit, mean calculated weigth of dried fruit and mean actual weight of dried fruit (left to right) per six-vine plot for each treatment, 1959 harvest. Least significant differences ($P = 0.05$) 15.8, 4.2 and 4.8 Kg respectively.

Fig. 2: Mean weight of fresh fruit per six-vine plot for each treatment at each harvest from 1960 to 1964 (open, left to rigth) together with the mean for the five-year period (hatched).
Least significant difference ($P = 0.05$) between the five-year means 10.7 Kg.

For both fresh weight and actual dried weight vines from all treatments except 2,4-D and 2,3,4-T yielded significantly more than control vines but only PCPA and GA20 gave yields not significantly different from cincturing. There were significant differences between treatments in sugar concentration which tended to cancel out the differences in fresh weight. This is reflected in the reduced differences in calculated dry weight but it can be seen from Figure 1 that this did not apply to the actual dry weight. The reason for this discrepancy appears to have been the differences in the degree of splitting and partial drying of the fruit while still on the vines following rain shortly before the harvest, this being greater for the treatments which increased the yield of fresh fruit. The sample taken for sugar determination was of undamaged fruit only. However since no moisture determinations were made on the dried fruit the possibility cannot be ruled out that the larger berries from the more effective treatments were not as completely dried.

Figure 2 shows the mean weight of fresh fruit per plot for each treatment at each harvest from 1960 to 1964 and also the overall mean for the five year period. The yields from the two phenoxyacetic acid treatments were significantly greater than those from control but they were significantly less than those from cincturing. GA20, but not GA10, was more effective than cincturing in increasing the yield of fresh fruit, while GA10 in addition to cincturing led to a further significant increase in yield. The interaction between treatments and seasons was significant at the 0.1% level but was nevertheless small in comparison to the overall differences between seasons and between treatments.

In 1960 and from 1962 to 1964 actual dry weights were obtained after combining the fruit from all plots of each treatment and then sundrying on racks according to usual district practice (PERMEZEL 1964). Hence no statistical analyses were possible for the separate seasons but as in 1959 the dry weights generally followed the fresh weights closely enough to suggest that the same conclusions would apply to both. In 1960 and 1962 sugar determinations were made on samples of sound berries and in both seasons there were differences between actual and calculated dry weights as in 1959, less pronounced in 1960 than in 1959 but very marked in 1962 (Table 1). District records showed that damage to currants from rain and humid weather before harvest was very severe in 1962 but only moderate in 1960. From 1962 to 1964 the dried fruit from the various treatments was delivered to the packing house separately. Only in 1964 did the larger-berried fruit from the GA treatments obtain a

Table 1

Total weight of dried fruit (kg) actually obtained from vines in each treatment compared with the expected weight calculated from the weight of fresh fruit and sugar concentration

Treatment	1960		1962	
	Actual	Calculated	Actual	Calculated
Control	129	131	88	69
2,4-D	139	135	105	82
PCPA	140	128	125	86
GA 10	171	164	154	118
GA 20	193	178	188	141
GA 10 + cinct.	179	166	171	132
Cinct.	191	181	128	85

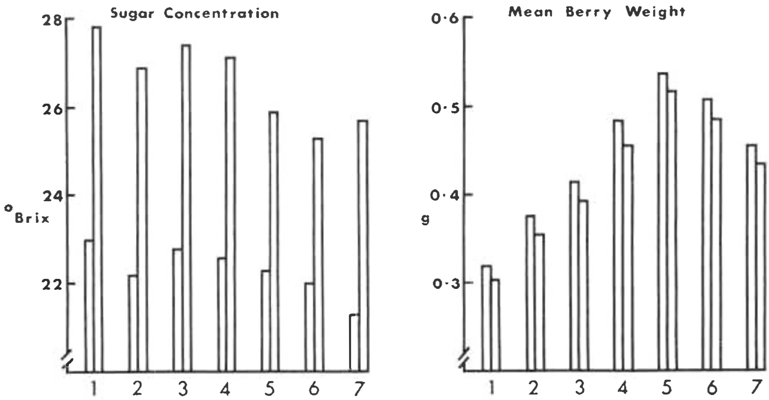

Fig. 3: Mean sugar concentration and mean berry weigth for each treatment a fortnight before and at harvest.

Left-sampled 18—20/1/60, right-sampled 3—5/2/60. Numbers 1 to 7 refer to the treatments in the same order as shown in Figures 2 and 4. Least significant differences (P = 0.05) between sugar concentration means 0.84 and 1.43° Brix and between berry weight means 0.045 and 0.039 g respectively.

higher grading. Differences in moisture content were slight and the greater differences between actual and calculated dry weights in 1962 for the cincture and PCPA treatments may indicate that rain damage was most severe for these.

In 1960 samples were taken not only at harvest but also a fortnight earlier for determination of sugar concentration and mean berry weight. The results are shown in Figure 3. There was little change in berry weight between the two times of sampling. The slight decrease in weight, which was consistent for all treatments, was presumably due to net water loss, even in apparently sound berries. Sugar concentration on the other hand increased markedly over the fortnight in all treatments. Although the increases were not equal for all treatments the differences between them did not quite reach the 10% level of significance. However only the GA20 and GA10 + cinct treatments had appreciably smaller differences than the control and a test of these two as one group against the other treatments as a second group showed significance at the 1% level. This might be taken as evidence that the fruit matured earlier in the two treatments of the first group than in the others, but the complete absence of any effect of GA10 or cincturing treatments on their own suggests that such a selection among the treatments may not be justified. When the mean berry weights were used to calculate the number of berries for each plot it was found that only the cincturing treatment had greater mean number than the control and that in any case none of the differences was significant.

In 1961 the fruit was harvested in excellent condition and a more extensive series of observations was made at harvest. In addition to a mean berry weight determination on a sample of 400 berries, individual berries were weighed and then examined for the presence of hard seeds. The seeds referred to had a mean weight of about 9 mg and occurred in the largest of the normal range of berries. They were not the larger seeds of about 25 mg occurring in the much larger berries sometimes found on currant bunches and known in Australia as "boys" or "bucks". At first more than 100 berries per plot were weighed and examined but it was found that almost as accurate an estimate of the weight of the smallest berry with seeds and the largest berry without seeds could be obtained from about 50 berries in the appropriate size range. The mean values obtained for each treatment are shown in Figure 4. All three variables showed much the same trend and differences between treatment means were significant at the 0.1% level in each case. Analysis of the ratios of the weight of the smallest berry with seeds for each plot to the mean berry weight for the plot showed no significant differences between treatments. Similarly analysis of the differences between the weight of the smallest berry with seeds and the largest berry without seeds for each plot showed no significant differences between treatments. Although the actual distribution of berry weight within each treatment was not determined there was nothing to suggest that any appreciable differences would have been found. In the absence of such differences the data of Figure 4 would indicate that the proportion of seeded berries was similar for all treatments and that a similar proportion of seedless berries would have been discarded from each if berries over a given size had been rejected to reduce the occurrence of seeded berries to any desired level.

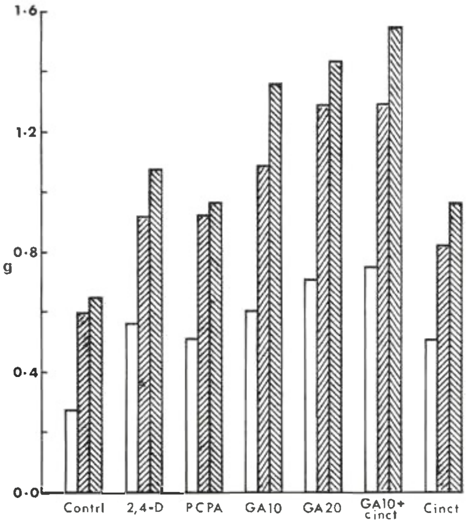

Fig. 4: Mean berry weight, mean weight of smallest berry with seeds and mean weight of largest berry without seeds (left to right) for each treatment, 1961 harvest.

Least significant differences (P = 0 05) 0.073, 0.203 and 0.180 g respectively.

Also in 1961 a sample of 12 bunches was harvested at random from each plot and weighed. The mean bunch weight so obtained was used in conjunction with the other data to calculate the number of berries per bunch and the number of bunches per plot .Means for each treatment are shown in Figure 5. Differences in mean bunch weight were significant at the 0.1% level but there were no significant differences in the other two variables. Thus it would appear that the differences between treat-

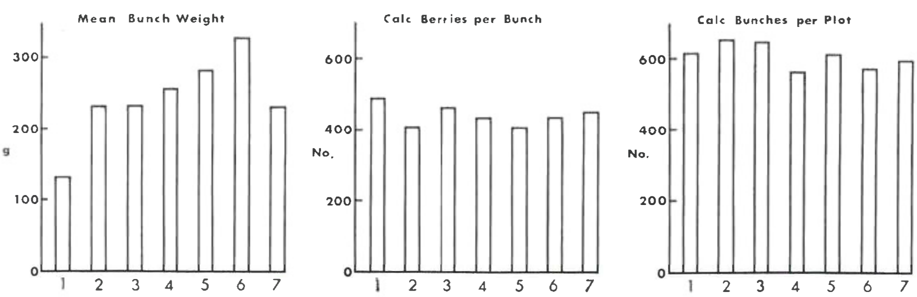

Fig. 5: Mean bunch weight, mean calculated number of berries per bunch and mean calculated number of bunches per plot for each treatment, 1961 harvest.

Numbers 1 to 7 refer to the treatments in the same order as shown in Figures 2 and 4. Least significant differences (P = 0.05) 39.3 g, 72.1 and 71.6 respectively.

Table 2

Yield of fresh fruit per plot (kg), sugar concentration (°Brix) and calculated yield of dried fruit per plot (kg) for each treatment at 1961 harvest

Treatment	Fresh Fruit	Sugar	Dried Fruit
Control	81.1	26.0	25.1
2,4-D	145.9	22.7	37.0
PCPA	129.1	23.2	33.8
GA 10	147.4	22.4	37.0
GA 20	168.6	21.6	40.4
GA 10 + cinct.	199.3	18.9	42.1
Cinct.	148.2	21.4	34.9
LSD 5%	17.7	1.5	4.5
LSD 0.1%	31.1	2.6	7.8

ments in yield of fresh fruit were due to differences in mean bunch weight, and that these in turn were due to differences in mean berry weight.

Differences between treatments in sugar concentration in 1961, when yields were very high, were large and reached the 0.1% level of significance. However although they tended to cancel out the differences in the yield of fresh fruit differences in the calculated weight of dried fruit were still large and reached the 0.1% level of significance (Table 2). In view of the excellent condition of fruit and the extensive sampling programme actual dry weights were not obtained in this season.

Discussion

Phenoxyacetic acid sprays, both 2,4-D and PCPA, have been widely used in Australia for many years as a satisfactory substitute for cincturing on old currant vines with a previous history of cincturing. More recently gibberellic acid sprays have proved even more effective in increasing crop but have drawn some unfavourable reactions from packing houses due to imperfect drying of the fruit when the berries were too large.

The present work suggests that with young vines which have never been cinctured the phenoxyacetic acid sprays may be less effective than cincturing. The concentrations of 2,4-D and PCPA used here were near the limit beyond which the risk of damage to the vines becomes too great. The amount of 2,3,4-T available was enough for only the first season, when at the concentrations used it was no more effective than 2,4-D. Twice the concentration of 2,3,4-T used here has been applied to older currant vines with no formative effects whatever (Antcliff 1957) but in this earlier trial 40 p.p.m. and 100 p.p.m. sprays were equally effective in increasing bunch weight (by about 46%). With gibberellic acid the limit is likely to be set by the maximum berry size which will prove acceptable and yields greater than those achieved by cincturing should be readily possible.

Throughout the experiment described there was no problem with setting on the control vines, the low yields being simply due to the very small berry size. In work with gibberellic acid Weaver and McCune (1959) found a similar number of berries per cluster withouth treatment, with girdling, and with concentrations of GA from 1 to 500 p.p.m., but in earlier work with PCPA (Weaver 1956) a very poor set without treatment was recorded.

There was no serious problem with seeded berries in the present experiment. Apparently spraying with PCPA was always after the critical time found by WEAVER (1956) before which large numbers of seeded berries were induced.

Summary

A field trial using young currant vines (*Vitis vinifera* var. Zante currant) which had never been cinctured showed that over a 5-year period with treatments applied at about 90% capfall phenoxyacetic acid sprays were somewhat less effective and gibberellic acid sprays more effective than cincturing (girdling) in increasing crop. Parachlorophenoxyacetic acid at 20 p.p.pm. and 2,4-D at 5 p.p.m. were equivalent in effect. Gibberellic acid at 10 p.p m. was about equal in effect to cincturing and at 20 p.p.pm. more effective. Gibberellic acid at 10 p.p.m. in addition to cincturing gave a further significant increase in yield.

The increased yield in all cases appeared to be entirely due to an increase in mean berry weight. Small hard seeds were found in the largest berries from each treatment in one season when an examination was made and there did not appear to be any difference in the proportion of such berries among the various treatments. There was little evidence for any differences in time of maturity due to treatment.

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Eingegangen am 29. 8. 1966

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