Vitis 7, 299—302 (1968)

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# The effect of varying the berry number on Gordo Grape vines with constant leaf area

by

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## Introduction

A grape-vine has a source of carbohydrates, namely leaves exposed to light, and a sink for carbohydrates, namely new vegetative growth plus storage capacity within existing wood and roots plus berry growth plus respiratory requirements. In a previous paper (1) an experiment was described in which the source size of potted grape-vines was varied by varying leaf number, and effects on various components of the sink were measured. As leaf number was reduced root dry weight was most severely affected, followed in turn by berry development, reserves of available carbohydrate in trunk and shoot and lastly dry weight per unit length of trunk and shoot.

It is possible that the carbohydrate economy within plants might be similarly affected on one hand by decreasing the source size and on the other hand by increasing the sink size. Sink size can readily be manipulated by varying bunch size. The present paper describes an experiment in which berry number per plant was varied and effects on various components of the sink were measured.

## Material and Methods

In the winter of 1966 rooted vines (*Vitis vinifera* L., c. v. Muscat Gordo Blanco, syn. Muscat of Alexandria) were obtained from a nursery and planted into 25 cm porous earthenware pots which were positioned in a glasshouse. After budburst in spring plants were pruned to leave one new shoot which grew through the summer and which in autumn was pruned back to the fourth bud. Before spring 1967 the pots were placed outdoors and at bud-burst all shoots other than that arising from the apical bud were removed. On December 1, 1967, after berry-set, 52 plants were selected for uniformity and that portion of the shoot distal to the third leaf above the apical-most bunch was removed. The uppermost three main leaves on the resulting plants were retained and all other leaves were removed; all laterals were cut back close to the shoot. There were four treatments, each with 13 replicates, as follows: 1) no berries, 2) 30 berries, 3) 60 berries, 4) 90 berries. When there were two bunches present the upper one was removed, except in cases where there were insufficient berries on the lower bunch alone. Berry reduction to the required number was made by removing berries from the apex of the bunch. New laterals with associated leaves continually arose from residual buds at each node on the shoot and were removed at least once each week. When a retained leaf showed signs of senescence or serious weather-damage, a corresponding area of new leaf was permitted to remain at the appropriate node. The diameters of five selected berries on each plant were measured at weekly intervals from December 5 to March 12. At fortnightly intervals from February 6 to March 12 one berry was removed from the apex of one bunch on each plant and the sugar content of its expressed juice measured using a hand refractometer.

Plants were harvested on March 12, 1968. Measurements were made for each plant of the dry weight of the following: roots, apical 5 cm of trunk, basal 5 cm

of shoot, total trunk, total shoot and berries. The total sugar and starch content of trunks was determined as specified in a previous paper (1).

## Results

Volume per berry increased in a similar way for each treatment, and the form of the growth curve resembled that obtained with berries on 3-leaf plants in a previous experiment (1). Berries of the 30-berry treatment were largest and those of the 60-berry treatment were smallest over the whole period of growth, but differences reached significance (P 5%) only on February 20 and 27. However the 90-berry growth curve lay between the other two throughout, and it is concluded that differences in berry size stemmed from sample variation already existing on December 5, and not from effects due to berry number.

There was no effect of treatment on rate of increase in sugar concentration. On March 12 the concentration in expressed juice was approximately 19 per cent.

Dry weights and results of carbohydrate analyses are presented in Table 1, and the same results expressed as percentages of the control value are shown in Fig. 1. The data fell into three groups. First, root dry weight and dry weight per berry were not affected; secondly the dry weight of trunk and shoot as well as sugar content of the trunk were measurably affected although the affect was relatively small; and thirdly the starch content of the trunk was affected to a relatively large degree.

## Discussion

From the previous experiment (1) it is known that potted Muscat vines limited to three leaves are severely retarded, in terms of dry weight accumulation of plant parts and of carbohydrate accumulation, in comparison with plants with non-limited leaves. It was thought that in the present experiment plants should have suffered an approximately similar degree of retardation, but with a gradation in severity according to berry number. The observed effects of increasing berry number (sink size) differed sharply from effects of decreasing leaf number (source size) (1). Instead of root dry weight being the most affected it was the least affected parameter and berry weight was not influenced. These facts could be interpreted as indicating that reduction in source size (leaf area) affects carbohydrate economy in a different way to increase in sink size (berry number).

Under normal vineyard practice a condition popularly described as "overcropping" can exist. This is associated with a high berry/leaf number ratio. This condition

Table 1

Mean dry weight of berries and root systems, dry weight per 5 cm of trunk and shoot, and percentage sugar and starch contents of trunks at the final harvest

| | Berries per plant | | | | L.S.D. 5% |
|---|---|---|---|---|---|
| | 0 | 30 | 60 | 90 | |
| Weight per berry (g) | — | 0.36 | 0.33 | 0.33 | N. S. |
| Weight per root system (g) | 69.0 | 76.6 | 67.5 | 65.6 | N. S. |
| Trunk dry weight / 5 cm (g) | 2.87 | 2.41 | 2.49 | 2.03 | 0.32 |
| Shoot dry weight / 5 cm (g) | 1.91 | 1.69 | 1.63 | 1.51 | 0.17 |
| Sugars as % dry weight | 2.1 | 1.8 | 1.7 | 1.3 | 0.3 |
| Starch as % dry weight | 6.6 | 4.0 | 2.4 | 1.0 | 4.2 |

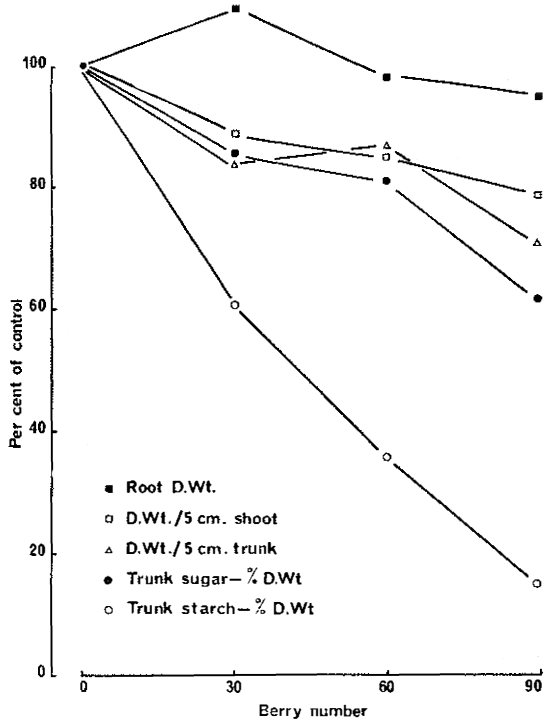


Fig. 1: Data from Table 1 as percentages of zero-berry values plotted against berry number.

manifests itself in a reduced development of either the berries or the wood, or of both. Associated with reduced wood development is reduced storage of carbohydrate reserves in both roots and other plant parts. WINKLER (3) gathered many observations indicating that established vineyards in California were overcropped from time to time, with deleterious results on fruit maturation, acid/sugar relationships and shoot growth and maturation. The treatments in the present experiment can be looked upon as involving overcropping, with a rising severity of overcropping in the sequence zero berries to 90 berries per plant. WINKLER (3) observed that when the crop on Muscat vines was increased from 6 to 12 tons, the date of harvest, based on maturation, was delayed from September 11 to October 13. Similarly WEAVER and MCCUNE (2) found that with the variety Alicante Bouschet overcropping led to delayed fruit maturation, poorer-coloured juice, as well as reduced carbohydrate accumulation in all parts of the plant. In the present experiment however berry growth and sugar accumulation were not delayed despite a three-fold increase in crop load. This discrepancy could be due to the different nature of the plants used in the two investigations. Data of the other workers was obtained from established vineyard vines presumably with unrestricted root and shoot growth, so that berries would have met with relatively much more competition than in the repeatedly-pruned pot-grown plants of the present study. It follows that the relative effects of overcropping on different organs of the plant could vary with plant age.

**Summary**

The leaf number of potted Muscat Gordo Blanco grape-vines was fixed but berry number per plant was varied. Root and berry dry weight, as well as rate of berry growth, were unaffected by treatment, dry weight per unit length of shoot and trunk and sugar level in trunks somewhat reduced, and starch level in trunks most severely affected. These results are in contrast with those of an earlier experiment in which it was observed that a progressive reduction in retained leaf number affected root dry weight most severely, followed by berry development, starch and sugar levels of shoots and finally dry weight per unit length of shoots. Thus the effect of reducing leaf area (source size) was not the same as increasing crop load (sink size).

**Acknowledgement**

The technical assistance of Miss A. POTTS and Miss P. BEACH is gratefully acknowledged.

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*Eingegangen am 5. 8. 1968*

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