Vitis **11**, 296—302 (1972)

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Long-term response of Sultana vines to harvest pruning

by

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Langzeitreaktion von Sultana-Reben auf den „Ernteschnitt"

Zusammenfassung. — Von Reben der Sorte Sultana wurden zur Zeit der Traubenlese sämtliche Tragruten abgeschnitten, die ja die meisten fruchtenden Triebe besitzen. Die Auswirkungen dieses Holzschnittes, der die Einsparung von Handarbeit bei der Ernte bezweckt, wurden in zwei Versuchen geprüft. Nach sieben bzw. fünf Vegetationsperioden war die Rosinenausbeute an den zur Lese geschnittenen Reben nicht signifikant zurückgegangen, wenngleich Tendenzen zu geringerem Traubenertrag und vermindertem Holzzuwachs vorhanden waren.

Gegenüber einer Standarddrahtrahmenerziehung mit einem Abstand von 30 cm zwischen den beiden Tragrutendrähten beeinflußte ein Drahtabstand von 45 oder 90 cm die Entwicklung der Reben nicht signifikant. Die Vorteile des weiten Drahtabstandes für das auf dem Holzschnitt basierende Erntesystem werden diskutiert.

Es wird gefolgert, daß der Ernteschnitt nicht zu fortschreitenden schweren Ertragseinbußen führt, daß jedoch unter Umständen Verluste bis zu 15% auftreten können. Maßnahmen zu ihrer Vermeidung werden beschrieben.

Introduction

In an earlier report (MAY and KERRIDGE 1967), a method of harvesting and drying Sultana grapes (*Vitis vinifera* L., syn. Sultanina, Thompson Seedless) was described, which aims at reducing the amount of hand-labour during harvest. The method consists of severing from the vine at harvest time the one-year old canes which carry most of the fruit-bearing shoots, spraying the fruit after one or two days' wilting with an alkaline oil emulsion ("dipping-emulsion"; GRNCAREVIC and RADLER 1971) which accelerates drying, and shaking the dried fruit off the trellis wires.

MAY and KERRIDGE stated that yield and vegetative growth were not affected measurably when vines had been harvest-pruned once, but that further investigations were needed to test the effect of repeated harvest-pruning. The present paper reports on these tests. It also includes results from trellis treatments designed to facilitate the pruning of vines in full leaf.

Experimental

Experiment 1 of this report is the continuation of the trial described as Experiment 2 by MAY and KERRIDGE (1967). The vines formed part of an irrigated vineyard of the CSIRO Division of Horticultural Research at Merbein, Victoria. The two treatments, harvest-pruning (HP) and control (C), were applied in four times replicated blocks, each plot consisting of three adjacent vines. They were trained on a T-trellis with two cane wires 30 cm apart and 90 cm above ground level and a single foliage wire at 130 cm height. The vines carried their fifth crop when first harvest-pruned in 1966.

In the first three years of the experiment (1966—68), the fruit of the C-vines was hand-picked and, without dipping treatment, spread on ground sheets of hessian

placed between the rows in the vineyard. The fruit from the HP-vines was left hanging on the trellis wires for one or two weeks, then hand-picked, and spread on hessians. The dried fruit was weighed, its moisture content determined from samples, and the weight of fruit per vine, adjusted to 13.5 per cent moisture, calculated. At the subsequent four harvests, all fruit was picked fresh, treated with dip emulsion, and dried on drying racks. Yield per vine of dried fruit at 13.5 per cent moisture was calculated from fresh weight of fruit and sugar concentration of a sample of juice. Harvest dates in the seven seasons of the experiment varied between February 8 and March 16[1]).

During the winter pruning of the seasons for which values are shown in Table 1, the one-year old wood removed from the vine was weighed. In the HP-plots, the fresh weight of the harvest-pruned shoots was calculated from determinations of the air-dried weight and the moisture content of fresh and air-dried samples. In the 1968, 1971, and 1972 seasons, the vines were pruned, as nearly as possible, to eight canes each of 14 nodes; in 1967, 1969, and 1970, the number of nodes retained at pruning was visually related to the amount of pruning wood removed and to the number of available canes.

In spring, the number of bunches was counted. Apart from harvest-pruning, the vineyard was maintained according to normal commercial practice.

Experiment 2 was also conducted in the Merbein vineyard of CSIRO. The 40-year old vines had been trained previously on a T-trellis identical to the one described above. In winter 1967, three trellis treatments were established in five times replicated blocks, where each plot consisted of one row of 18 vines. In the first and second treatments, the two cane wires were respectively 30 cm and 45 cm apart in the horizontal plane, and 105 cm above ground level; in the third treatment, the cane wires were 90 cm apart at 120 cm height. One half of each row, chosen at random, was harvest-pruned, the other half served as control.

During the 1968 and 1972 harvests, all fruit was hand-picked and dried on the drying rack; in 1969 and 1970, the C-plots were harvested in this manner, but the fruit of the HP-plots was dried on the trellis wires after spraying it with dip-mixture by means of an over-the-row hood attached to a power sprayer. In 1971, the fruit was not harvested because heavy rain had badly damaged it, but the vines were harvest-pruned.

In all seasons, eight canes each of about 14 nodes were retained at pruning on each vine. The calculations of yield of dried fruit (at 13.5 per cent moisture), the counting of bunches, the measuring of pruning weights and the maintenance of the vineyard were the same as in Experiment 1.

Results

1. Effects of harvest-pruning on vegetative growth

The effects of harvest-pruning on the vegetative growth of the vines was measured by weighing the mature, one year old wood (Table 1). HP vines gave lower values than C-vines in all seasons of both experiments when measurements were taken.

It is considered that these differences exaggerate the effects of harvest-pruning on vine size. They were probably caused in part by the growth of shoots on C-vines between harvest and winter-pruning, which was prevented on HP-vines by the harvest-pruning.

[1]) In the southern hemisphere, a growing season extends over two calendar years. Here, the season is named after the year of harvest.

Table 1

Fresh weight (kg) of one-year old prunings from control (C) and harvest-pruned (HP) vines in Experiments 1 and 2

Season	Experiment 1			Experiment 2[1])		
	C	HP	L.S.D.	C	HP	L.S.D.
1967	n.a.	n.a.	n.a.	—	—	—
1968	2.11	1.68	NS	n.a.	n.a.	n.a.
1969	2.99	1.82	1.17+	n.a.	n.a.	n.a.
1970	n.a.	n.a.	n.a.	1.67	1.29	0.18+++
1971	1.71	1.15	NS	1.76	1.40	0.12+++
1972	3.00	2.10	NS	2.49	2.29	NS
Mean 1968—1972	2.45	1.69		1.97	1.66	

n.a. not available.
\+ significant $P < 5\%$.
+++ significant $P < 0.1\%$.
NS not significant.
L.S.D. Least Significant Difference ($P < 5\%$).
[1]) Means for all trellis treatments, in the absence of trellis-pruning interaction.

The number of mature shoots near the crown of the vine also indicates vine size. In Experiment 1, an average of 17.5 canes per vine was counted on both C- and HP-vines in 1968. In 1972, both types of vines carried 16.0 canes. This indicates that vine size of HP-vines had not decreased seriously during the course of the experiment.

This result is also supported by the aerial view of Experiment 1, taken just before harvest 1972 (Fig. 1). Here, and during frequent field inspections, it was not possible to distinguish between C- and HP-plots.

2. Effect of harvest-pruning on bunch number and yield

The effect of harvest-pruning on the number of bunches and the yield of dried fruit (at 13.5 per cent moisture) per vine is shown in Table 2. As there were no interactions between the trellis and pruning treatments in Experiment 2, the overall means of the latter are given.

Harvest-pruning did not affect the number of bunches in the following season. The treatment differences in Experiment 1, seasons 1967, 1969 and 1970, were caused mainly by differing node numbers left at pruning. Mean number of bunches per node in these three seasons was 0.80, 0.52, and 0.46 for the C-vines and 0.76, 0.53, and 0.46 for the HP-vines.

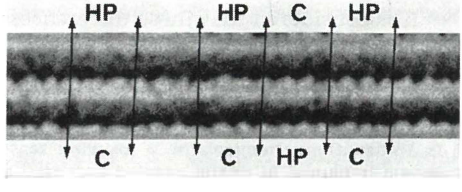

Fig. 1: Aerial photograph of Experiment 1, taken on March 4, 1972. C = Control plots, HP = Harvest-pruned plots.

Table 2

Number of bunches per vine and yield of dried fruit (at 13.5 per cent moisture) per vine for control (C) and harvest-pruned (HP) vines in Experiments 1 and 2

Season	Experiment 1			Experiment 2[1])		
	C	HP	L.S.D.	C	HP	L.S.D.
	Number of bunches					
	n	n		n	n	
1967	80.9	70.5	NS	—	—	—
1968	69.9	65.2	NS	57.3	58.1	NS
1969	84.8	78.7	NS	53.9	53.7	NS
1970	75.6	68.7	4.3+	64.4	60.0	NS
1971	48.9	49.0	NS	37.0	35.2	NS
1972	70.2	75.4	NS	65.0	63.0	NS
All seasons	430.3	407.5		277.6	270.0	
	Dried fruit					
	kg	kg		kg	kg	
1967	6.80	7.24	NS	—	—	—
1968	9.52	8.25	NS	5.66	5.64	NS
1969	5.87	5.76	NS	4.30	3.51	0.75+
1970	7.65	6.89	NS	7.43	5.83	0.52+++
1971	4.65	4.29	NS	n.a.	n.a.	n.a.
1972	7.06	6.20	NS	6.34	6.07	NS
All seasons	41.55	38.63		23.73	21.05	

n.a. not available.
\+ significant $P < 5\%$.
+++ significant $P < 0.1\%$.
NS not significant.
L.S.D. Least Significant Difference ($P < 5\%$).
[1]) Means for all trellis treatments, in the absence of trellis-pruning interaction.

In yield of dried fruit, HP-vines tended to be inferior to C-vines in all cases except in the 1967 season of Experiment 1; but the differences reached 5 per cent significance only for the second and third harvest of Experiment 2. Then the lower yield of the HP-vines was at least partly due to fruit being knocked to the ground by the spray-hood. In 1972, after being harvest-pruned twice more, HP-vines yielded only slightly less than C-vines; according to 95% fiducial limits, the reduction would have been at most 11.5 per cent of the mean yield of the C-vines.

In Experiment 1, seasons 1969 and 1970, the small yield differences were also related to differing node numbers: C-vines yielded 36 g and 46 g dried fruit per node, HP-vines produced 38 g and 46 g. The accumulated six-year yields of dried fruit per vine in Experiment 1 were 41.6 kg for C-vines and 38.6 kg for HP-vines. The difference was statistically not significant; according to 95% fiducial limits HP-vines may have yielded from 0 to 17.5 per cent less than C-vines.

3. Effects of trellis width, Experiment 2

Harvest-pruning can be done much more easily on vines with open canopies, as produced by widening the trellis. Table 3 describes some of the responses to the

Table 3

Number of bunches and yield of dried fruit (at 13.5 per cent moisture) per vine for vines on three types of trellis[1]), Experiment 2

	Season				
	1968	1969	1970	1971	1972
	Bunch number				
	n	n	n	n	n
30 cm trellis	57.9	48.6	60.3	34.0	60.9
45 cm trellis	56.2	53.8	58.6	34.5	60.9
90 cm trellis	59.0	59.0	69.5	39.9	70.3
L.S.D. ($P < 5\%$)	NS	6.0+	7.3+	NS	2.6+++
	Dried fruit				
	kg	kg	kg	kg	kg
30 cm trellis	5.49	3.83	6.78	n.a.	6.26
45 cm trellis	5.61	3.74	6.14	n.a.	5.89
90 cm trellis	5.84	4.14	6.98	n.a.	6.46
L.S.D. ($P < 5\%$)	NS	NS	NS	n.a.	NS

n.a. not available.
+ significant $P < 5\%$.
+++ significant $P < 0.1\%$.
NS not significant.
L.S.D. Least Significant Difference.
[1]) Means for all trellis treatments, in the absence of trellis-pruning interaction.

three trellis treatments in Experiment 2. As there were no interactions between pruning and trellis treatments, the overall means of the latter are shown. There was no significant effect on pruning weight or yield of dried fruit. However, bunch numbers were higher on the widest trellis in three of the four seasons in which trellis modifications could have affected bud fruitfulness.

Discussion

The two experiments have shown that harvest-pruning will not lead to a breakdown in the productivity of the vine, even if it is practised for as long as seven consecutive seasons. In particular, no cumulative effects were measured or observed, as might have been expected if the premature removal of about half the leaves had led to progressive reduction of reserve materials stored in the vine. Both the young vines of Experiment 1, which should be at peak productivity, and the old, smaller-sized vines of Experiment 2, which are near the end of their economic usefulness, reacted in the same way.

However, harvest-pruning may result in small yield losses. It is clear that much larger experiments will be needed to assess this reliably. Continuing long-term tests in a number of locations will also have to examine the effect of climatic differences on, and the response of vines of various sizes to, harvest-pruning.

No attempts have been made so far to study the physiological effects of harvest-pruning. In the climatic conditions of the Murray Valley, Sultanas retain their leaves for up to three months after harvest. ALEXANDER (1957) showed for the period

from harvest (late February-March) until leaf fall (June) that the nitrogen content of the leaves drops sharply from a peak at the beginning of this period, while that of the perennial roots and trunk increases slowly. He concluded that some of the leaf-nitrogen is resorbed into the perennial parts of the vine. Likewise, carbohydrates increase rapidly in the perennial parts of the vine (WINKLER and WILLIAMS 1945). In spring, the vines rely on carbohydrate reserves for several weeks from bud burst until the new leaves can satisfy demands (BUTTROSE 1966). Experiments are under way to estimate how the early and sudden removal of so many leaves modifies the incorporation of reserve materials into the plant.

Widening the trellis from 30 cm to 90 cm did not produce the significant improvements in yield obtained on still wider trellises (SHAULIS and MAY 1971; MAY unpublished). But even in the absence of improved yields, a wide trellis has important advantages over a narrow trellis in the harvesting system based on harvest-pruning. Firstly, a wide trellis allows easier positioning of the pruning-cut on vines in leaf, possibly even by machine. Secondly, the fruit within the open foliage canopy of a wide trellis can be sprayed more thoroughly with "dipping-emulsion". Thirdly, this trellis separates spatially the shoots near the crown of the vine, which serve as replacement canes, from the main fruiting zones. Thus, fewer of their leaves will be hit by the spray, which may act as a leaf-desiccant.

Changes in the time of harvest-pruning tried during the course of the two experiments did not produce measurable differences in vine performance. If harvest-pruning is delayed into autumn detrimental effects on the vine become less likely, but the drying of the fruit on the trellis becomes commercially impossible.

If yield should in fact be lower on vines which are harvest-pruned annually over many years, biennial pruning is likely to avoid such losses. In established vineyards, this could be done by dividing the Sultana plantings into two parts, which would be harvest-pruned or hand-harvested in turn. This, and another system applicable mainly for newly planted vineyards, are under test. In the latter system, a vine with two trunks, or two vines side by side, are grown in each planting position. One trunk carries the current season's crop which is gleaned by harvest-pruning, while the other trunk carries only spurs which produce next season's fruiting canes and which are therefore not harvest-pruned. In the following season, the two trunks reverse their roles. Thus each trunk is harvest-pruned only every second year. No conclusive results are as yet available on the performance of such a vineyard, but the system has been proved to be viticulturally feasible.

Summary

The effect of harvest-pruning of the grapevine cv. Sultana, i. e. severing from the vine at harvest time the canes which carry most of the fruiting shoots, was investigated in two experiments. After seven and five seasons respectively, yields of dried fruit had not decreased significantly on harvest-pruned vines, although there were trends towards lower yield and reduced vegetative growth.

Compared with a standard 30 cm-wide trellis, 45 cm- or 90 cm-wide trellises did not affect vine performance significantly. Advantages of wide trellis to the harvest system based on harvest-pruning are discussed.

It was concluded that harvest-pruning will not lead to increasingly severe reductions in productivity, but that losses of up to 15 per cent could possibly occur. Measures which may help to avoid such losses are described.

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Acknowledgements

Mr. E. A. Lawton supplied Fig. 1. Thanks are due to the vineyard staff of CSIRO, Merbein, for the management of the trials.

Eingegangen am 21. 7. 1972

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