

Studies on pruning of grape

II. Influence of dormant pruning on the carbohydrate metabolism of Pusa Seedless (*Vitis vinifera* L.)*

by

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Knowledge about the seasonal changes in carbohydrate and other reserve substances in canes is necessary to study the responses of the vines to fruiting. Investigations on both *V. labrusca* (ANTCLIFF *et al.* 1958; RICHEY and BOWERS 1924) and *V. vinifera* varieties (WINKLER and WILLIAMS 1945) have shown, however, that there is no appreciable transfer of sugars or starch from canes to the roots after leaf-fall in autumn. The total carbohydrate content of stems of Concord grape became markedly higher during the dormant season. SCHRADER (1924) also found considerable quantity of the alcohol insoluble non-sugar material in the shoots of Concord. Previous investigations however indicate that the severity of pruning has profound influence on the level of carbohydrate in the canes and that there is no translocation of carbohydrate in dormant season. Hence it was considered desirable to study the effect of severity of pruning on the level of carbohydrate in Pusa Seedless. Its influence on production capacity of vines has already been reported in a previous paper (GUHGARE and MUKHERJEE 1967).

Material and Methods

Eighty five three-year old vines of Pusa Seedless (*Vitis vinifera* L.) of uniform size, trained on the Head and the four-arm, single trunk Kniffin system on wire trellis, under spur and cane pruning system, growing in the Experimental Orchard of the Division were used for the investigation. In cane pruning, six, nine and twelve buds were retained, but only three buds were kept in spur pruning. Two dates of pruning December 15–21 and January 15–21 were chosen. In the control, the vines were not pruned. Each vine was the unit of observation, and received uniform cultural treatment, and manured after pruning with 226.5 g of nitrogen and 141.6 g of phosphoric acid. The experiment had 17 treatments with 5 replications in simple randomized layout.

For chemical analysis, the material was collected from two entire canes (shoots in case of summer sampling) from each vine. All the canes from a treatment for a given date were mixed together to make one sample collected on the dates as given in Table I, and dried in an oven at 65° C and sieved after grinding.

Chemical analysis

Sugars: For determining the sugars, the samples were extracted with 95 per cent ethyl alcohol for 6 hours, evaporated to a small volume. The residue in warm water, was subsequently treated with an excess of neutral lead acetate. The excess lead was removed by addition of potassium oxalate crystals. The total sugars were estimated in terms of glucose after acid hydrolysis (A. O. A. C. 1955).

Starch: The alcohol extract residue served as the sample for determining the starch, as glucose after hydrolysis with malt diastase and then by concentrated

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Table 1
Mean percentage of sugars and starch (on basis of dry matter) in the canes of Pusa Seedless

Treatment	December, 1962			January, 1963			June, 1963			December, 1963			January, 1964		
	Total sugars	Starch	Sugars and starch	Total sugars	Starch	Sugars and starch	Total sugars	Starch	Sugars and starch	Total sugars	Starch	Sugars and starch	Total sugars	Starch	Sugars and starch
Pruning	8.05	6.91	14.96	8.06	6.94	15.00	2.61	0.57	3.18	10.41	8.43	18.84	10.18	8.53	18.71
Non-pruning	—	—	—	8.20	10.20	18.40	2.70	0.60	3.30	—	—	—	11.60	10.60	22.20
Training systems (TR)															
Head	8.28	6.55	14.83	8.25	6.58	14.83	2.52	0.53	3.05	9.93	8.28	18.21	9.88	8.28	18.16
Kniffin	7.82	7.28	15.10	7.88	7.30	15.18	2.69	0.61	3.30	10.90	8.58	19.48	10.48	8.78	19.26
Pruning methods (P)															
Spur	7.45	6.80	14.25	7.50	6.75	14.25	2.44	0.54	2.98	8.75	7.50	16.25	8.45	7.35	15.80
Cane	8.25	6.95	15.20	8.25	7.00	15.25	2.66	0.58	3.24	10.97	8.73	19.70	10.75	8.92	19.67
Degrees of pruning															
3 bud	7.45	6.80	14.25	7.50	6.75	14.25	2.44	0.54	2.98	8.75	7.50	16.25	8.45	7.35	15.80
6 bud	8.00	6.75	14.75	8.05	6.83	14.90	2.47	0.59	3.06	10.50	8.50	19.00	10.40	8.50	18.90
9 bud	8.35	7.15	15.50	8.30	7.20	15.50	2.81	0.58	3.39	11.30	9.25	20.55	10.80	9.55	20.35
12 bud	8.40	6.95	15.35	8.40	6.96	15.35	2.70	0.56	3.26	11.10	8.45	19.55	11.05	8.70	19.75
Mean	8.05	6.91	14.96	8.13	8.57	16.70	2.61	0.57	3.18	10.41	8.43	18.84	10.89	9.56	20.45

hydrochloric acid (A. O. A. C. 1955). The figure thus obtained was multiplied by a factor of 0.90 to get the amount of starch present.

Results and Discussion

The data on the mean percentage of total sugars and starch in canes under different treatments are presented in Table 1. The present studies reveal that the total sugars, starch and sugars plus starch or carbohydrates have remained unchanged in almost all the treatments during the two dates of dormant pruning in December and January in both the years, which indicate that there is no translocation of carbohydrates during the dormant period from canes to other parts of the vine, as reported by RICHEY and BOWERS (1924), SCHRADER (1924), WINKLER and WILLIAMS (1945) and ANTCLIFF *et al.* (1958). The data also indicate that the total carbohydrate level remained stable and the increase in starch content is accompanied by decrease in sugar content and *vice versa*. Thus, the changes are from one form of carbohydrate to another and not in the total amount of reserve food. WINKLER and WILLIAMS (1945) also reported that the winter disappearance of starch in *V. vinifera* grapevines was almost quantitatively accounted for by the appearance of an equivalent amount of sugar in the aboveground sections. The effect of dormant pruning on the carbohydrate metabolism suggests that pruning had a depressing effect and that the carbohydrate content was much lower in the pruned vines than that observed in non-pruned vines during both the seasons. It may be due to the fact that in the non-pruned vines, the growth was more favourable for the production and accumulation of carbohydrates, as suggested by WINKLER (1929, 1932), who observed that the weight of total carbohydrates in the unpruned vine was four times that in the normally pruned and ten times that in the severely pruned Muscat of Alexandria vine. The non-pruned vines contained three or four times higher reducing sugars and total carbohydrates at the beginning of the growing season than the normally pruned vines. Total shoot elongation proceeds much more rapidly in the early growing season on the non-pruned vines than on the severely or normally pruned vines.

The carbohydrate content of canes in the Kniffin system was slightly higher than that found in the Head system during 1962-63 and 1963-64, which also reveals that the growth of the vine is more favourable when it is trained to this system for Pusa Seedless, which is allied to Thompson Seedless. Cane pruning gave slightly higher carbohydrates than spur pruning.

Treatment 9 bud gave the highest amount of carbohydrates, followed by 12 bud treatment and the 6 bud treatment, whereas the lowest content was observed in 3 bud treatment. The highest carbohydrate content in the 9 bud treatment may be due to higher metabolic activity in larger leaf area produced as a result of higher number of bud burst observed in this treatment.

The data on the amount of carbohydrate after the harvest of the crop on June 28, 1963 indicate that both sugar and starch contents were much lower in all the treatments than those observed during the dormant period.

The present investigation reveals that the greater vine growth of the lightly pruned and non-pruned vines is a result of more favourable nutrition of the vine over the entire season. These studies further indicate that the variation in the time of pruning in the dormant season might not have any marked influence as there was no appreciable transfer of carbohydrates from the canes to the roots during the dormant season. Thus, it may be concluded that in the vines trained to the Kniffin system, cane pruned with 9 buds during any time from December 15 to January 21, the growth was more favourable to the maximum production and accumulation

of carbohydrates. Hence these treatments are indicated to have superiority over the others, under the conditions prevailing at Delhi.

Summary

The studies on the effect of training systems, pruning methods, severity of pruning, time within dormant pruning and pruning versus non-pruning on the level of carbohydrates in the canes of Pusa Seedless, which is allied to Thompson Seedless, were conducted during 1962-63 and 1963-64.

1. There was no appreciable transfer of carbohydrates from the canes to other parts of the vine during the dormant season. So the variation in the time of pruning in the dormant season may not have any marked influence on the carbohydrate status of the cane.
2. The total carbohydrate level in the canes of Pusa Seedless remained stable, and the winter disappearance of starch was almost quantitatively accounted for by the appearance of an equivalent amount of sugar.
3. In the vines of Pusa Seedless trained to the Kniffin system, cane pruned with 9 bud canes and pruned any time during December 15 to January 21, the growth was more favourable for the maximum production and accumulation of carbohydrates. Hence these treatments are indicated to have superiority over the others.

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