Crop Res. 6 (2) : 276–283 (1993)
With one figure
Printed in India

Comparison of ripening of Thompson Seedless and Arkavati grapes on different training systems

S. D. SHIKHAMANY, P. L. SAROJ AND G. S. PRAKASH
Division of Fruit Crops
Indian Institute of Horticultural Research, Bangalore-560 089, India

ABSTRACT

The experiment was carried out at Indian Institute of Horticultural Research, Bangalore during 1992 to compare the ripening of Thompson Seedless and Arkavati grapes on different training systems. A great variation in not only the berry weight at harvest but in its increase at different stages after veraison on different systems of training has been observed. The T. S. S. and T. S. S./acid increased till the final sampling in both the cultivars, while acidity reduced. Fruit quality is judged by T. S. S./acid ratio, was best on Geneva double curtain system, while it was least on double cross-arm trellis irrespective of the cultivar. Ripening was faster on Geneva double curtain system when compared to bower. The former system hastened ripening by seven days in Thompson Seedless and by two to three days in Arkavati.

Key words : Arkavati, ripening, Thompson Seedless, training, *Vitis*

INTRODUCTION

Being a non-climacteric fruit, grape can only be harvested at optimum stage of ripening for good eating quality but is very difficult to determine the right stage of maturity by visual observations specially in white varieties. The ripening process of grape berries starts with the onset of variation marked by the breaking of green colour in coloured varieties and softening in white varieties. It is very much influenced by the factors like climate, nutrition, cultural practices and various systems of training employed to train the grapevines. Each training system differs greatly with other in respect of canopy architecture of grapevines leading to the variation in the ventilation, sunlight and micro climate in the vine canopy. Since these factors have profound influence on the ripening of grapes, the present investigation was carried out to compare the ripening of Thompson Seedless and Arkavati grape cultivars on different systems of training.

MATERIALS AND METHODS

The investigation was carried out at Indian Institute of Horticultural Research, Bangalore during 1992 to compare the ripening of Thompson Seedless and Arkavati (A seedless hybrid between Black Champa×Thompson Seedless, developed from Indian Institute of Horticultural Research) grapes on different

Contribution No. 71/92

systems of training. The training systems on which the vines grown were power, telephone, Geneva double curtain, single cross-arm trellis, double cross-arm trellis and Tatura trellis. The brief description of training the vines in these systems is given below :

1. **Bower :** Vines trained to overhead arbour to have eight secondaries of 1.2 m length.
2. **Telephone :** Vines trained to 'T' trellis to have two primary arms of 1.5 m length at a height of 1.35 m above the ground level.
3. **Geneva double curtain :** Vines trained to 'T' trellis to have four secondaries of 1.5 m length 60 cm apart at a height of 1.35 m above the ground level.
4. **Single cross-arm trellis :** Vines trained to 'T' trellis to have two primary arms of 1.5 m length at a height of 90 cm above the ground level with the shoots trailing on two parallel foliage wires 60 cm apart and 45 cm above the arms resulting in 'V' shaped cross section of the vine canopy.
5. **Double cross-arm trellis :** Vines trained to 'T' trellis to have four secondaries of 1.5 m length 45 cm apart at a height of 90 cm above the ground level with the shoots trailing on two parallel foliage wires 60 cm apart and 45 cm above the secondary arms resulting in 'U' shaped cross section of the vine canopy.
6. **Tatura trellis :** Vines trained to 1.8 m height 'V' shaped trellis to have three pairs of secondaries on either side of the trellis in three tiers, with a gap of 60 cm between two successive tiers on each side.

In the second year of flowering, 50 uniform panicles were tagged randomly in identical shoots in each system of training, Sampling was done on alternate day intervals commencing from 90th day after veraison. A composite sample of 50 berries at the rate of one per bunch was picked up from the middle portion of the bunches in every training system. The berries were weighed and crushed. The T. S. S. content in the juice was recorded by hand refractometer. The titrable acidity was determined by titrating against N/10 NaOH using phenolphthalein as indicator. The T. S. S./acid ratio was computed. The total heat unit summation corresponding to each sampling date was also calculated.

RESULTS AND DISCUSSION

Weight of Berries

Data given in Table 1 reveal that the berry weight increased rapidly upto 5th sampling (16th March) in both the cultivars in all the training systems. Thereafter, it either remained constant or increased slightly. In Thompson Seedless, maximum berry weight was recorded in bower (172.0 g) followed by telephone (155.50 g), single cross-arm trellis (143.50 g), Geneva double curtain (138.0 g), Tatura trellis (127.50 g) and minimum in double cross-arm trellis (124.0 g), while in

Table 1. Variation in 50-berry weight (g) on different training systems

Date	Heat unit summation	Bower		Telephone		Geneva double curtain		Single cross-arm		Double cross-arm		Tatura	
		Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati
7.3.92	86.50	150.00	94.50	129.50	91.00	123.50	94.00	122.00	87.50	113.00	85.50	114.50	83.63
9.3.92	111.50	156.00	95.50	144.00	95.00	126.00	96.00	124.00	90.00	114.00	86.00	125.00	89.33
11.3.92	136.50	157.50	103.50	149.00	98.50	127.00	96.00	127.00	99.00	115.00	91.00	125.67	89.83
13.3.92	162.50	170.00	104.50	149.00	103.00	129.00	98.00	129.00	100.00	123.50	96.00	127.00	96.83
16.3.92	201.00	170.00	107.00	152.00	105.00	137.00	100.00	142.00	102.00	124.00	105.00	127.17	99.17
18.3.92	227.50	172.00	108.00	155.00	108.00	140.50	100.00	142.50	102.50	124.00	106.50	128.80	99.00
20.3.92	257.40	172.00	108.50	155.50	110.50	138.00	98.50	143.50	102.50	124.00	106.50	127.50	98.50

Arkavati, the maximum berry weight was in telephone (110.50 g) followed by bower (108.50 g), double cross-arm trellis (106.50 g), single cross-arm trellis (102.50 g) and minimum in Geneva double curtain and Tatura trellis (98.50 g) at the final stage of sampling. Generally the berry weight of Arkavati is less as compared to Thompson Seedless in all the training systems at every stage of sampling. The variation in berry weight of Thompson Seedless was more ranging from 124.0 g to 172.0 g under different systems of training, whereas the differences in berry weight of Arkavati were narrow ranging from 98.50 g to 110.50 g only. The rate of increase in berry weight of Thompson Seedless was highest during 7th and 9th March corresponding to 20th and 22nd day after variation during the 22nd and 24th day on bower in Arkavati. Considerable differences in the weight of berries on different training systems have also been reported by Wali *et al.* (1989).

In Geneva double curtain system of training the berry weight of Arkavati increased upto 5th sampling, which remained constant in 6th sampling (18th March) and then after decreased in final sampling (20th March), while in Tatura trellis the weight of berries started declining just after 5th sampling. Whereas the berry weight of Thompson Seedless both in Geneva double curtain and Tatura trellis increased upto 6th sampling and declined thereafter. Reduction in berry weight was observed on the final date of sampling in both the cultivars on Geneva double curtain and Tatura trellis. This can be attributed to the shrinkage of berries due to more exposure to radiation. In view of the observations made by Singh *et al.* (1972) that longer retention of berries on the vines would result in the weight loss due to physiological deterioration. It can also be inferred that the optimum ripening in these two systems was attained on 18th March corresponding to 31st day after veraison in both the cultivars.

T. S. S. and Acidity

It is apparent from Fig. 1 (A to F) that the T. S. S. content increased continuously after veraison till the final sampling, whereas acidity decreased sharply in in both the cultivars in all the training systems. The results are in agreement with Rawat *et al.* (1979) and Hrazdina *et al.* (1984). The increase in T. S. S. and decrease in acidity was more striking upto 6th sampling (18th March) but then after the rate of increase in T. S. S. and decrease in acidity was either nil or very low in both the cultivars in all the training systems. In Thompson Seedless maximum T. S. S. was recorded in Geneva double curtain (20.60%) closely followed by telephone (20.40%), while minimum in double cross-arm trellis (19.10%) but the differences in T. S. S. content in bower (19.50%), Tatura trellis (19.70%) and double cross-arm trellis (19.80%) were very low. Whereas in case of Arkavati, the maximum T. S. S. was recorded in bower (23.0%) followed by Geneva double curtain (22.50%), telephone (22.40%), single cross-arm trellis (21.70%). Tatura trellis (21.60%) and double cross-arm trellis (21.40%), respectively. Besides variety, the T. S. S. content of

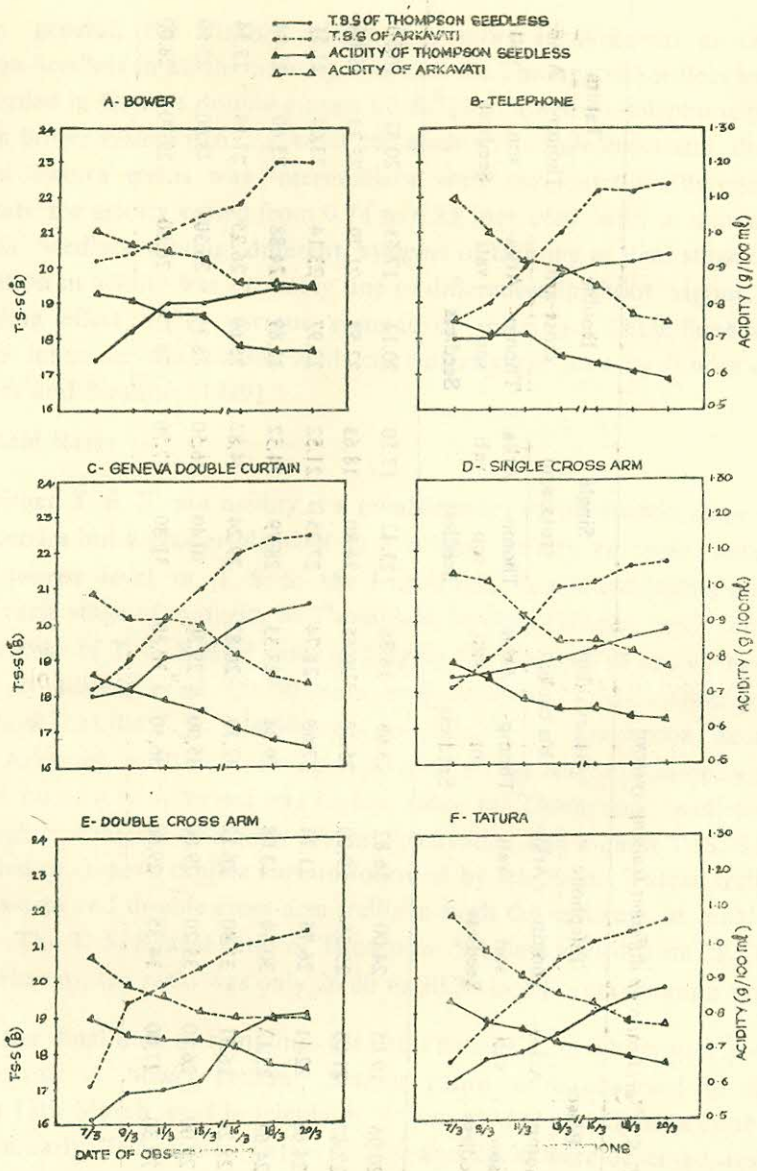

Fig. 1. Pattern of T. S. S. and acidity of Thompson Seedless and Arkavati on different training systems.

grape berry is also influenced by crop load (Singh and Chundawat, 1980), light regimes (Kliewer, 1977), leaf photosynthetic activity (Reynolds *et al.*, 1985; Schneider, 1989; Swanepoel *et al.*, 1990) and leaf area (Purohit *et al.* 1979; Chittiraichelvan *et al.*, 1985), etc. Therefore, the variation in T. S. S. content on different training systems can be attributed to the variation in shoot vigour, leaf exposure to sunlight and the available light and temperature in the vine canopy.

Table 2. Variation in T. S. S./acid ratio on different training systems

Date	Heat unit summation	Bower		Telephone		Geneva double curtain		Single cross-arm		Double cross-arm		Tatura	
		Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati	Thompson Seedless	Arkavati
7.3.92	86.50	20.96	19.05	24.00	16.82	23.68	18.38	23.42	17.50	20.12	17.63	20.32	16.30
9.3.92	111.50	22.47	21.03	25.35	19.00	25.28	20.65	24.80	18.63	22.53	21.79	22.73	19.08
11.3.92	136.50	24.68	22.11	26.76	21.74	27.68	21.74	27.25	21.52	22.97	23.14	23.64	21.51
13.3.92	162.50	24.68	23.12	30.64	23.08	29.24	23.33	28.79	24.52	23.89	24.88	25.60	23.84
16.3.92	201.00	28.24	26.51	31.90	26.12	32.79	26.83	29.24	24.82	25.69	26.25	27.14	25.34
18.3.92	227.50	29.00	26.80	33.20	29.00	35.00	29.30	30.40	26.50	28.35	26.30	28.60	27.50
20.3.92	257.50	29.30	27.00	34.35	29.80	36.50	30.30	31.30	27.70	28.75	26.80	29.70	28.00

In general, the titrable acidity was more in Arkavati as compared to Thompson Seedless in all the training systems. In Thompson Seedless lowest acidity was recorded in Geneva double curtain (0.56%) followed by telephone (0.59%) and highest in bower system (0.67%), while the acidity in single cross-arm, double cross-arm and Tatura trellis was intermediary with very narrow differences. In case of Arkavati, the acidity varied from 0.74 to 0.85 per cent with a similar trend as Thompson Seedless among different systems of training at final stage of sampling. The variation in acidity was probably due to differences in shoot vigour, crop load and shading effect under various systems of training. These factors have been shown to influence the titrable acids content in grape juice by Bindra *et al.* (1980) and Archer and Straauss (1989).

T. S. S./Acid Ratio

Neither T. S. S. nor acidity is a reliable index of the correct stage of ripening of grape berries but a proper blend of T. S. S. and acidity is more reliable index. Even at desired level of T. S. S. the fruit quality is not acceptable due to higher acidity at early stage of maturity in Thompson Seedless (Murthy and Singh, 1991). The importance of T. S. S./acid ratio in judging the ripening of grapes has also been suggested by Rawat *et al.* (1979) and Al-Kaisy *et al.* (1981). Data presented in Table 2 show that the T. S. S./acid ratio was higher in Thompson Seedless than those of Arkavati in all the training systems at all the stages of sampling, although the T. S. S. content in Arkavati was higher than in Thompson Seedless. This is due to higher contents of acidity also in Arkavati. The highest T. S. S./acid ratio was recorded in Geneva double curtain followed by telephone, Tatura trellis, bower, single cross-arm and double cross-arm trellis in both the cultivars at final stage of sampling. The T. S. S./acid ratio of Thompson Seedless varied from 28.75 to 36.50, while in Arkavati, the ratio was only 26.80 to 30.30 in different training systems.

At the final date of sampling, the ratio was 29.30 in Thompson Seedless and 27.0 in Arkavati on bower system. Similar ratios were observed in Thompson Seedless on 13th March itself in telephone system (30.64) and Geneva double curtain (29.24). Similarly, T. S. S./acid ratios of 29.0 and 29.30 were observed, respectively, on telephone and Geneva double curtain systems on 18th March. These results suggest the scope of hastening of ripening in Thompson Seedless by seven days and in Arkavati by two to three days training the vines to telephone or Geneva double curtain system. The heat unit summation was also recorded throughout the experimental period. The 257.50 degree days of centrigrade were found to be optimum for harvesting in both the cultivars particularly for the vines trained to Geneva double curtain and Tatura trellis in view of the shrinkage in berry weight at this point.

ACKNOWLEDGEMENT

The authors are highly grateful to Dr. R. M. Pandey, Director, Indian Institute of Horticultural Research, Bangalore for providing necessary facilities and encouragement during the course of this investigation.

REFERENCES

Al-Kaisy, A. M., Sachde, A. G. and Ghalib, H. L. (1981). Physical and chemical changes during ripening of some grape varieties in Basrah. *Am. J. Enol. Vitis.* **32** : 268-71.

Archer, E. and Straauss, H. C. (1989). Effect of shading on the performance of *Vitis vinifera* L. cv. Cabernent Souvignon. *South Afric. J. Enol. Vitic.* **10** : 74-76.

Bindra, A. S., Sanghavi, K. U. and Brar, S. S. (1980). Relationship between vine growth, bearing and fruit quality in grapes. *Acta Bot. Indica* **8** : 206-09.

Chittiraichelvan, R., Shikhamany, S. D. and Chadha, K. L. (1985). Contribution of leaf area towards bunch development in Thompson Seedless grape. *Indian J. Hort.* **42** : 156-60.

Hrazdina, Geza, Parsons, F. G. and Mattick, L. R. (1984). Physiological and biochemical events during development and maturation of grape berries. *Am. J. Enol. Vitic.* **35** : 220-27.

Kliewer Mark, W. (1977). Influence of temperature, solar radiation and nitrogen on colouration and composition of Emperor grape. *Am. J. Enol. Vitic.* **28** : 96-103.

Murthy, B. N. S. and Singh, R. (1991). Quality in table grapes as influenced by cultivar and maturity. *Drakshavitrra Souvenir* **11** : 57-60.

Purohit, A. G., Shikhamany, S. D. and Prasanna Kumar, B. (1979). Effect of number of leaves per bunch on growth and quality of tropical grape variety Anab-e-Shahi (*Vitis vinifera* L.). *Indian J. Hort.* **36** : 36-41.

Rawat, M. L., Shukla, H. S. and Chaturvedi, K. N. (1979). A note on maturity standards for grape cultivars Bhokri and Motia. *Prog. Hort.* **11** : 13-16.

Reynolds, A. G., Pool, R. M. and Mattick, L. R. (1985). Effect of training system on growth, yield, fruit composition and wine quality of Seyval Blanc. *Am. J. Enol. Vitic.* **36** : 156-64.

Schneider, C. (1989). Introduction of ecophysiology of the grapevine. Application of training systems. *Bull. de l' olv.* **62** : 498-15.

Singh, I. S. and Chundawat, B. S. (1980). Effect of crop level and leaf area on growth and quality of Beauty Seedless grape. *Ann. Arid Zone* **19** : 293 96.

Singh, I. S., Nagina, R. P. and Bhutani, V. P. (1972). Studies on maturity tests for important varieties of grapes. *Indian J. Hort.* **29** : 162-67.

Swanepoel, J. J., Hunter, J. J. and Archer, E. (1990). Effect of trellis systems on the performance of *Vitis vinifera* L. cv. Sultanina and Chenel in lower orange river region. *South Afric. J. Enol. Vitic.* **11** : 56-66.

Wali, V. K., Tiku, A. K. and Koul, B. L. (1989). Effect of four training systems and pruning levels on productiveness of four commercial cultivars of grapes under agroclimatic conditions of Kashmir. *Adv. Plant Sci.* **2** : 268-71.