Journal of
Plant Sciences

ISSN 1816-4951

Academic
Journals Inc.

www.academicjournals.com

Journal of Plant Sciences 1 (2): 176-181, 2006
ISSN 1816-4951

Yield and Quality in Relation to Different Crop Loads on Tas-A-Ganesh Table Grapes (*Vitis vnifera* L.)

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Abstract: The effect of variation in bunch load (40, 50, 60 and 80 bunches/vine) on yield and quality components in table grapes were studied at the research farm of National Research Centre for Grapes, Pune during the year 2003-2005. The trial was conducted on five-year-old Tas-A-Ganesh grapes and was compared with vines grafted on Dog Ridge rootstock. In the grafted vines, the average bunch size was higher than own rooted vines. Higher berry diameter of 17.23 mm was recorded in grafted vines as against 16.21 mm in own rooted vines. The yield per vine in grafted vines was increased by 44.93% over own rooted vines. The total soluble solids also reduced with the increase in yield per vine. As the bunch load per vine was increased, there was reduction in quality in terms of berry diameter and TSS; however, the total yield per vine was increased.

Key words: Tas-A-Ganesh, Dog Ridge, own root, berry diameter, yield per vine

Introduction

Grape is one of the major important fruit crop grown in India. The major produce in the country is used as table purpose and the small quantity is converted into raisin, wine and juice. The produce is exported to the markets of Europe, Chile, Holland and Middle East. To produce the quality grapes, it requires careful control of crop size to balance the amount of fruit to vegetative growth, quality fruit and adequate vine growth for consistent productivity. Excess fruit production leads to poor fruit quality and reduced vegetative growth resulting into poor yield in the coming years. Due to the continuous problems of drought and build up of salinity in the soil in the grape growing regions, the growers shifted to use of rootstock for grape cultivation. Incorrect application of cultural practices in grafted and own rooted vines may lead to negative effects on vegetative growth and fruit quality. In India, the proportion of harvested grapes having exportable quality is less than the expected. However, the remaining produce is sent to the local market. The requirement of cultural practices are different for local market and for export purpose. The grower tries to exploit the vine to the maximum extent by retaining maximum number of bunches per unit area on the vine leading to poor quality that ultimately harvest minimum quantity of exportable produce. Due to the heavy load on the vine, cluster drying from the tip is also observed in majority of the vineyards. However, controlling of yield via pruning is an important way to increase the table grapes quality (Harun Coban and Serdar Kara, 2002). As in sugar accumulation the colour of grape is also influenced by many factors like climatic conditions (Pirie and Mullins, 1977), training systems (Reynolds *et al*, 1994; Smart *et al*, 1985).

Considering these above-mentioned problems, an investigation was carried out to study the effect of different crop load so as to maintain the quality fitting into the standards for local market and also for export in Tas-A-Ganesh grapes grafted on Dog Ridge rootstock and on own rooted vines.

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Materials and Methods

The experiment was carried out at the farm of National Research Centre for Grapes, Pune during the year 2003-2005. The five-year old vines of Tas-A-Ganesh, a clone of Thompson Seedless grafted on Dog Ridge rootstock and own rooted vines were selected for the experiment. Dog Ridge rootstock and own rooted Tas-A-Ganesh were planted at a spacing of 10 X 6 distance and were trained on flat roof gable system of training with 1.3 m stem height. According to the climatic condition during the year of study (data not given) there was enough rainfall with favorable weather after October pruning and the crop was considered as normal. The soil of this region is black having pH 7.75 and EC 0.46 dS/m (Sharma and Upadhyay, 2005). In the Peninsular India, double pruning and single cropping is a crop pattern followed in grapes. After harvest of crop, back pruning was performed by retaining 1-2 basal buds on the cane. Excess, weak and very vigorous shoots were removed and appropriate numbers of shoots having uniform vigour were retained on each vine under study. Since the bud differentiation takes place during 45-60 days after back pruning, shoot-thinning operation was considered to be important in point of harvesting enough sunlight by individual buds. All the vines under experiment were given uniform cultural practices such as fertilizers, irrigation and plant protection.

The fruit pruning was done during October and the vines under each treatment were cluster thinned at pre bloom to setting stage to four different crop levels of 40, 50, 60 and 80 bunches/vine to create moderate to heavy crop load on own rooted and grafted vines. The excess number of bunches were thinned out. Under each treatment of bunch load, five vines were selected for study. The experiment was designed in Factorial randomized block design (FRBD) with five replication. The details of the factors are as below.

Factor A
Plant type

- Own rooted Tas-A-Ganesh
- Tas-A-Ganesh grafted on Rootstock

Factor B
Bunches/vine

- 40 Bunches/vine
- 50 bunches/vine
- 60 bunches/vine
- 80 bunches/vine

To study the effect of these treatments on growth, yield and quality on grafted vines in comparison with own rooted vines, bunches under each treatment were harvested on the same date. The shoot length, shoot diameter was measured at 75th days after October pruning. When the target of approximate 18^0 Brix total soluble solids concentration was reached, all bunches were harvested. The harvested bunches were weighed for different characters. Harvested grape bunches were brought to laboratory for physico chemical analysis and following parameters were studied. From the lot, 100 berries were selected randomly and total soluble solids (TSS) were determined using digital refractometer (model ERMA of Japan). A drop of juice was extracted and placed on clean prism of

refractometer and the lid was closed. Reading was taken directly from the scale at room temperature. The acidity was determined by described method. Ten ml of the extracted juice was titrated against 0.1 N NaOH. The remaining bunches from all the treatments were harvested and yield per vine, average berry weight, berry diameter, 50-berry weight, bunch weight and yield per vine were recorded (Winkler *et al*., 1974). The data was statistically analyzed as per Panse and Sukhatme (1967).

Results and Discussion

Growth Performance

The data analyzed on growth parameters is given in Table 1. Significant differences were recorded among the plant type. The shoot growth and shoot diameter was more in case of Tas-A-Ganesh vines grafted on Dog Ridge rootstock as compared to the own rooted vines. Higher shoot length of 80.67 cm was recorded in grafted vines as compared to 63.5 cm in own rooted vines. It was observed that increase in number of bunches per vine had reduced the shoot growth. When minimum number of bunches per vine was retained, the shoot growth was found to be higher. The reduction in number of bunches per vine might have resulted into weakening of the sink, the bunch that resulted in increased shoot growth. Christensen *et al*. (1994) also reported that increased crop load has a negative effect on vegetative growth. However, the differences for the interaction of bunch number and plant type (grafted vs. own rooted) were found to be non significant. Higher shoot diameter was recorded when minimum number of bunches were retained per vine. Increase in number of bunches resulted into reduction in shoot diameter. This might be due to competition among bunches for their growth resulted into weak shoot.

Bunch and Berry Characters

Berry diameter is an important quality parameter considered while exporting the grapes. There were significant differences among the bunch load treatments in own rooted and also in grafted vines. Overall performance of grafted vines was found to be superior for bunch and berry characters to the own rooted vines. Higher berry diameter was recorded in grafted vines (17.23 mm) as compared to the own rooted vines (16.21 mm). In grafted vines, 40 bunches per vine resulted into higher berry diameter of 18.50 mm as compared to 17.56 mm in own rooted vines. The reduction in number of bunches per vine had increased the berry quality. Dhillon *et al*. (1990;1992) also reported the improved fruit quality of Perlette grapes by reducing the crop load either by cluster or berry thinning. The increase in berry diameter might be due to proper utilization of food material by bunch, the sink. These results confirm the results obtained by Hunter and Visser (1988 b) who reported that the fruit after berry set becomes the very large sink. The increase in bunch number reduced the berry diameter. When the heavy crop load/vine was maintained (80 bunches) the berry diameter reduced to the maximum. Since the grapes to be exported requires to have minimum 18 mm diameter, retention of 40 bunches seems to be ideal in grafted vines. However for local market 14 to 16 mm berry diameter can serve the purpose in the Indian market. The same trend was observed for 50-berry weight (Table 1). In general, 1.0 to 1.5 mm increased berry diameter was recorded on grafted vines than on own rooted vines in a given situation.

The average bunch weigh was more in case of reduced number of bunches per vine in both the plant type. In grafted vines, higher bunch weight of 350 g was recorded when minimum number of bunches (40) were retained. The reduction in bunch weight was recorded with the increase in bunch number per vine (Table 2). Dhillon *et al*. (1998) also reported that increased crop load decreased the

Table 1: Effect of crop load on growth and berry characters in Tas-A-Ganesh grapes

	Shoot length (cm)			Shoot diameter (mm)			50 berry wt. (g)			Berry diameter (mm)		
Treatment	Own root	Grafted	Mean B	Own root	Grafted	Mean B	Own root	Grafted	Mean B	Own root	Grafted	Mean B
40 bunch	75.20	93.10	84.15	6.75	7.54	7.15	153.60	168.00	160.80	17.56	18.50	18.03
50 bunch	72.20	89.00	80.60	6.70	7.03	6.86	141.00	139.42	140.21	16.76	17.20	16.98
60 bunch	54.80	72.60	63.70	6.25	7.00	6.62	121.00	128.00	124.50	15.50	16.80	16.15
80 bunch	51.80	68.00	59.90	6.15	6.88	6.51	112.60	123.40	118.00	15.02	16.42	15.72
Mean A	63.5	80.67	---	6.46	7.11	----	132.05	139.70	----	16.21	17.23	----
	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B
SE m ±	1.18	1.68	2.37	0.044	0.062	0.088	1.52	2.15	3.04	0.10	0.15	0.21
P = 0.05	3.44	4.87	NS	0.12	0.18	0.34	4.41	6.23	NS	0.31	0.44	NS

Table 2: Effect of crop load on bunch and quality characters in Tas-A-Ganesh grapes

	Bunch wt. (g)			Yield vine (kg)			TSS (°Brix)			Acidity (%)		
Treatment	Own root	Grafted	Mean B	Own root	Grafted	Mean B	Own root	Grafted	Mean B	Own root	Grafted	Mean B
40 bunch	246.4	350.0	298.2	9.856	14.000	11.928	22.16	18.60	20.38	0.71	0.74	0.72
50 bunch	213.0	230.4	266.7	10.650	16.020	13.335	21.72	19.80	20.76	0.72	0.75	0.73
60 bunch	181.0	257.4	219.2	10.860	15.684	13.272	22.02	19.82	20.92	0.70	0.80	0.75
80 bunch	148.0	211.4	179.7	11.840	16.912	14.376	19.92	20.24	20.08	0.66	0.82	0.74
Mean A	197.1	284.8	----	10.801	15.654	----	21.45	19.61	----	0.70	0.78	----
	A	B	A×B	A	B	A×B	A	B	A×B	A	B	A×B
SE M ±	3.41	4.82	6.82	0.15	0.22	0.31	0.16	0.23	0.33	0.008	0.012	0.017
P = 0.05	9.88	13.97	19.76	0.45	0.64	NS	0.48	NS	0.97	0.025	NS	0.051

Table3: Effect of different crop load on yield parameters in Tas-A-Ganesh grapes

	Yield acre (tone)			Brix yield acre		
Treatment	Own root	Grafted	Mean B	Own root	Grafted	Mean B
40 bunch	7.154	10.163	8.659	1.58	1.89	1.73
50 bunch	7.731	11.695	9.713	1.67	2.31	1.99
60 bunch	7.884	11.386	9.635	1.73	2.25	1.99
80 bunch	8.594	12.277	10.436	1.72	2.48	2.10
Mean A	7.841	11.380	----	1.67	2.23	----
	A	B	A×B	A	B	A×B
SEM ±	0.11	0.16	0.23	0.026	0.037	0.053
P = 0.05	0.33	0.47	NS	0.077	0.10	0.15

mean cluster weight in Perlette grapes. In the grafted vines the vigour in the form of shoot growth was also found enough. The shoot vigor was also maintained in grafted vines than in own rooted vines. This might be due to the supply of available food reserve to the developing berries that has resulted into good quality form these vines. Eynard and Gay (1992) also suggested that equilibrium of crop load versus vegetative development is important for quality fruit.

Yield and Quality Characters

In grapes, berry diameter, sugars and colour are major quality contributing parameters. Total soluble solids in berries were recorded higher at 40-bunch load (22.16 in own rooted vines and 20.24 in grafted vines) as compared to the maximum bunch load of 80 bunches per vine (19.92 and 18.60, respectively). Higher TSS was recorded in own rooted vines (21.45° Brix) compared to the grafted vines (19.61^0 Brix). As the yield increased by increasing the number of bunches, there was decline in quality in terms of TSS and berry diameter (Table 1 and 2). The berries containing increased total soluble solids (above 20° Brix) are not preferred in the international market. However, in the local market higher grapes containing higher TSS is given due importance. Hence, the grapes

harvested from own rooted vines having high total soluble solids and minimum berry diameter can serve the requirement of the local market. Significantly higher yield was recorded in grafted vines (15.654 kg) as compared to the own rooted vines (10.801 kg). The increase in number of bunches per vine resulted into increase in yield/vine. Though the bunch weight was less in more number of bunches per vine treatment, the overall yield per vine was increased due to cumulative increase in bunch load. These results are in accordance with the results obtained by Jackson and Lombard (1993) who reported that high yields and vigour often reduce grape quality. Production practices used to maximize grape quality parameters or yield can have a significant effect on the source-sink relationship of the grapevine (Williams, 1996). Availability of more number of bunches in the form of high yield delays the maturity (Bravado *et al*., 1985). The yield per acre was more in case of grafted vines (11.38 tone) than the own rooted vines (7.84 tone). The increase in total yield with the increase in crop load was also supported with the results obtained by Howell *et al*. (1991) and Reynolds (1994). This is mainly because the shoot vigour that is required for photosynthesis and formation of food reserve was less in own rooted vines. As the yield per vine increased with the increase in number of bunches, the yield per acre was also increased. The yield per acre was more in grafted vines than in own rooted vines. Maximum yield of 11.380 tone/acre was recorded than 7.481 tone in own rooted vines (Table 3). It was observed that, with the increase in bunch load, the overall yield per vine and also yield/acre in both the plant type was increased. The Brix yield is said to be the important criteria for considering the yield level of the vine. Maximum Brix yield of 2.23 was recorded in grafted vines as compared to 1.67 in own rooted vines. The yield per vine in grafted vines was increased by 44.93% over the own rooted vines under study.

The grapes harvested form the vine should fulfill the requirement of the consumers. For export, the bunch weighing 350 to 400 g having 18 mm and above diameter with 18^{0} Brix total soluble solids is considered to be ideal. The bunch load retained as 40 bunches per vine in grafted vines has fulfilled the requirement. Hence, such type of bunch load per vine can be retained keeping in view the purpose of exporting the grapes however, the number of bunches can be increased up to 60 per vine if the produce is considered for local market. The results on bunch load and plant type revealed that under the adverse situation of soil and water, establishment of grape vineyards the vineyards on rootstock is the alternative for grape cultivation that can results in higher berry quality in terms of berry diameter, average bunch weight and yield per vine as compared to own rooted vines.

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