Effect of cluster thinning on bunch yield, berry quality and biochemical changes in local clone of table grape cv. Jumbo Seedless (Nana Purple)

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ABSTRACT

A field experiment was conducted during the year 2011-2012 to study the effect of cluster thinning on bunch yield, berry quality and biochemical changes in black seedless local clone of table grape. Crop load level was adjusted to 23, 27, 33, 37, 45 and 50 clusters per vine. Significant differences were observed for all physico-chemical parameters except pH. Shoot length was positively correlated (0.98) with the internodal length. Highest bunch weight (673.0 g) was recorded at lowest crop load level (23 clusters per vine) and *vice-versa*. Highest berry weight (7.89 g) and berry diameter (24.78 mm) was also recorded at lowest crop load level, which resulted into increased in bunch weight. It was observed that the reduction in clusters per vine resulted into increase in total soluble solids in berries. Significant differences were recorded for reducing sugar, total phenols, total proteins and total carbohydrates. The concentration of reducing sugar was reduced with the increase in number of clusters per vine. With the increase in clusters per vine, carbohydrate content in berries was also reduced. Therefore, thinning upto 27 clusters per vine spaced at a distance of 3.0 m x 1.66 m is recommended for better yield, quality and returns to the grape growers.

Key words: Grape, crop load, physico-chemical parameters.

INTRODUCTION

Clones of Sharad Seedless grape variety such as Jumbo Seedless, Mahadev Seedless, and Krishna Seedless are more popular in Maharashtra and neighbouring states. Popularity of these superior clones is mainly due to bold berry and high demand during off-season. This variety is in cultivation particularly for local market and export to Bangladesh, Dubai, Sri Lanka, etc. To meet the demand, maintaining the quality of grapes is prequisite. Therefore, proper balance between quality and the quantity needs to be maintained. The production of high quality Jumbo Seedless (Nana Purple) grapes is still a challenge. Over-cropping can reduce fruit quality in the current season, and can also result in poor bud-break, delayed growth, and reduced fruit yield in the following season (Nick Dokoozlian, 14).

It is well known that the best grapes come from those vineyards where vegetative growth and crop yield are in balance (Dry *et al.*, 3). Vine balance was defined by Gladstones (7) by stating, “balance is achieved when vegetative vigour and fruit load are in equilibrium and consistent with high fruit quality”. Balanced pruning is the standard cultural practice used to control grapevine crop level and regulate vine vigour. Some table grape cultivars developed, tend to be vigorous and produce an over abundant amount of fruiting clusters. Extra clusters retained through bloom may result into reduced berry set per cluster. A practice commonly used to decrease cluster compactness and improve berry size is cluster thinning. When fewer clusters on the vine are retained, the grape clusters have more berries set on the rachis and larger berries result. Due to the heavy load on the vine, cluster drying from tip is also observed in the majority of vineyards. However, controlling yield *via* cluster thinning is an important way to increase grape quality. Considering this, the research work was carried out to study the effect of clusters load levels on quality of a local grape clone.

MATERIALS AND METHODS

The study was carried out at the grape grower vineyards near Indapur, Maharashtra during 2011-2012. The 3-year-old Jumbo Seedless (Nana Purple) grape variety grafted on 110-R rootstock (*Vitis berlandieri* × *V. rupestris*) was trained to *pandal* training system of trellis (Bower) with a spacing of 3.0 m × 1.66 m. The soil structure of this vineyard was loamy and well drained. Routine cultural practices such as fertilization and plant protection measures were taken at proper growth stages. In the peninsular India, double pruning and single cropping is 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 number of shoots having uniform

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vigour were retained on each vine. Since the fruit-bud differentiation takes place during 45-60 days after back pruning, shoot thinning operation was done at 6-7 leaf stage so as to allow individual buds to harvest appropriate sunlight.

The fruit pruning was done during September and the vines under each treatment were cluster thinned after berry set. The canopy size was controlled by shoot thinning before inflorescence emergence. The cluster level was controlled by thinning to 23, 27, 33, 37, 45 and 50 clusters per vine, respectively. The experiment was conducted in randomized block design with four replications. Excess number of clusters were thinned out under each treatment. Five vines were selected under each replication to record observations. To study the effect of these treatment on growth, yield and quality, bunches under each treatment were harvested at the same date. The vegetative parameters such as shoot length, internodal length, cane diameter and leaf area were measured at 120 days after fruit pruning.

Total soluble solids were recorded in the field and maturity data were collected one week before harvest. At harvest, fifty berry samples were randomly selected from each replication. The samples were processed in a blender and strained through two layers of muslin cloth. Total soluble solids was determined for juice using a digital refractometer (model ERMA, Japan). The juice was then used to determine pH using a digital pH meter.

Estimation of carbohydrate was done by anthrone method. Reducing sugar was estimated by DNSA method described by Lowry *et al*. (11). For protein estimation, 0.5 g of crushed samples homogenized in 0.1 M phosphate buffer (pH 7.0) was used. The homogenate was centrifuged at 5,000 rpm for 15 min. at 40°C and supernatant was used as a source for protein estimation. Berry quality was determined by average bunch and berry weight, berry diameter, berry length, skin and pedicel thickness. The biochemical parameters were correlated with berry qualities. The data was statistically analysed using SAS 9.3 software.

RESULTS AND DISCUSSION

The observations recorded on vegetative parameters are presented in Table 1. Significant differences were recorded for shoot length. Minimum shoot length of 80.0 cm was recorded when the maximum clusters were retained per vine, whereas, the highest shoot length was recorded in minimum number of cluster retention. With the increase in shoot length, internodal length was also found to increase. This was mainly due to increased vigour of shoot resulting into increase in internodal length. A positive correlation was also observed with shoot length and inter-nodal length (Table 3). Reduction in shoot length was related with the reduction in cane diameter and leaf area.

The bunch weight increased linearly with reduction in number of clusters per vine. Highest cluster weight of 673.0 g was recorded in minimum cluster retention (23 clusters/ vine) as compared to the highest (50) clusters per vine (430.203 g). This result confirms the study of Dami *et al*. (2) on Chambourcin grapevine. With the increase in number of clusters per vine, the total yield per vine was also enhanced. The reduction in yield following cluster thinning has been previously reported in several other grape cultivars (Howell, 8; Miller and Howell, 11; Naor *et al*., 13). The increase in yield per vine might be due to increase in both number of clusters per vine and also the cluster

Table 1. Physico-chemical parameters of grape bunches at different cluster loads.

No. of clusters per vine	Shoot length (cm)	Inter nodal length (cm)	Cane dia, (mm)	Leaf area (cm^2)	Days taken for cane maturity	Bunch wt. (g)	Berry wt. (g)	Berry dia. (mm)	Berry length (mm)	Skin thickness (mm)	Pedicel thickness (mm)
23	95.00^a	5.60^a	10.00^a	193.10^a	85.00^b	673.00^a	7.89^a	24.78^a	24.46^d	0.29^a	2.48^a
27	95.50^a	5.50^{ab}	10.00^a	183.31^b	85.00^b	521.17^b	7.64^b	21.50^b	27.83^a	0.27^b	2.48^a
33	94.50$_a$	5.39^b	9.80^b	181.63^b	85.00^b	505.37^c	7.44^c	20.21^c	26.71^b	0.25^c	2.21$_b$
37	85.00^b	5.00^c	8.50^c	162.5^c	90.00^a	467.67^d	7.09^d	19.75^d	25.79^c	0.24^d	2.21^b
45	83.10^b	5.00^c	8.50^c	153.20^d	91.40^a	458.33^e	6.52^e	19.46^d	27.71^c	0.226^e	2.21^b
50	80.00^c	4.83^d	7.95^d	131.00^e	91.60^a	430.23^f	5.84^f	18.43^e	24.20^d	0.22^f	2.20^b
$CD_{(0.05)}$	1.79	0.10	0.19	3.39	5.84	9.10	0.13	0.36	0.54	0.004	0.041
Sig	**	**	**	**	*	**	**	**	**	**	**
CV%	5.39	5.56	5.31	5.97	5.04	5.02	6.32	5.34	5.44	5.28	5.92

weight. These results also confirm the findings of Fawzi *et al*. (5) who reported the increase in yield per vine due to increase in number of clusters in Crimson Seedless (Ali *et al*., 1) and Omar and Abdel-awi (15) on Thompson Seedless grapevines.

Significant differences were recorded for berry weight and diameter in relation to cluster thinning treatment. Increase in berry weight and diameter were found to be associated with reduction in clusters per vine (Table 1). The highest berry diameter of 24.78 mm was recorded in 23 clusters per vine as compared to the lowest berry diameter of 18.43 mm in 50 clusters per vine. Earlier, Omar and Abdel-kawi (15) reported that decrease in bunch weight was associated with increase in bud load on a vine. These finding supports the results of Dami *et al.* (2).

Significant differences were recorded for total soluble solids in the berries (Table 2). It was observed that reduction in clusters per vine resulted into increase in total soluble solids in berries. This finding is in accordance with the results obtained by Dami *et al.* (2). The increase in total soluble solids with cluster thinning has also been reported in the other grape cultivars (Naor *et al.*, 13; Kliewer and Dokoozlian, 10).

Though the acidity reduces with the increase in number of clusters, the retention among the different cluster thinning treatments did not justify. Jackson and Lombard (9) in their study reported that the low yield leads to the highest total soluble solids and lower acid levels, therefore, resulting in higher sugar/ acid ratio. Fawzi *et al.* (5) reported increase in acidity by increased bud load per vine. It is clear from the present investigation that the effect of clusters per vine on total soluble solids also had similar effect on acidity. The changes in clusters per vine did not have any effect on the juice pH.

The data recorded on various biochemical parameters is presented in Table 2. Significant differences were recorded for reducing sugar, total phenols, total proteins and total carbohydrates. The concentration of reducing sugar in berries declined with the increase in clusters per vine, whereas, reducing sugar in berries increased with the reduction in clusters per vine. Highest concentration of reducing sugar (71.16 mg/g) was recorded in 23 clusters per vine as compared to minimum (31.89 mg/g) in 50 clusters per vine treatment. Earlier, Fawzi *et al.* (5) in their studies on Crimson Seedless found that total sugars decrease by increasing bud load per vine. Potential to produce carbohydrate to meet the demands of fruit production and vegetative growth based on effective leaf area, whereas, proper crop load is important to achieve maximum yields of highest quality fruit without sacrificing vine capacity. Fruit production and shoot growth compete for the available carbohydrates. Fruit growth and shoot growth are inversely related. As fruit production increased, shoot growth showed a declined.

With the increase in clusters per vine, carbohydrate content in berries was also reduced to the maximum extent. The increase in carbohydrate content might be due to profuse canopy with increase in leaf area in lowest cluster load treatment that have been resulted in highest active photosynthesis rate, which helps to store more carbohydrates in the sink, the bunch. This increase in food material is then transported from source to sink, the berries. The present investigation supports the results obtained by Gao and Cahoon (6) who reported that increase in leaves leads to heavy canopy with increase in active photosynthesis and storage of carbohydrate in the new canes. Similar results were also obtained by Omar and Abdel-

Table 2. Biochemical parameters of berry juice in grape cv. Jumbo Seedless.

No. of clusters per vine	TSS (°Brix)	Acidity (%)	pH	Reducing sugar (mg/g)	Total phenols (mg/g)	Total proteins (mg/g)	Total carbohydrates (mg/g)
23	17.35^a	0.47^a	3.43^a	71.16^a	11.42^a	25.90^a	50.1^a
27	16.40^b	0.46^a	3.46^a	67.25^c	11.18^b	22.60^b	47.82^b
33	15.50^c	0.49^a	3.38^a	67.53^b	09.40^c	21.42^c	45.49^c
37	15.00^d	0.48^a	3.43^a	44.25^d	08.26^e	19.18^d	43.08^d
45	14.85^d	0.48^a	3.39^a	39.89^d	08.64^d	18.6^e	44.25^e
50	14.70^d	0.40^b	3.42^a	31.89^f	7.4^f	18.5^e	42.44^e
$CD_{0.05}$	0.48	0.05	0.27	1.56	0.18	0.39	2.09
Sig	**	**	NS	**	**	**	**
CV%	5.83	7.58	5.95	5.38	5.22	5.58	5.20

Table 3. Correlation between various physio-chemical and biochemical parameters based on different clusters number per vine in the grape cv. Jumbo Seedless.

	RS	TP	P	TC	Bu W	Be W	BD	BL	ST	PT	SL	IL	CD	LA	CM	TSS	A	pH
RS	1.00	0.86	0.89	0.86	0.82	0.93	0.81	0.11	0.89	0.65	0.97	0.97	0.96	0.96	-0.93	0.84	0.56	0.08
		0.028	0.017	0.028	0.045	0.006	0.051	0.841	0.018	0.162	0.001	0.001	0.001	0.001	0.006	0.036	0.252	0.878
TP		1.00	0.92	0.98	0.85	0.89	0.89	0.21	0.96	0.93	0.91	0.96	0.93	0.90	-0.84	0.95	0.39	0.43
			0.009	0.000	0.032	0.018	0.016	0.686	0.002	0.008	0.011	0.002	0.007	0.013	0.037	0.004	0.448	0.391
P			1.00	0.97	0.97	0.85	0.97	-0.16	0.98	0.86	0.85	0.93	0.88	0.87	-0.86	0.99	0.27	0.35
				0.001	0.001	0.033	0.001	0.766	0.000	0.026	0.031	0.008	0.022	0.024	0.029	0.0002	0.609	0.491
TC				1.00	0.93	0.84	0.95	0.04	0.97	0.91	0.86	0.94	0.89	0.87	-0.82	0.98	0.32	0.35
					0.007	0.036	0.003	0.934	0.001	0.012	0.027	0.005	0.017	0.024	0.047	0.0006	0.532	0.490
Bu W					1.00	0.79	0.99	-0.25	0.94	0.79	0.73	0.84	0.77	0.81	-0.71	0.95	0.31	0.27
						0.059	0.000	0.634	0.005	0.061	0.094	0.036	0.076	0.048	0.111	0.0032	0.548	0.609
Be W						1.00	0.82	0.22	0.92	0.72	0.94	0.94	0.92	0.99	-0.83	0.84	0.66	0.29
							0.044	0.679	0.009	0.108	0.006	0.005	0.008	0.000	0.042	0.037	0.156	0.574
BD							1.00	-0.17	0.96	0.85	0.75	0.86	0.78	0.83	-0.71	0.97	0.32	0.37
								0.75	0.002	0.03	0.08	0.03	0.07	0.04	0.12	0.001	0.531	0.476
BL								1.00	-0.02	0.03	0.29	0.19	0.26	0.23	-0.07	-0.10516	0.55	-0.099
									0.977	0.953	0.583	0.719	0.622	0.660	0.892	0.8428	0.257	0.851
ST									1.00	0.90	0.89	0.95	0.90	0.92	-0.83	0.99	0.38	0.45
										0.014	0.020	0.004	0.015	0.009	0.039	0.0003	0.463	0.376
PT										1.00	0.73	0.80	0.76	0.71	-0.71	0.92612	0.07	0.69
											0.103	0.053	0.080	0.113	0.116	0.0080	0.900	0.12
SL											1.00	0.98	0.99	0.96	-0.95	0.82996	0.53	0.21
												0.000	<.0001	0.002	0.004	0.0409	0.279	0.691
IL												1.00	0.99	0.97	-0.93	0.91245	0.48	0.26
													0.000	0.001	0.006	0.0112	0.331	0.625
CD													1.00	0.95	-0.95	0.85799	0.49	0.22
														0.003	0.003	0.0288	0.328	0.671
LA														1.00	-0.86	0.85117	0.66	0.21
															0.028	0.0316	0.154	0.692
CM															1.00	-0.81644	-0.28	-0.24
																0.0475	0.595	0.647
TSS																1.00	0.24	0.46
																	0.647	0.358
A																	1.00	-0.31
																		0.554
pH																		1.00

*RS = Reducing sugar, TP = Total phenols, P = Total proteins, TC = Total carbohydrates, Bu W = Bunch weight, Be W = Berry weight, BD = Berry diameter, BL= Berry length, ST = Skin thickness, PT = Pedicle thickness, SL = Shoot length, IL = Internodal length, CD = Cane diameter, LA = Leaf area, CM = Days taken for cane maturity, TSS = Total soluble solids, A = Acidity.

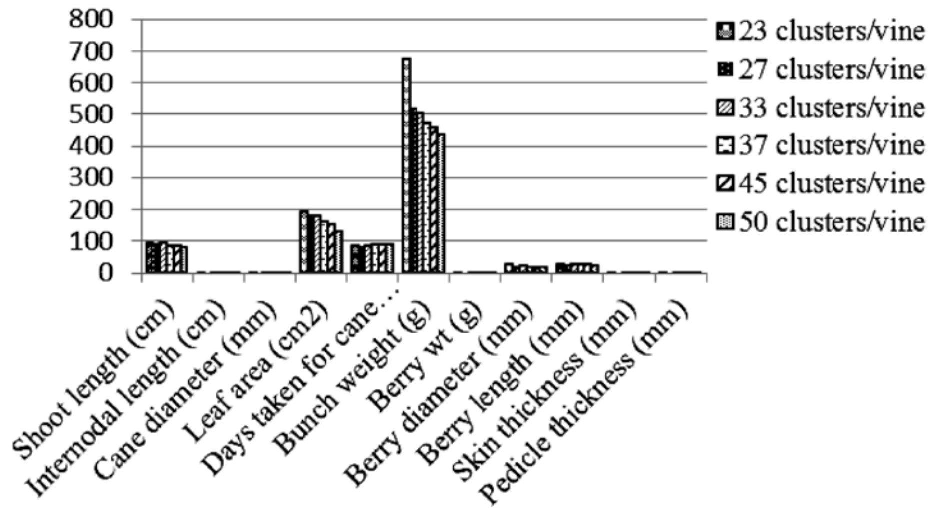

Fig. 1. Comparative physico-chemical contents in grape cv. Jumbo Seedless at various crop load levels.

kawi (15) on Thompson Seedless grapevine and El-Baz *et al.* (4) on Crimson Seedless grapevine. The same trend was also observed for total phenols and proteins in the grape berries (Table 2). Over cropping ordinarily delays fruit maturation, therefore decreases berry sugar and colour if harvest cannot be delayed. However, the effect of crop load on berry composition depends on how a difference in crop load is achieved.

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Received: May, 2012; Revised: March, 2014;
Accepted: April, 2014