DOI : 10.5958/0974-0112.2018.00068.3

Indian J. Hort. 75(3), September 2018: 399-404

Effect of bud load and fertilizer application on growth, yield and quality of Sahebi grape

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ABSTRACT

The studies on the influence of bud load and fertilizer application on growth, yield and quality of grape cv. 'Sahebi' were carried out in model grapevine orchard of department of Horticulture at Kralbagh, Tehsil Lar Distt. Ganderbal (J&K) for two consecutive years. The treatment consisted of 3 levels of bud load (B_1-96 buds/ vine), B_2 -128 buds/ vine and B_3-160 buds/vine), 3 levels of fertilizer doses, F_1=FYM (50 kg/vine) + recommended dose (NPK: 555, 227, 470g/vine), F_2=FYM (50 kg/vine)+ 2 times recommended dose (NPK: 1110, 454, 940g/vine), F_3=FYM (50 kg/vine)+ 3 times recommended dose (NPK: 1665, 681, 1410g/vine and their combinations replicated thrice with a double plot size in a completely randomized block design. The individual effect of as well as Fertilizer level F_2 (FYM-50 kg/vine + 2 times recommended dose-NPK: 1110, 454, 940 g/vine). Bud load B_2 (128 buds/vine) recorded the maximum percentage of fruitful shoots per vine, number of leaves/shoot, fruit yield, bunch length, berry weight, berry length, juice content, TSS, total sugars, anthocyanin content, benefit- cost ratio and the minimum acidity. B_2F_2 interaction resulted in highest percentage of fruitful shoots per vine, fruit yield, berry length, TSS, total sugars, anthocyanin content, benefit- cost ratio and the minimum acidity during both years. Therefore, budload B_2 (128 buds/vine), fertilizer dose F_2 (FYM-50 kg/vine + 2 times recommended dose-NPK: 1110, 454, 940 g/vine) and their combination is the best for improving growth, yield and quality of grape cv. Sahebi.

Key words: *Vitis vinifera*, quantitative traits, biochemical traits.

INTRODUCTION

Grape (*Vitis vinifera* L.) is one of the most important fruit crops of temperate zone, which has acclimatized to sub tropical and tropical agro climatic conditions prevailing in the Indian sub-continent. It is a refreshing fruit, rich in sugars, acids, minerals, vitamins and tannins. It can be eaten raw or can be used for making jam, juice, jelly, vinegar, wine, raisins, molasses and grape seed oil. In Jammu and Kashmir, grapes are grown in an area of 321 hectares with a production of 648 MT, but the productivity of grape vines had been declining and has come down to a very low level (Anonymous, 3). Further, quality of grape is also poor as compared to other grape growing states of India. The possible reasons are non-adoption of improved varieties, proper management practices particularly pruning and fertilizer application etc. Judicious pruning plays an important role in sustaining the productivity of grape for longer period of time. The purpose of pruning is to regulate or encourage good yield and to improve size and quality of fruit. Grape is a heavy feeder of nutrients and N, P, K are removed from the soil in large amounts. Therefore, it is necessary to apply the nutrients through manures and fertilizers to meet the growth and reproductive needs of the grapevine. Further, the optimum combination of the pruning severity and the fertilizer rate play an important role in regulating the tree performance. The main grape growing belt of Kashmir valley is district Ganderbal. Sahebi is the predominating grape variety of the area but grape vines in the area are not being maintained on the scientific lines with respect to pruning, application of nutrients and other cultural techniques. Hence, the present study was carried out to standardize the bud load and fertilizer dose for optimum growth, yield and quality of grape cv. Sahebi.

MATERIALS AND METHODS

The study was carried out to assess the influence of bud load, fertilizer levels and their combinations on growth, yield and quality of grape cv. 'Sahebi' in model grapevine orchard of department of Horticulture at Kralbagh, Tehsil Lar Ganderbal (J&K) for two consecutive years (2011 & 2012). The treatment consisted of 3 levels of bud load (B_1-96 buds/ vine, B_2 -128 buds/ vine and B_3-160 buds/vine), 3 levels of fertilizer doses, F_1=FYM (50 kg/vine) + Recommended dose (NPK: 555, 227, 470 g/vine), F_2=FYM (50 kg/vine)+ 2 times recommended dose (NPK: 1110, 454, 940 g/vine), F_3=FYM (50 kg/vine) +

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3 times recommended dose (NPK: 1665, 681, 1410 g/vine and their combinations replicated thrice with a double plot size in a completely randomized block design. Data on percentage of fruitful shoots/vine was calculated by dividing the number of fruitful shoots with total number of shoots emerged and multiplying by 100. Percentage of vegetative shoots per vine was calculated by dividing the number of vegetative shoots with total number of shoots emerged and multiplying by 100. Leaf area was calculated with the help of leaf area meter (Licor model 3100) and expressed in centimeter square (cm^2). Number of leaves in the randomly selected four canes in different directions were counted and then mean number of leaves per shoot was worked out. Total number of bunches per vine was counted from each replication and the mean number of bunches per vine was calculated. Fruit yield per vine was calculated based on the number of bunches and the mean weight of bunches at harvest as suggested by Khanduja and Balasubramanyam (10). The weight of five bunches from each replication was observed on laboratory balance and the mean weight per bunch was recorded in grams. Five bunches were randomly selected replication wise and the mean bunch length was recorded in centimeters. Each bunch length was measured from the apex to the base. Five bunches from each replication were randomly selected and their mean diameter was recorded in centimeters. Each bunch diameter was recorded at the place of maximum spread. Fifty berries were separated from five randomly selected bunches per replication (10 berries per bunch) and weighed on laboratory balance. The mean weight per berry was calculated in grams. Ten berries were taken randomly from each bunch and the berry length was noted in centimeters with a vernier caliper and from this the average berry length was calculated. Ten berries were randomly taken from each bunch and the berry diameter was recorded in centimeters with a vernier caliper and from this the average berry diameter was noted. Fruit juice percentage was measured as per the method described by Mazumdar and Majumder (12).

Freshly extracted juice of fifty randomly selected berries was strained through muslin cloth. It was thoroughly stirred and a drop of it was placed on the hand refractometer and the TSS reading was recorded in ^{o}Brix. The readings were corrected at 20^{o}C with the help of temperature correction chart (A.O.A.C., 1). Titrable acidity was estimated by titrating a known quantity of homogenised juice against 0.1N NaOH solution using phenolphthalein as indicator (A.O.A.C., 1) and was expressed in terms of tartaric acid. Total sugars were estimated by Lane and Eynon method (Ranganna, 15). Quantitative determination of ascorbic acid was done by 2, 6-dichlorophenol indophenol visual titration method (Ranganna, 15). Anthocyanin content was extracted with ethanolic hydrochloride and the intensity of the colour appeared was measured colorimetrically (Kaur and Dhillon, 9). The data generated were subjected to statistical analysis as per the procedures described by Gomez and Gomez (7).

RESULTS AND DISCUSSION

Bud load, fertilizer dose and their interactions appreciably influenced percentage of fruitful shoots per vine and vegetative shoots per vine, leaf area, number of leaves per shoot and number of bunches per vine (Table 1). Significantly highest percentage of fruitful shoots per vine was recorded with B_2 (45.33 and 46.43 %) and F_2 (44.10 and 44.99 %) in comparison to other bud load and fertilizer doses. Among bud load and fertilizer dose combination, the highest number of shoots per vine was recorded with B_2F_2 (46.13 and 47.13 %). Significantly higher percentage of vegetative shoots/vine (58.84 and 58.36%) was observed when vines were pruned to B_3 level during both the years. Fertilizer dose F_3 resulted in the maximum percentage of vegetative shoots/ vine (57.49 and 56.76 %) during both the years, respectively. Significantly maximum percentage of vegetative shoots/vine was recorded in B_3F_3 (59.87 and 59.76 %) during both the years, respectively. More fruitful and vegetative shoots per vine might be due to the fact that moderate vigour of vines (less competition for food) are usually more fruitful because of optimum nutrient supply to vines, which is responsible for fruitfulness and the results are in agreement with those of Salem *et al.* (16) and Fawzi *et al.* (4).

The maximum leaf area (203.28 and 212.01 cm^2) was recorded in vines pruned to B_1 and with fertilizer level F_3 (188.74 and 195.54 cm^2). Combination of B_1F_3 registered the maximum leaf area (210.07 and 219.53 cm^2) in comparison to other bud load and fertilizer doses during both the years, respectively. The highest number of leaves per shoot was recorded with budload B_2 (61.07 and 67.74) and fertilizer level F_1 (54.42 and 61.65). However, number of leaves per shoot with combined effect of budload and fertilizer dose were statistically non-significant. Increased leaf area and number of leaves per shoot might be due to optimum bud load and nutrient supply under these treatments. The results are in conformity with the findings of Shalan (17) and Salem *et al.* (16) who reported that leaf area was significantly increased by decreasing the level of node load cm^{-2} trunk cross-sectional area.

Table 1. Effect of bud load, fertilizer level and their combinations on growth characteristics of grape cv. Sahebi.

Treatments	Fruitful shoots per vine (%)		Vegetative shoots per vine (%)		Leaf area (cm^2)		Number of leaves per shoot		Number of bunches per vine	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
B1	43.48	44.41	56.52	55.59	203.28	212.01	41.40	50.23	42.98	45.72
B2	45.33	46.43	54.67	53.57	181.46	186.35	61.07	67.74	48.14	53.87
B3	41.16	41.64	58.84	58.36	161.06	163.83	51.24	59.25	54.69	58.95
$CD_{(0.05)}$	0.11	0.10	0.13	0.14	2.43	2.57	0.53	0.62	2.45	1.98
F1	43.36	44.25	56.64	55.75	174.73	179.31	54.42	61.65	48.59	53.03
F2	44.10	44.99	55.90	55.01	182.33	187.35	51.23	59.11	50.90	55.01
F3	42.51	43.24	57.49	56.76	188.74	195.54	48.06	56.45	46.31	50.50
$CD_{(0.05)}$	0.13	0.12	0.17	0.19	2.76	2.84	2.20	2.55	1.13	1.11
B1F1	43.54	44.37	56.46	55.63	196.73	203.68	43.85	53.34	43.15	45.86
B1F2	43.99	45.02	56.01	54.98	203.03	212.83	41.24	49.87	44.52	48.87
B1F3	42.92	43.85	57.08	56.15	210.07	219.53	38.11	47.47	41.27	42.43
B2F1	45.37	46.53	54.63	53.47	173.93	178.66	63.54	69.80	47.98	54.25
B2F2	46.13	47.13	53.87	52.87	181.89	185.60	60.91	67.89	50.20	55.54
B2F3	44.48	45.64	55.52	54.36	188.56	194.70	57.76	65.52	46.23	51.81
B3F1	41.17	41.86	58.83	58.14	153.53	155.59	52.87	61.82	54.65	58.98
B3F2	42.17	42.83	57.83	57.17	162.07	163.61	51.55	59.57	57.99	60.61
B3F3	40.13	40.24	59.87	59.76	167.59	172.30	48.30	56.35	51.43	57.25
$CD_{(0.05)}$	0.16	0.14	0.18	0.21	2.82	2.92	NS	NS	2.48	2.19

Number of bunches per vine was significantly affected by bud load and fertilizer dose during both the years of study. Budload B_3 had the maximum number of bunches per vine (54.69 and 58.95) in comparison to other bud load levels. Significantly higher number of bunches per vine (50.90 and 55.01) was observed in fertilizer level F_2. Among the bud load and fertilizer level interaction, in treatment combination B_3F_2 the maximum number of bunches per vine (57.99 and 60.61) was recorded. As the number of buds per vine increases, the number of bunches formed on a vine also increased and the results are inconformity with the findings of Omar and Abdel Kawi (13) and Fawzi *et al.* (4). Optimum nitrogen, phosphorus and potassium application through fertilizers might have converted sterile buds to fertile buds through increased carbohydrate accumulation and the results are in accordance with the findings of Girgis *et al.* (6) and Abd El-Razek *et al.* (2).

Effect of bud load, fertilizer dose and their interaction on fruit yield, bunch weight, length and diameter and berry weight length and diameter is given in Table 2. The highest fruit yield per vine (21.73 and 25.23 kg/vine) was recorded in vines pruned to B_2 and with fertilizer level F_2 (20.08 and 23.10kg/vine). Combination of B_2F_2 registered the maximum fruit yield (22.70 and 25.90 kg/vine) in comparison to other bud load and fertilizer doses during both the years, respectively. This may be due to increase in both number of clusters per vine and cluster weight and better flower set, improved pollen viability, germination and fertilization, reduced fruit drop and increase in the berry size. These results are in agreement with the findings of Prabu and Singaram (14) and Fawzi *et al.* (4).

Among bud load treatments, the highest bunch weight (451.52 and 468.64 g), bunch length (24.65 and 25.64 cm), bunch diameter (13.44 and 13.25 cm) was recorded with budload B_2. Among fertilizer levels, highest bunch weight (412.61 and 436.98 g), bunch length (23.06 and 24.37 cm), bunch diameter (13.87 and 13.68 cm) was recorded with fertilizer dose F_3. Combination of B_2F_3 resulted in highest bunch weight (465.49 and 491.58 g), bunch length (25.41 and 26.40 cm) and bunch diameter (13.80 and 13.77 cm) during both the years under study. The increase in bunch weight and size may be due to more number of leaves which might have resulted in better photosynthesis and optimum supply and uptake of nutrients under these treatments. These results agreed with the findings of Fawzi *et al.* (4) and Abd El-Razek *et al.* (2).

Table 2. Effect of bud load, fertilizer level and their combinations on fruit yield and fruit physical characteristics of grape cv. Sahebi.

Treatments	Fruit yield (Kg/vine)		Bunch weight (g)		Bunch length (cm)		Bunch diameter (cm)		Berry weight (g)		Berry length (cm)		Berry diameter (cm)	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
B1	16.76	19.50	390.27	426.85	22.13	23.69	14.61	14.72	8.40	8.84	2.87	3.05	1.88	1.95
B2	21.73	25.23	451.52	468.64	24.65	25.64	13.44	13.25	10.05	10.25	3.21	3.34	1.65	1.73
B3	19.25	21.82	352.25	370.55	20.38	21.40	12.14	11.42	7.05	7.53	2.57	2.76	1.54	1.52
$CD_{(0.05)}$	1.45	1.62	20.13	15.53	0.12	0.10	NS	NS	0.17	0.19	0.10	0.07	NS	NS
F1	18.64	21.50	385.01	407.92	21.70	22.75	12.91	12.57	8.01	8.36	2.76	2.96	1.61	1.66
F2	20.08	23.10	396.41	421.14	22.41	23.61	13.41	13.13	8.51	8.86	2.89	3.04	1.70	1.73
F3	19.02	22.00	412.61	436.98	23.06	24.37	13.87	13.68	8.98	9.41	2.99	3.15	1.76	1.81
$CD_{(0.05)}$	0.73	0.81	4.31	4.58	0.67	NS	0.48	0.55	0.48	0.55	0.12	0.13	0.07	0.09
B1F1	16.12	19.00	373.54	414.51	21.47	23.09	14.17	14.26	7.89	8.42	2.77	2.96	1.79	1.87
B1F2	17.20	20.90	386.41	427.07	22.04	23.71	14.61	14.68	8.42	8.80	2.87	3.05	1.88	1.94
B1F3	16.96	18.60	410.85	438.98	22.88	24.28	15.05	15.21	8.89	9.31	2.98	3.15	1.96	2.04
B2F1	20.97	24.30	436.94	447.99	23.85	24.92	13.09	12.70	9.40	9.69	3.07	3.25	1.58	1.65
B2F2	22.70	25.90	452.14	466.36	24.69	25.61	13.42	13.29	10.13	10.25	3.22	3.33	1.65	1.73
B2F3	21.52	25.50	465.49	491.58	25.41	26.40	13.80	13.77	10.61	10.80	3.33	3.45	1.71	1.81
B3F1	18.84	21.30	344.55	361.27	19.78	20.25	11.46	10.77	6.74	6.95	2.45	2.68	1.46	1.45
B3F2	20.33	22.40	350.69	370.00	20.49	21.52	12.19	11.42	6.97	7.54	2.57	2.75	1.55	1.52
B3F3	18.59	21.80	361.50	380.37	20.87	22.44	12.77	12.06	7.45	8.10	2.67	2.85	1.61	1.58
$CD_{(0.05)}$	1.53	1.73	21.17	17.32	NS	NS	NS	NS	NS	NS	0.13	0.16	0.19	0.17

The highest berry weight (10.05 and 10.25 g), berry length (3.21 and 3.34 cm) and berry diameter (1.65 and 1.73 cm) was recorded with budload B_2. Among fertilizer levels, highest berry weight (8.98 and 9.41 g), berry length (2.99 and 3.15 cm) and berry diameter (1.76 and 1.81 cm) was recorded with fertilizer level F_3. Combination of B_2F_3 resulted in highest berry weight (10.61 and 10.80 g), berry length (3.33 and 3.45 cm) and berry diameter (1.71 and 1.81 cm) during both the years of study. The increase in berry weight and size may be due to higher bunch weight and size due to better photosynthesis and optimum supply and uptake of nutrients under these treatments. The results are inconformity with the findings of Fawzi *et al.* (4) and Abd El-Razek *et al.* (2).

Data on response of bud load and fertilizer levels and their interaction on berry juice percentage, TSS, titrable acidity, total sugars, ascorbic acid and anthocyanin conent is presented in Table 3. Highest fruit juice (69.91 and 72.15 %) was recorded with budload B_2. Among fertilizer levels, highest fruit juice (68.18 and 69.63 %) was recorded with F_3. Combination of B_2F_3 resulted in highest fruit juice (71.31 and 73.08 %) during both the years under study. Higher berry juice in the present investigation may be due to the maximum berry weight with these treatments. Similar observation has been recorded by Gill and Sharma (5).

The maximum TSS (17.80 and 18.98 °Brix), total sugars (14.84 and 15.36 %) and lowest acidity (0.444 and 0.466%) was recorded with budload B_2. Among fertilizer levels, highest TSS (16.78 and 17.95 °Brix), total sugars (13.33 and 13.84 %) and lowest acidity (0.480 and 0.498%) was recorded with F_2. Combination of B_2F_2 interaction resulted in highest TSS (18.32 and 19.43 °Brix), total sugars (15.61 and 16.21 %) and lowest acidity (0.423 and 0.453%) in comparison to other treatments during both the years of study. This may be due to enhanced photosynthates production, more hydrolysis of polysaccharides into monosaccharides and increased catabolization of organic acids into sugars. These findings are in parallel with those of Fawzi (4) and Abd-EL Razek *et al.* (2) who reported increased TSS, total sugars and reduced acidity with increased in potash fertilzers.

Table 3. Effect of bud load, fertilizer level and their combinations on fruit chemical characteristics and benefit: cost ratio of grape cv. Sahebi.

Treatments	Juice %		TSS (°Brix)		Titrable acidity (%)		Total sugars (%)		Ascorbic acid (mg/100 g)		Anthocyanin (mg/100 g)		Benefit : cost ratio	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
B1	67.12	68.59	16.25	17.47	0.500	0.507	12.60	12.83	6.86	7.17	58.43	60.04	2.14	2.42
B2	69.91	72.15	17.80	18.98	0.444	0.466	14.84	15.36	8.90	9.32	65.47	68.94	2.87	3.17
B3	63.80	64.70	14.88	15.47	0.551	0.562	10.70	11.12	7.86	8.32	51.14	51.34	2.47	2.67
$CD_{(0.05)}$	1.32	1.37	0.45	0.53	0.04	0.03	1.75	1.67	NS	NS	1.12	1.15	-	-
F1	65.73	67.22	16.32	17.30	0.495	0.511	12.71	13.08	7.54	7.90	58.60	59.76	2.48	2.74
F2	66.92	68.60	16.78	17.95	0.480	0.498	13.33	13.84	7.83	8.27	61.23	63.15	2.61	2.88
F3	68.18	69.63	15.83	16.67	0.514	0.526	12.10	12.37	8.24	8.64	55.20	57.41	2.39	2.64
$CD_{(0.05)}$	1.27	1.29	0.13	0.13	0.01	0.01	0.58	0.73	NS	NS	1.18	1.20	-	-
B1F1	66.07	67.24	16.25	17.44	0.490	0.500	12.62	12.75	6.41	6.74	58.74	59.33	2.11	2.43
B1F2	67.18	68.69	16.68	18.06	0.476	0.486	13.19	13.61	6.90	7.19	61.31	63.53	2.20	2.64
B1F3	68.12	69.83	15.83	16.90	0.516	0.536	11.90	12.12	7.26	7.59	55.23	57.25	2.11	2.20
B2F1	68.87	71.13	17.85	18.99	0.450	0.466	14.83	15.39	8.60	8.95	65.91	68.94	2.84	3.13
B2F2	69.55	72.24	18.32	19.43	0.423	0.453	15.61	16.21	8.84	9.31	68.04	71.90	3.01	3.27
B2F3	71.31	73.08	17.22	18.51	0.460	0.480	14.08	14.47	9.25	9.69	62.47	65.99	2.76	3.13
B3F1	62.25	63.29	14.86	15.46	0.546	0.566	10.68	11.11	7.60	8.02	51.16	51.00	2.50	2.67
B3F2	64.04	64.85	15.35	16.35	0.540	0.556	11.19	11.71	7.75	8.30	54.36	54.03	2.63	2.75
B3F3	65.12	65.97	14.44	14.61	0.566	0.563	10.22	10.53	8.22	8.65	47.90	49.98	2.30	2.59
$CD_{(0.05)}$	1.51	1.55	0.49	0.57	NS	NS	1.89	1.71	NS	NS	1.20	1.22	-	-

Ascorbic acid content was not influenced by budload, fertilizer levels and their interactions. However higher ascorbic acid content was recorded with budload B_2 (8.90 and 9.32 mg/100 g), fertilizer level F_3 (8.24 and 8.64 mg/100 g) and combination of B_2F_3 (9.25 and 9.69 mg/100 g). Similar results were reported by Ingle *et al.* (8).

Budload B_2 resulted in significantly higher anthocyanin content in berries (65.47 and 68.94 mg/100 g). Among the fertilizer levels, F_2 had more anthocyanin accumulation (61.23 and 63.15 mg/100 g). Combination of B_2F_2 resulted in the highest anthocyanin accumulation (68.04 and 71.90 mg/100 g) in comparison to other interactions during both the years. The increase in anthocyanin content with these treatments may be due to better light penetration and more translocation of metabolites to the berries in vines with moderate budload and stimulation of the activity of phenylalanine ammonia lyase enzyme which is involved in anthocyanin synthesis. The results are inconformity with the findings of Mahfouz (11) and Singh (18). Benefit cost ratio was highest with budload B_2 (2.87 and 3.17), fertilizer dose F_2 (2.61 and 2.88) and B_2F_2 combination (3.01 and 3.27) in comparison to other treatment combinations during both the years.

From the present study, it is concluded that budload B_2 (128 buds/vine), fertilizer dose F_2 (FYM-50 kg/vine + 2 times recommended dose-NPK: 1110, 454, 940 g/vine) and their combination is the best for improving growth, yield and quality of grape cv. Sahebi with highest benefit : cost ratio.

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Received : August, 2017; Revised : July, 2018; Accepted : August, 2018