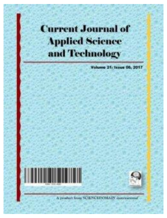

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Combined Influence of Bud Load and Micronutrients on Physico-chemical Traits of Grape cv. Sahebi

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Authors' contributions

This work was carried out in collaboration between all authors. Author AK performed the study, carried out the statistical analysis of the study and wrote the first draft of the manuscript. Authors NN, MKS, RB, KJ and SA designed and monitored the study and managed the analysis of the study. Author AK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The study on the combined influence of bud load and micronutrients on physicochemical traits of grape cv. Sahebi was carried out in model grapevine orchard of the Department of Horticulture at Kralbagh, Tehsil Lar Distt. Ganderbal (J&K) for two consecutive years to standardise the bud load and micronutrients application for improving physic-chemical traits in grape cv. Sahebi. The experiment consisted of 15 treatments with 3 levels of budload B_1 (96 buds/vine), B_2 (128 buds/ vine) and B_3 (160 buds/vine), 3 levels of micronutrients viz. M_1 (Solubor 0.1%), M_2 ($ZnSO_4$ 0.4%) and M_3 (Solubor 0.1% + $ZnSO_4$ 0.4%) applied two weeks before bloom and their 9 combinations (B_1M_1 , B_1M_2, B_1M_3, B_2M_1, B_2M_2, B_2M_3, B_3M_1, , B_3M_2, , B_3M_3) replicated thrice with a double plot size in a completely randomized block design. Among the different treatments budload B_2 (128 buds/vine) recorded maximum fruitful shoots, bunch length, berry length, total soluble solids /acid ratio and

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minimum shot berry percentage Maximum fruitful shoots, number of bunches, bunch diameter, berry length, berry diameter, total soluble solids/acid ratio, ascorbic acid and shot berry percentage was observed in micronutrient M_1 (Solubar-0.1%). The combination of B_2M_1 observed highest fruitful shoots, berry length, total soluble solids /acid ratio, ascorbic acid, and lowest shot berry percentage. Thus it was concluded that budload B_2 (128 buds/vine), M_1 (Solubor 0.1%) and their combination B_2M_1 proved to be the best for improving physico–chemical traits of grape cv. Sahebi.

Keywords: Budload; grape; micronutrients; sahebi; solubor; quality.

1. INTRODUCTION

Grape (*Vitis vinifera* L.) is one of the most favoured commercially grown fruit crops of the country. Grape cultivation is believed to have originated in Armenia near the Caspian Sea in Russia from where it seems to have spread westward to Europe and eastward to Iran and Afghanistan and was introduced into India in 1300 A.D. by Muslim invaders from Iran and Afghanistan. It is a fruit, rich in sugars, acids, minerals, vitamins and tannins. Major constituents of fruits are carbohydrates (15%), minerals (0.2-0.6%), organic acids (0.3-1.5%), nitrogenous compounds (0.03-0.7%), iron (0.003-0.017%), calcium (0.004-0.025%), potassium (0.15-0.25%), vitamin A (1-80 microgram), vitamin B complex (391-636 mg/100g) and vitamin C (1.0-12.5 mg/100 g). Tannins are present in skin and seeds of berries, which influence palatability of fruits and products. In India, the major grape growing states are Maharashtra, Karnataka, Andhra Pradesh, Punjab and Tamil Nadu and the bulk of the production is used for table purpose followed by raisin. In Jammu and Kashmir, grapes are grown in an area of 321 hectares with a production of 648 MT [1]) but the productivity of grape vines had been declining and has come down to a very low level. Further quality of grape is also poor when compared to other grape growing states of India. The possible reason is non-adoption of proper management practices particularly pruning and micronutrient application. The productivity and quality of grapes is dependent mainly on perfect pruning and nutrition. Maintaining proper budload plays an important role in sustaining the productivity for longer period of time. The purpose of pruning is to regulate or encourage good yield and to improve size and quality of fruit. Micro-nutrients e.g. B and Zn are those essential nutrient elements which are required in very small quantity but they have specific structural physiological and metabolic roles in the plant system. Boron is an important micro-nutrient governing many plant processes. It plays an important role in nitrogen metabolism, hormone movement and its action, sugar transport, cell wall synthesis and lignifications. It is also associated with Ca uptake and also increases permeability of the membrane. Zinc is an important nutrient for growth, flowering and quality of fruits. It is involved in the biosynthesis of the plant hormone, indoleacetic acid and it is a component of variety of enzymes such as carbonic anhydrase, alcohol dehydrogenase and also plays a role in nucleic acid and protein synthesis and helps in the utilisation of phosphorus and nitrogen.

In Kashmir, grapes are mainly confined to district Ganderbal where Sahebi is the most popular purple variety grown but grape vines in the area are not being managed on the scientific lines concerning budload, application of nutrients and other cultural techniques thus resulting in low yields of poor quality berries. Hence the present investigations were carried out to standardise the bud load and micronutrient application for optimum productivity and quality of grape cv. Sahebi.

2. MATERIALS AND METHODS

These investigations were carried out to assess the combined influence of bud load and micronutrients on physico-chemical traits of grape cv. 'Sahebi'(own rooted purple variety) in model grapevine orchard of the department of Horticulture at Kralbagh, Tehsil Lar District Ganderbal (J&K) for two consecutive years. Lar is located between 34.262^o North latitude and 74.765^o East longitude at an average elevation of 1650m (5410 ft) above mean sea level approximately. The study was conducted on 23-year old own rooted sahebi vines trained on bower system. The vines were planted at a distance of 14ft x15ft. Uniform set of cultural practices for irrigation, weed management and plant protection practices were followed throughout the investigation to keep the plant in healthy condition.

The soil status of the experimental orchard revealed that pH in surface layers ranged from 7.10-7.15 and in subsurface layers ranged from 7.21-7.36, electrical conductivity of the experimental orchard varied from 0.24-0.28 dSm^{-1} in surface layers and 0.13-0.24 dSm^{-1} in subsurface layers, organic carbon status ranged from 1.82-1.91 % in surface soil layers and 1.36-1.79 % in subsurface layers, the available nitrogen ranged from 327.4-347.4 kg/ha in surface layers and 314.2-336.5 kg/ha in subsurface layers, the available phosphorus status of the soil indicated a range of 14.2-17.7 kg/ha in surface layers and 9.6-16.1 kg/ha in sub-surface layers, the available potassium varied from 182.4-198.4 kg/ha in surface soil layers and 170.1-182.4 kg/ha in subsurface soil layers, the available calcium status varied from 4322-4433 kg/ha in surface layer and 4354-4483 kg/ha in subsurface layers, the available boron content of the soil was found in the range of 0.24-0.36 ppm in surface layers and 0.21-0.32 ppm in sub-surface layer. The DTPA extractable zinc content varied from 1.55-1.76 ppm in surface layers and 0.93-1.46 ppm in subsurface layers during the two years.

2.1 Treatments

The treatment consisted of 3 levels of budload (B_1-96 buds/vine, B_2 -128 buds/ vine and B_3-160 buds/vine), 3 levels of micronutrients viz. M_1 (Solubor 0.1%), M_2 ($ZnSO_4$ 0.4%) and M_3 (Solubor 0.1% + $ZnSO_4$ 0.4%) applied two weeks before bloom and their 9 combinations replicated thrice with a double plot size in a completely randomized block design.

2.2 Vegetative and Production Characteristics

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). 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 [2].

2.3 Fruit Physical Characteristics

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. 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. Berry L/D ratio was computed by dividing the average length of a berry by its average diameter. Seeds were extracted from 50 randomly selected berries in each replication. The seeds were counted and average number per berry was calculated.

2.4 Fruit Chemical Characteristics and Incidence of Shot Berry

Total soluble solids/acid ratio was obtained by dividing the total soluble solids value with titrable acidity. In order to calculate total soluble solids and acid ratio value, total soluble solids value and acid value was calculated separately. 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 total soluble solids 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., [3]). Titrable acidity was estimated by titrating a known quantity of homogenised juice against 0.1N NaOH solution using phenolphthalein as indicator [3] and was expressed in terms of tartaric acid. Quantitative determination of ascorbic acid was done by 2, 6-dichlorophenol indophenol visual titration method [4]. The percentage of shot berries was calculated by determining percentage of total number of shot berries on a bunch from total number of berries on a bunch [5] and [6]. The data generated were subjected to statistical analysis as per the procedures described by [7].

3. RESULTS AND DISCUSSION

Maximum percentage of fruitful shoots/vine was recorded in vines pruned to budload, B_2 (128 buds/vine) (45.33 and 46.43 %), micronutrient application, M_1 (Solubor-0.1%) (43.57 and 44.40 %) and B_2M_1 (45.55 and 45.33 %)-Table 1. Maximum percentage of fruitful shoots/vine recorded in budload, B_2 (128 buds/vine) is due to the fact that moderated vigor vines (less competition for food) are usually more fruitful because of optimum phosphorus level in vines, which is responsible for fruitfulness as depicted from leaf and fruit phosphorus in vines. Getting light into the canopy help form fruitful buds for the following year which rarely happened with the high bud load, therefore the greater vegetative shoots which obtained at a higher bud load decreased photosynthetic efficiency of grapevine. Highly shaded leaves can actually result in a net carbon loss as the rate of respiration can be greater than the carbon fixed through photosynthesis. In addition, shoots developing on exposed canes are generally more fruitful and exhibit better vegetative growth than shoots on shaded canes. The results are in agreement with those reported by [8] and [9]. Micronutrient M_1 (Solubor-0.1%) registered highest percentage of fruitful shoots/vine. This is because of role of boron in the metabolism of nitrogen biosynthesis, translocation of carbohydrates and fruiting process.These results are in conformity with the findings of [10,11] and [12].

Significantly highest percentage of vegetative shoots/vine was produced by bud load, B_3 (160 buds/vine)- (58.84 and 58.36%), micronutrient, M_2 ($ZnSO_4$-0.4%)- (56.91 and 56.04%) and B_3M_2 - (59.28 and 58.73 %). Vegetative shoots/vine followed an opposite trend to that of fruitful shoots/vine under the influence of bud load and micronutrient application. Maximum percentage of vegetative shoots/vine was registered in B_3 (160 buds/vine and M_2 ($ZnSO_4$ 0.4%) because of less percentage of fruitful shoots/vine recorded in these treatments. This is in line with the findings of) [8,12] and [13].

Maximum leaf area was recorded in vines pruned to 96 buds/vine-B_1 (203.28 and 212.01 cm^2) followed by 128 buds/vine-B_2 (181.46 and 186.35 cm^2), micronutrient, M_3 (Solubor-0.1% + $ZnSO_4$-0.4%)- (184.48 and 190.08 cm^2) followed by $M_{1,}$ (Solubor-0.1%)-(181.97 and 187.50 cm^2) and B_1M_3 combination (205.81 and 214.91 cm^2). Leaf area was maximum in budload B_1 (96 buds/vine) followed by B_2 (128 buds/vine). This is due to the fact that increased budload linearly reduces leaf formation, internode elongation and leaf surface expansion. Also light appears to be of primary importance and strong leaves are found in areas of canopy with relatively high light levels. This is in conformity with the findings of [8,14] and [15]. With regard to micronutrients, treatment M_3 (Solubor-0.1% + $ZnSO_4$-0.4%) recorded highest value of leaf area followed by M_1 (Solubor-0.1%). Boron has a direct effect on plant tissue growth via cell wall development (toughness and firmness) and protein synthesis. Zinc also increases the source of energy used in producing chlorophyll and preparing the joined enzymes in the active operation especially in generating chlorophyll and increasing surface area of leaves. The results are in agreement with the reports [12] and [16].

Budload B_3(160 buds/vine) recorded maximum no. of bunches/vine (54.69 and 58.95) followed by budload, B_2-128 buds/vine (48.14 and 53.87). Maximum number of bunches/vine was recorded in micronutrient M_1 (Solubor-0.1%)-(49.39 and 53.60) and B_3M_1 combination (55.81 and 59.65). Number of bunches/vine was maximum in B_3 (160 buds/vine) followed by B_2 (128 buds/vine) because as the budload increased, the number of bunches/vine also increased. This is due to the reason that as number of buds retained on a vine is increased, number of bunches formed on a vine also increases. This is in line with the findings of [9] and [17]. Maximum number of bunches/vine obtained in micronutrient M_1 (Solubor-0.1%) is due to the role of boron in flower set, pollen viability, germination, fertilization, fruitset and reduced fruit drop. This is in conformity with the findings of [11,12] and [18].

Higher yield was produced in bud load, B_2 (128 buds/vine)- (21.73 kg/vine and 25.23 kg/vine, micronutrient, M_1 (Solubor-0.1%). - (19.78 and 22.81 kg/vine) and B_2M_1 (22.20 and 25.93 kg/vine). The yield was maximum in bud load B_2 (128 buds/vine) which may be attributed to increasing in both number of clusters/vine and cluster weight in this treatment. This is in parallel with the findings of [9]), [10] and [17] and Maximum yield was reported by the foliar application of micronutrient M_1 (Solubor-0.1%). This increase in yield may be because of better flower set, improved pollen viability, germination and fertilisation, better fruit set, reduced fruit drop, increase in the berry size and reduction in shot berries. These results are in agreement with the findings of [19].

Maximum bunch length was exhibited by budload, B_2 (128 buds/vine)- 24.65 and 25.64cm,

Table 1. Influence of buload level, micronutrients and their combinations on vegetative characteristics and yield of grape cv. Sahebi

Treatments	Fruitfull shoots per vine (%)		Vegetative shoots per vine (%)		Leaf area (cm^2)		No. of bunches		Yield (Kg)	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
B_1	43.48	44.41	56.52	55.59	203.38	212.01	42.98	45.72	16.76	19.50
B_2	45.33	46.43	54.67	53.57	181.46	186.35	48.14	53.87	21.73	25.23
B_3	41.16	41.64	58.84	58.36	161.06	163.83	54.69	58.95	19.25	21.82
$CD_{(0.05)}$	0.11	0.10	0.13	0.14	2.43	2.57	2.45	1.98	1.45	0.81
M_1	43.57	44.40	56.43	55.61	181.97	187.5	49.39	53.60	19.78	20.11
M_2	43.09	43.96	56.91	56.04	179.35	184.61	47.80	52.12	18.73	18.92
M_3	43.31	44.14	56.69	55.86	184.48	190.08	48.62	52.81	19.23	19.46
$CD_{(0.05)}$	0.13	0.11	0.10	0.12	1.43	1.57	0.15	0.12	0.15	0.17
B_1M_1	43.60	44.55	56.40	55.45	202.96	211.86	43.59	46.61	17.27	20.11
B_1M_2	43.43	44.34	56.57	55.66	201.05	209.26	42.16	44.89	16.22	18.92
B_1M_3	43.42	44.35	56.58	55.65	205.81	214.91	43.19	45.66	16.79	19.46
B_2M_1	45.55	45.33	54.45	53.42	181.27	186.52	48.76	54.55	22.20	25.93
B_2M_2	45.13	44.93	54.87	53.74	179.16	184.05	47.62	53.04	21.29	24.45
B_2M_3	45.31	45.14	54.69	53.54	183.95	188.48	48.03	54.01	21.69	25.30
B_3M_1	41.56	42.05	58.44	57.95	161.68	164.13	55.81	59.65	19.87	22.38
B_3M_2	40.72	41.27	59.28	58.73	157.84	160.52	53.62	58.42	18.68	21.43
B_3M_3	41.19	41.61	58.81	58.39	163.66	166.85	54.65	58.76	19.22	21.64
$CD_{(0.05)}$	0.18	0.13	0.19	0.20	2.75	2.83	2.52	2.13	1.48	1.68

Table 2. Influence of buload level, micronutrients and their combinations of bunch and berry physical characteristics of grape cv. Sahebi

Treatments	Bunch length (cm)		Bunch diameter (cm)		Berry length (cm)		Berry diameter (cm)		Berry L/D ratio		No. of seeds	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
B_1	22.13	23.69	14.61	14.72	2.87	3.05	1.88	1.95	1.485	1.566	2.55	2.36
B_2	24.65	25.64	13.44	13.25	3.21	3.34	1.65	1.73	1.837	1.934	2.92	2.73
B_3	20.38	21.40	12.14	11.42	2.57	2.76	1.54	1.52	1.670	1.819	2.18	2.03
$CD_{(0.05)}$	0.12	0.10	NS	NS	0.10	0.13	NS	NS	NS	NS	NS	NS
M_1	22.37	23.59	13.55	13.31	2.92	3.08	1.72	1.76	1.656	1.760	2.59	2.44
M_2	22.65	23.85	13.40	13.12	2.88	3.05	1.68	1.73	1.666	1.771	2.55	2.36
M_3	22.74	23.30	13.23	12.95	2.84	3.02	1.66	1.70	1.669	1.788	2.51	2.33
$CD_{(0.05)}$	0.14	0.13	0.06	0.08	0.01	0.01	0.01	0.02	NS	NS	NS	NS
B_1M_1	22.10	23.69	14.77	14.87	2.90	3.08	1.92	1.99	1.472	1.553	2.55	2.44
B_1M_2	22.39	23.89	14.62	14.73	2.87	3.06	1.87	1.95	1.493	1.570	2.55	2.33
B_1M_3	21.90	23.48	14.45	14.54	2.84	3.02	1.85	1.91	1.491	1.576	2.55	2.33
B_2M_1	24.64	25.65	13.55	13.43	3.25	3.37	1.67	1.76	1.835	1.918	3.00	2.77
B_2M_2	24.95	25.91	13.44	13.25	3.21	3.35	1.64	1.73	1.842	1.932	2.88	2.77
B_2M_3	24.36	25.36	13.32	13.09	3.15	3.31	1.62	1.70	1.834	1.954	2.88	2.66
B_3M_1	20.37	21.42	12.34	11.63	2.60	2.78	1.56	1.54	1.663	1.811	2.22	2.11
B_3M_2	20.61	21.75	12.16	11.39	2.56	2.76	1.54	1.52	1.664	1.811	2.22	2.00
B_3M_3	20.16	21.04	11.93	11.23	2.53	2.73	1.51	1.49	1.682	1.834	2.11	2.00
$CD_{(0.05)}$	0.18	0.14	0.19	0.24	0.11	0.07	NS	NS	NS	NS	NS	NS

micronutrient M_2 ($ZnSO_4$-0.4%)-(22.65 and 23.85cm) followed by micronutrient M_1, Solubor-0.1% (22.37 and 23.59 cm) and combination B_2M_2 -(24.95 and 25.91 cm)-Table 2. Highest bunch length was observed in budload B_2 (128 buds/vine) followed by B_1 (96 buds/vine). This is due to an adequate number of canes in this treatment which received sufficient supply of food materials like carbohydrates, proteins and minerals. The results of this connection agree with those obtained by [9]. Bunch length was found to be highest by the application of micronutrient M_2 ($ZnSO_4$-0.4%) followed by M_1 (Solubor-0.1%). This may be due to the fact that Zn plays an important role in increasing fruitset which may have resulted in larger bunches. Increased uptake of nitrogen by boron application may have resulted in more photosynthetic activity by way of enhanced leaf area which may have increased the bunch length. These results are in agreement with the findings of [20] and [21].

Budload recorded non-significant influence on bunch diameter. Similar results were obtained by [8,22] and [23] Vines receiving micronutrient M_1 (Solubor-0.1%) recorded maximum bunch diameter (13.55 and 13.31 cm). The combined effect between budload and micronutrients showed that maximum bunch diameter was recorded in B_1M_1 (14.77 and 14.87cm). Micronutrient M_1 (Solubor-0.1%) recorded maximum bunch diameter which is because boron is involved in increasing the fruitset, enhancing the uptake of nutrients, increasing the chlorophyll content and consequently increasing the photosynthetic activity. These findings are in agreement with those of [20] and [21].

Significantly maximum berry length was recorded in budload, B_2 (128 buds/vine)- (3.21 and 3.34cm), M_1 (Solubor-0.1%)-(2.92 and 3.08cm) and B_2M_1 (3.25and 3.37cm). Budload B_2 (128 buds/vine) recorded highest value of berry length. This may be due to optimum fruitload in this treatment as a result of which the food material available reached the individual fruit in sufficient quality. This may also be due to better development of berries on shoots exposed to optimum light. Length of berry was increased under the micronutrient M_1 (Solubor-0.1%). This increase in berry length could be related to more growth produced by vines which received boron application. Similar response was observed by [10] and [12].

There was no significant effect of budload on berry diameter. This is in accordance with the findings of [8,23,24] and [25]. Highest berry diameter (1.72 and 1.76cm) was recorded in micronutrient, M_1 (Solubor-0.1%) treated vines. Budload and micronutrient revealed a non-significant effect on berry diameter. Vines treated with micronutrient M_1 ((Solubor-0.1%) registered highest berry diameter due to an enhanced supply of food material by way of increased leaf area due to boron. These results are in agreement with the findings of [12,26] and [27].

The main effect, as well as interaction effect of budload, fertiliser dose and micronutrients, had no significant influence on berry L/D ratio in both years of study. As length/diameter ratio indicates fruit shape which infact is a characteristic genetic feature of a genotype and cannot be easily altered by external factors like budload, fertilizer and micronutrients. Similar results have been reported by [8] and [28].

The main effect and the interaction effect of budload and micronutrients had a non-significant influence on a number of seeds/berry. These results are in line with the findings of [29,30] and [31].

Budload produced the minimum percentage of shot berry, B_2 (128 buds/vine)- (10.46 and 10.00%), micronutrient M_1 (Solubor-0.1%)-(14.14 and 13.33%) and B_2M_1 -(10.02 and 9.60%) treatment-Table 3. Minimum percentage of shot berries observed in budload B_2 (128 buds/vine) may be due to high fruitfulness as well as adequate nutrition to the berries as a result of optimum photosynthesis in this treatment. Similar results have been obtained by [24]. Micronutrient M_1 ((Solubor-0.1%) recorded minimum percentage of shot berry. The decrease of shot berries due to boron may be due to better pollination, germination and fertilization of ovules. These results are in conformity with the findings of [32,33] and [34].

Maximum total soluble solids/acid ratio was noticed in budload B_2 (128 buds/vine)- (40.17 and 40.72), micronutrient M_1 (Solubor-0.1%)-(34.30 and 35.13) and B_2M_1-(41.51 and 41.30). The effect of budload B_2 (128 buds/vine) on total soluble solids/acid ratio was found to be most significant as this treatment recorded highest value of total soluble solids and lowest value of acidity. These results are in accordance with [24] and [9]. Micronutrient M_1 ((Solubor-0.1%) which was statistically at par with micronutrient M_3 ((Solubor-0.1% + $ZnSO_4$-0.4%) recorded maximum total soluble solids /acid ratio. This

Table 3. Influence of fertilizer level, micronutrients and their combinations on Incidence of shot berry and berry chemical characteristics

Treatments	Shot berry (%)		Total soluble solids /acid ratio		Ascorbic acid (mg/100 g)	
	1st year	2nd year	1st year	2nd year	1st year	2nd year
B_1	14.45	13.45	32.93	34.50	6.86	7.17
B_2	10.46	10.00	40.17	40.72	8.90	9.32
B_3	18.86	17.83	27.03	28.15	7.86	8.32
$CD_{(0.05)}$	2.31	2.28	2.01	1.97	NS	NS
M_1	14.14	13.33	34.30	35.13	7.87	8.30
M_2	15.05	14.18	32.44	33.36	7.76	8.15
M_3	14.58	13.76	33.40	34.87	7.98	8.37
$CD_{(0.05)}$	0.19	0.13	1.00	0.94	0.12	0.14
B_1M_1	14.30	12.99	33.83	35.35	6.86	7.25
B_1M_2	14.60	13.85	32.22	33.36	6.74	7.01
B_1M_3	14.43	13.51	32.75	34.80	6.97	7.26
B_2M_1	10.02	9.60	41.51	41.30	8.89	9.34
B_2M_2	10.92	10.38	38.35	39.53	8.78	9.22
B_2M_3		10.00	40.63	41.31	9.03	9.39
B_3M_1		17.41	27.56	28.74	7.86	8.31
B_3M_2		18.31	26.74	27.20	7.78	8.21
B_3M_3		17.78	26.80	28.50	7.93	8.45
$CD_{(0.05)}$		2.37	2.13	2.05	0.16	0.18

may be due to maximum total soluble solids and minimum acidity recorded in these treatments. This is in accordance with the findings of [35], [36] and [37].

Budload showed no significant effect on ascorbic acid [38] Also interaction effect of budload and micronutrients was non-significant in influencing ascorbic acid. Highest value of ascorbic acid (7.98 and 8.37 mg/100g) was recorded in vines treated with micronutrient, M_3 (Solubor-0.1% + $ZnSO_4$-0.4%) which was statistically at par with micronutrient, M_1: Solubor-0.1% (7.87 and 8.30 mg/100g). This improvement in ascorbic acid might be due to synthesis of its precursor glucose-6 phosphate during conversion of starch into sugars and by the catalytic influence of growth substances in the biosynthesis of ascorbic acid. This is in accordance with the findings of [39] and [40].

4. CONCLUSION

Thus it can be concluded from the present investigation that maintaining the budload, B_2 (128 buds/vine-16 canes with 8 buds on each cane) and applying micronutrient M_1 (Solubor-0.1%) were most effective in enhancing physico-chemical traits and minimising the incidence of shot berry in grape cv. Sahebi.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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