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Effect of Fertilizer and Micronutrients on Leaf and Fruit Mineral Status of Grapes cv. Sahebi

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ABSTRACT: Grapes occupy an important place among the fruit crops. However its productivity in Jammu and Kashmir state is low when compared to other major grape producing states. The main reason for this being the unscientific approach for grape cultivation and inadequate supply of macro as well as micro nutrients leading to reduced quality as well as quantity of the produce. Thus in order to given the proper recommendation of macro and micro nutrients in Grapes an experiment was conducted in model grapevine orchard of department of Horticulture at Kralbagh, Tehsil Lar, Ganderbal on 23-year old vines trained on bower system. Also the effect of these macro and micro-nutrients was assessed on leaf and fruit nutrient status of grapes cv. Sahebi. The treatment consisted of 3-levels of fertilizer doses (F_1=FYM 50 kg/vine + Recommended dose of NPK: 555, 227, 470g/vine, F_2=FYM 50 kg/vine+ 2 times recommended dose of NPK, F_3=FYM 50 kg/vine+ 3 times recommended dose of NPK) and micronutrient treatment also consisted of 3-levels viz, M_1: (0.1%) , M_2: $ZnSO_4$(0.4%), M_3: (0.1%)+$ZnSO_4$ (0.4%). Treatments and their combinations were replicated thrice with a double plot size in a completely randomized block design. Highest level of fertilizer dose, F_3 exhibited maximum leaf petiole nitrogen to the tune of 1.60 and 1.63% and also highest fruit nitrogen (1.083 and 1.158%) during the 2 years respectively. Micronutrient M_1 (-0.1%) registered maximum fruit nitrogen (1.040 and 1.106%), maximum leaf petiole phosphorus (0.401 and 0.429 %) as well as the fruit phosphorus (0.062 and 0.067 %) during the 2 year study respectively. Maximum leaf petiole phosphorus (0.419 and 0.447%) and fruit phosphorus content (0.063 and 0.068 %) was observed in fertilizer dose, F_2 in both the years. Highest leaf petiole potassium (1.98 and 2.09%) and fruit potassium (0.492 and 0.482 %) was recorded in fertilizer dose F_2 and the vines treated with micronutrient M_1 (-0.1%) recorded maximum leaf petiole potassium (1.87 and 1.96 %), highest fruit potassium content (0.481 and 0.470%) and also maximum leaf petiole boron (43.29 and 45.48 ppm) during 1st and 2nd year of study. During the two years, application of fertilizer dose, F_1 recorded highest leaf petiole calcium (1.30 and 1.32%) and boron (43.73 and 45.58ppm) respectively. Micronutrient, M_3 (-0.1% + $ZnSO_4$-0.4%) registered highest leaf petiole calcium (1.27 and 1.29%) during the two year study respectively. Fertilizer dose, F_2 applied to vines obtained maximum fruit calcium (0.036 and 0.038%) during the Ist and 2nd year of study. During the two years, fertilizer at medium dose, F_2 recorded highest value of fruit boron (8.77 and 9.14 ppm) respectively. Application of micronutrients to the vines revealed that micronutrient M_3 (-0.1% + $ZnSO_4$-0.4%) recorded maximum content of fruit boron (8.69 and 9.05ppm). Thus it can be concluded that fertilizer dose, F_2 (FYM-50 kg/vine + 2 times recommended dose-NPK: 1110, 454, 940 g/vine) and micronutrient, M_1 (Solubar-0.1%) proved to be the best in improving the leaf and the fruit nutrient status of grape.

Keywords: nutrients, fertilizer, leaf petiole, fruit mineral, Micronutrients on Leaf.

INTRODUCTION

Grape (*Vitis vinifera* L.) is one of the delicious as well as the most popular fruit. Besides it is a rich source of vitamins and minerals. Botanically grape is a berry, a non-climacteric fruit, grows on the deciduous and perennial woody vines and belongs to the genus *Vitis*. In India grapes are cultivated in an area of 140 thousand ha with a total production of 3041 thousand tons and productivity of 21.72 tons/ ha (Anonymous, 2019). In India grape is mostly grown in areas of Maharashtra, Karnataka, Andhra Pradesh, Punjab and Tamil Nadu. Maharashtra ranks first in production producing 62.7% of the total production of grapes. In Jammu and Kashmir, grapes cultivation is spread to the area of 332 hectares and the production of grapes in J&K is 1048 MT (Anonymous, 2018-19). As far as the grape productivity is concerned, it has been declining with coming years. Besides the quality production of grape is also declining when compared to other major producing states of India and the world. This is mainly because of unscientific methods of cultivation and inappropriate management practices particularly that of inadequate application of fertilizer and micronutrient. The supply of the mineral nutrients affects various aspects of vine growth and development and also enhance better quality production of the fruit. Besides grapes is also considered as a heavy feeder of mineral nutrients, particularly that of macronutrients (Nitrogen, Phosphorus and Potassium). Nutrient deficiency in grapes lead to reduced growth, yield as well as quality of the produce (Kumar *et al.*, 2015 and Mishra *et al.*, 2016). So there is a need to achieve higher production and productivity of grape by means of maintenance of proper nutrient dose and micronutrient management and thereby providing a package to the farmers for attaining high production and quality. Keeping all these aspects in mind, the present investigation was undertaken to assess the effect of fertilizers and micronutrients on the leaf and the fruit mineral status so as to give proper recommendation (for fertilizer and micronutrient dose) to the growers with the aim of obtaining higher yield as well as quality of the produce.

MATERIAL AND METHOD

The experiment was conducted in model grapevine orchard of department of Horticulture at Kralbagh, Tehsil Lar, Ganderbal. The experimental trees were 23-year old and were trained on bower system. The spacing between the vines was 14ft x15ft. The fertilizer treatment consisted of 3-levels of fertilizer doses (F_1=FYM 50 kg/vine + Recommended dose of NPK: 555, 227, 470g/vine, F_2=FYM 50 kg/vine+ 2 times recommended dose of NPK: 1110, 454, 940g/vine, F_3=FYM 50 kg/vine+ 3 times recommended dose of NPK: 1665, 681, 1410g/vine) and micronutrient treatment also consisted of 3-levels viz, M_1: solubor (0.1%) , M_2: $ZnSO_4$ (0.4%), M_3: solubor (0.1%) + $ZnSO_4$ (0.4%). Treatments and their combinations were replicated thrice with a double plot size in a completely randomized block design.

Fig. 1. An overview of experimental site.

For leaf nutrient analysis leaf petioles were collected according to the method described by Chapman (1964). About 50-60 number of leaves appearing at 5^{th} node (opposite to fruit cluster were collected after harvest. Petioles were separated from leaf blades and were decontaminated using two per cent teepol solution and 0.1N HCl followed by dip in distilled water and double distilled water in a series. The samples were first dried between the folds of blotting paper and then in a hot air oven 70±1°C until constant weight was reached. These samples were ground in Willey mill having stainless steel blades to pass through 1mm sieve and stored in an air-tight container. At the time of analysis, the ground samples were dried at 105°C for 5 minutes and then these samples were analysed for their nutrient constituents. For fruit nutrient analysis grape berry samples were first washed thoroughly in running tap and then in four successive containers containing 0.1N HCl, distilled water, distilled water and double distilled water. After washing, the fruits were sliced then air dried and later oven dried at 68^oC till a constant weight was obtained. The dried fruit samples were grounded and then kept in butter paper bags for nutrient analysis. Total nitrogen was determined by method described by Jackson (1973) using Micro-kjeldahl. For nitrogen, digestion was done using digestion mixture containing potassium sulphate, ferrous sulphate and copper sulphate in the ratio of 10:1:5. Concentrated sulphuric acid was used for nitrogen digestion. For phosphorus, potassium, calcium, zinc and boron digestion was carried using di-acid mixture. The di-acid was made by mixing nitric acid and perchloric acid in a ratio of 9:4. Vanado molybdo phosphoric yellow colour method (Jackson, 1973) was used for phosphorus determination. The colour intensity was measured at 440nm with the help of the spectrophotometer. Flame photometre was used for potassium content determination in petiole and fruit samples. E.D.T.A. method as described by Jackson (1973) was used determination of calcium. Atomic Absorption Spectrophotometer was used for zinc determination. For the estimation of boron, dry ashing of the leaf petiole and fruit material was done at 550^oC for three hours and the ash was taken in 10ml of 6.5N HCl (Chapman and Pratt, 1961). Boron determination was done by carmine method (Hatcher and Wilcox, 1950). For analysis and interpretation statistical methods described by Gomez and Gomez (1984) were followed with 5 per cent level of significance.

RESULTS AND DISCUSSION

Main effect of fertilizer dose had a significant influence on leaf petiole nitrogen during both the years of study whereas micronutrients had no significant effect on leaf petiole nitrogen (Table 1). Highest level of fertilizer dose, F_3 exhibited maximum leaf petiole nitrogen to the tune of 1.60 and 1.63% followed by fertilizer dose, F_2 and lowest fertilizer dose F_1 registered minimum leaf petiole nitrogen (1.45 and 1.46%) during two years respectively. The effect of different micronutrient levels on the leaf nitrogen was however found to be insignificant. The combined influence of micronutrient and fertilizer dose also showed non- significant influence on leaf petiole nitrogen in both years of study. The highest fruit nitrogen (1.083 and 1.158%) was obtained with fertilizer dose F_3 and lowest fruit nitrogen (0.958 and 1.014%) was recorded under fertilizer dose F_1 during the two years respectively. Micronutrient M_1 (solubor-0.1%) registered maximum fruit nitrogen (1.040 and 1.106%) and micronutrient M_3 (solubor-0.1% + $ZnSO_4$-0.4%) noticed minimum fruit nitrogen (1.003 and 1.060%) during 1^{st} and 2^{nd} respectively. This is because of higher nitrogen availability, as a result of which more nitrogen is translocated from root to other parts of tree leading to higher accumulation in leaves and fruits. These results are in conformity with the findings of Mohamed (2018), Mehmood (2003) and Abd El-Razek *et al.* (2011). The fruit N content was effected significantly by micronutrients and was found to be maximum by the application of micronutrient M_1 (solubor-0.1%). These results are in conformity with the findings of (Ekbic *et al.*, 2018), Mehmood (2003) and Abd El-Razek *et al.* (2011).

Perusal of the data in Table-1 revealed that both the factors (fertilizer dose and micronutrients) had a significant influence on leaf petiole phosphorus during both the years of study. Different fertilizer doses also had a significant influence on leaf petiole phosphorus. Maximum leaf petiole phosphorus (0.419 and 0.447%) was observed in fertilizer dose, F_2 and the minimum (0.363 and 0.392%) was recorded in fertilizer dose, F_1 in 1^{st} and 2^{nd} year of study respectively. Micronutrient, M_1 (solubor-0.1%) recorded maximum leaf petiole phosphorus (0.401 and 0.429 %) during 1^{st} and 2^{nd} respectively but in 2^{nd} year, it was non-significantly followed by micronutrient, M_3: solubor-0.1% + $ZnSO_4$-0.4% (0.419%) whereas micronutrient M_2 ($ZnSO_4$-0.4%) noticed minimum leaf petiole phosphorus (0.385 and 0.408%) during the two years respectively. Interaction effect of micronutrient and fertilizer dose revealed a non-significant effect on leaf petiole phosphorus content during both the years of study. The reason for this could be synergistic effect of boron with nitrogen. These results are in agreement with Jovanovic (1972), Neeraj (1975), Singh (1988) and Azad (1999). The fruit phosphorus was observed to be maximum (0.063 and 0.068%) in fertilizer, F_2 and minimum (0.056 and 0.059%) in fertilizer dose F_1 during the two years. The highest fruit phosphorus (0.062 and 0.067%) was noticed in micronutrient M_1 (solubor-0.1%) during 1^{st} and 2^{nd} year but in 1^{st} year it was statistically at par with micronutrient, M_3: solubor - 0.1% + $ZnSO_4$-0.4% (0.060%). Lowest fruit phosphorus (0.057 and 0.060%) was noted in micronutrient M_2 ($ZnSO_4$-0.4%) during the two years respectively. The combined application of micronutrients and fertilizers had no significant effect on fruit phosphorus during both the years. The possible increase of phosphorus content in the plants leaves is due to increased mobility of phosphorus under higher rates of phosphorus application. These findings are in agreement with Mohamed (2018) and Mehmood (2003). However this is not in conformity with Ekbic *et al.*, (2018) who reported high leaf phosphorus content with increase boron doses.

Different fertilizer doses revealed significant difference in leaf petiole potassium during the two years of study. Highest leaf petiole potassium (1.98 and 2.09%) was recorded in fertilizer dose, F_2 and lowest leaf petiole potassium (1.64 and 1.71%) was noticed in fertilizer dose, F_1 during the two years respectively. Vines treated with micronutrient M_1 (solubor-0.1%) recorded maximum leaf petiole potassium (1.87 and 1.96 %) and micronutrient M_2 ($ZnSO_4$-0.4%) registered the minimum leaf petiole potassium (1.75 and 1.84 %) during 1^{st} and 2^{nd} year respectively.

Table 1: Effect of fertilizer and micronutrient application on leaf and fruit macronutrient content in grape cv. Sahebi.

	Nitrogen				Phosphorus				Potassium			
	Leaf petiole		Fruit		Leaf petiole		Fruit		Leaf petiole		Fruit	
Treatments	**1^{st} year**	**2^{nd} year**	**1^{st} year**	**2^{nd} year**	**1^{st} year**	**2^{nd} year**	**1^{st} year**	**2^{nd} year**	**1^{st} year**	**2^{nd} year**	**1^{st} year**	**2^{nd} year**
F_1	1.45	1.46	0.958	1.014	0.363	0.392	0.056	0.059	1.64	1.71	0.437	0.417
F_2	1.56	1.59	1.020	1.077	0.419	0.447	0.063	0.068	1.98	2.09	0.492	0.482
F_3	1.60	1.63	1.083	1.158	0.393	0.417	0.060	0.063	1.83	1.92	0.463	0.455
CD ($p \leq 0.05$)	**0.02**	**0.02**	**0.01**	**0.01**	**0.014**	**0.016**	**0.001**	**0.003**	**0.12**	**0.14**	**0.020**	**0.010**
M_1	1.55	1.58	1.040	1.106	0.401	0.429	0.062	0.067	1.87	1.96	0.481	0.470
M_2	1.50	1.54	1.018	1.084	0.385	0.408	0.057	0.062	1.75	1.84	0.447	0.424
M_3	1.53	1.57	1.003	1.060	0.390	0.419	0.060	0.063	1.82	1.92	0.466	0.461
CD ($p \leq 0.05$)	**NS**	**NS**	**0.01**	**0.01**	**0.008**	**0.010**	**0.002**	**0.002**	**0.04**	**0.03**	**0.011**	**0.008**
F_1M_1	1.47	1.49	0.976	1.030	0.374	0.403	0.058	0.063	1.70	1.78	0.453	0.436
F_1M_2	1.42	1.43	0.956	1.016	0.355	0.382	0.054	0.056	1.56	1.62	0.420	0.390
F_1M_3	1.45	1.47	0.943	0.996	0.362	0.391	0.056	0.060	1.65	1.73	0.440	0.426
F_2M_1	1.56	1.60	1.043	1.106	0.427	0.458	0.066	0.072	2.02	2.14	0.506	0.500
F_2M_2	1.53	1.57	1.020	1.076	0.416	0.435	0.061	0.063	1.93	2.04	0.477	0.456
F_2M_3	1.58	1.60	0.996	1.050	0.417	0.449	0.062	0.068	1.98	2.09	0.494	0.490
F_3M_1	1.64	1.66	1.100	1.183	0.4.2	0.426	0.063	0.065	1.89	1.98	0.483	0.473
F_3M_2	1.57	1.61	1.080	1.160	0.385	0.409	0.057	0.062	1.76	1.86	0.445	0.426
F_3M_3	1.58	1.63	1.070	1.130	0.392	0.417	0.061	0.063	1.83	1.93	0.463	0.466
CD ($p \leq 0.05$)	**NS**	**NS**	**0.02**	**0.04**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

The interaction effect between micronutrient and fertilizer dose recorded non-significant difference on leaf petiole potassium during the course of study. Fertilizer at medium dose F_2 recorded highest value of fruit potassium (0.492 and 0.482%) and fertilizer at low dose F_1 resulted in lowest value of fruit potassium (0.437 and 0.417%) during the two years respectively. Application of micronutrients to the vines revealed that micronutrient M_1 (solubor-0.1%) recorded maximum fruit potassium (0.481 and 0.470%) whereas, micronutrient M_2 ($ZnSO_4$-0.4%) resulted in minimum fruit potassium content (0.447 and 0.424%) during the two years respectively. High the nitrogen level, lower is the potassium content of leaves and fruits. This is because of antagonistic effect between nitrogen and potassium. However, higher the leaf potassium level, higher will be the potassium level in the fruits. Being mobile, potassium is effectively translocated from roots to leaves and fruits resulting in its higher accumulation. Higher levels of soil potassium application create a concentration gradient between potassium ion concentration inside the root and soil solution, which ultimately results in higher uptake of potassium by the plants. Besides phosphorus and potassium cause the permeability of leaf cells to increased (by twice almost) which ultimately result in more potassium accumulation. The results are in conformity with those of Mohamed (2018), Mehmood (2003), Rather (2006) and Abd El-Razek (2011). Also organic fertilizers are needed to be added as basal fertilizer so as to ensure that soil organic matter and micronutrients are supplied to the grapevines during their growing period (Garcia-Orenes *et al.*, 2016). The increase in potassium content due to solubor is due to synergistic effect of boron with potassium. This is in agreement with the findings of Bybordi and Malakouti (2005) and (Ekbic *et al.*, 2018).

Data presented in Table 2 indicated that percentage of leaf petiole calcium was significantly influenced by fertilizer dose and micronutrients in both the years of study. Application of fertilizer dose, F_1 recorded highest leaf petiole calcium (1.30 and 1.32%) which was non significantly followed by fertilizer dose, F_2 and F_3 fertilizer dose registered minimum leaf petiole calcium (1.18 and 1.15%) during 1^{st} and 2^{nd} respectively. Micronutrient, M_3 (solubor-0.1% + $ZnSO_4$-0.4%) registered highest leaf petiole calcium (1.27 and 1.29%) which was statistically at par with micronutrient M_1: solubor-0.1% (1.25 and 1.26%) whereas micronutrient, M_2 ($ZnSO_4$-0.4%) exhibited lowest leaf petiole calcium (1.20 and 1.21%) during 1^{st} and 2^{nd} year respectively. Fertilizer dose, F_2 applied to vines obtained maximum fruit calcium (0.036 and 0.038%) and fertilizer dose, F_3 registered minimum fruit calcium (0.030 and 0.033%) during 1^{st} and 2^{nd} year respectively.

Fig. 2. Grape vine and fruit cv. Sahebi treated with fertilizer dose-F_2 (FYM (50 kg/vine) + Recommended dose (NPK: 555, 227, 470 g/vine) and micronutrient-M_1 (Solubor-0.1%).

Table 2: Effect of fertilizer and micronutrient application on leaf and fruit micronutrient content in grape cv. Sahebi.

	Calcium				**Boron**				**Zinc**			
	Leaf petiole		**Fruit**		**Leaf petiole**		**Fruit**		**Leaf petiole**		**Fruit**	
Treatments	**1st year**	**2nd year**	**1st year**	**2nd year**	**1st year**	**2nd year**	**1st year**	**2nd year**	**1st year**	**2nd year**	**1st year**	**2nd year**
F_1	1.30	1.32	0.032	0.036	43.73	45.58	8.65	9.05	48.92	46.09	1.29	1.32
F_2	1.25	1.28	0.036	0.038	41.56	40.92	8.77	9.14	46.76	43.47	1.43	1.46
F_3	1.18	1.15	0.030	0.033	34.26	33.64	8.51	8.82	43.35	41.61	1.117	1.19
CD ($p \leq 0.05$)	**0.06**	**0.05**	**0.003**	**0.001**	**2.42**	**4.72**	**0.17**	**0.19**	**2.32**	**2.79**	**0.07**	**0.09**
M_1	1.25	1.26	0.035	0.040	43.29	45.48	8.65	9.01	43.15	41.76	1.25	1.28
M_2	1.20	1.21	0.030	0.032	36.20	34.30	8.60	8.96	48.52	45.52	1.36	1.34
M_3	1.27	1.29	0.033	0.035	40.06	40.35	8.69	9.05	47.36	43.89	1.28	1.32
CD ($p \leq 0.05$)	**0.03**	**0.04**	**0.001**	**0.002**	**3.26**	**2.37**	**0.04**	**0.06**	**NS**	**NS**	**NS**	**NS**
F_1M_1	1.31	1.32	0.035	0.040	48.62	52.47	8.66	9.05	46.02	42.95	1.26	1.27
F_1M_2	1.25	1.27	0.028	0.031	38.16	35.51	8.60	9.03	50.13	48.89	1.34	1.37
F_1M_3	1.33	1.36	0.033	0.036	44.41	48.76	8.69	9.06	50.61	46.43	1.28	1.32
F_2M_1	1.26	1.28	0.037	0.042	44.03	47.72	8.78	9.15	43.97	41.65	1.38	1.46
F_2M_2	1.21	1.24	0.034	0.034	39.44	33.46	8.73	9.05	48.89	44.59	1.51	1.45
F_2M_3	1.27	1.31	0.036	0.038	41.21	41.58	8.82	9.23	47.42	44.17	1.40	1.49
F_3M_1	1.19	1.17	0.034	0.039	37.22	36.26	8.51	8.82	39.46	40.68	1.12	1.16
F_3M_2	1.14	1.11	0.027	0.028	31.00	33.94	8.47	8.79	46.55	43.07	1.22	1.22
F_3M_3	1.22	1.19	0.030	0.033	34.56	30.72	8.56	8.84	44.04	41.08	1.17	1.18
CD ($p \leq 0.05$)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

The maximum fruit calcium (0.035 and 0.040%) was obtained with micronutrient M_1 (solubor-0.1%) and minimum fruit calcium (0.030 and 0.032%) was noticed in micronutrient M_2 ($ZnSO_4$-0.4%) during the two years respectively. Interaction effect of micronutrients and fertilizers exhibited a non-significant effect on fruit calcium during both the years. The failure of nitrogen application to increase the calcium content in leaf petiole and fruit may be related to the slow mobility of calcium in plant tissues (Mika, 1975). Application of nitrogen fertilizer that releases ammonia are known to affect calcium levels in various ways (Shear, 1975) e.g. conversion of ammonia to nitrate releases H^+ ions which affect the calcium concentration in the soil.

In addition ammonium ions can reduce calcium uptake through competitive absorption. This is in accordance with the findings of Singh and Singh (2002) and Rather (2006). Micronutrients resulted in increasing the content of Ca in leaf petiole and fruit because of the synergism of zinc and boron with calcium. These results are in line with those obtained by Bybordi and Malakouti (2005), Ganai (2006), Darzi (2010) and (Ekbic *et al.*, 2018).

It is apparent from Table 2 that leaf petiole boron was affected significantly by fertilizer dose and micronutrients. Highest leaf petiole boron (43.73 and 45.58ppm) was recorded in fertilizer dose, F_1 which was non significantly followed by fertilizer dose, F_2 (41.56 and 40.92 ppm) and lowest leaf petiole boron

(34.26 and 33.64 ppm) was noticed in fertilizer dose, F_3 during 1st and 2nd year respectively. Application of micronutrient M_1 (0.1%) recorded maximum leaf petiole boron (43.29 and 45.48 ppm) during 1st and 2nd year respectively but in 1st year, it was non significantly followed by micronutrient, M_3: solubor -0.1% + $ZnSO_4$-0.4% (40.06ppm). Minimum leaf petiole boron (36.20 and 34.30 ppm) was registered in micronutrient M_2 ($ZnSO_4$-0.4%) during the two years respectively. Interaction effect of micronutrients and fertilizers had shown a non-significant influence on leaf petiole boron in both years of study. Fertilizer at medium dose, F_2 recorded highest value of fruit boron (8.77 and 9.14 ppm) which was followed non significantly by fertilizer dose F_1 (8.65 and 9.05 ppm) and fertilizer at high dose F_3 resulted in lowest value of fruit boron (8.51 and 8.82ppm) during the two years respectively. Application of micronutrients to the vines revealed that micronutrient M_3 (solubor-0.1% + $ZnSO_4$-0.4%) recorded maximum content of fruit boron (8.69 and 9.05ppm) which was non- significantly followed by micronutrient, M_1: solubor -0.1% (8.65 and 9.01 ppm) whereas, micronutrient M_2 ($ZnSO_4$-0.4%) resulted in minimum fruit boron (8.60 and 8.96 ppm) during both the year respectively. This is because boron content of leaves is reduced by heavy nitrogen fertilization and also by high phosphate fertilization, whereas application of potash fertilizers has been found to have no significant effect on boron (Labanauskas *et al*., 1958). Similar findings were also reported by Peryea *et al.*, (2003), Xuan *et al*., (2003) and Ganai (2006) who reported that increasing boron content of fruit tree with the application of boron. Also Bybordi and Malakouti (2005) reported the combined application of B and Zn increased the boron content in almond leaves as both B and Zn have the synergistic effect with boron.

Persual of the data (Table 2) revealed significant effect of fertilizer dose on leaf petiole zinc. It was noticed that fertilizer dose, F_1 recorded the highest leaf petiole zinc (48.92 and 46.09 ppm) which was statistically at par with fertilizer dose, F_2 (46.76 and 43.47 ppm) and fertilizer dose, F_3 registered lowest leaf petiole zinc (43.35 and 41.61ppm) during 1st and 2nd year respectively. Micronutrient dose exerted a non significant influence on leaf petiole zinc. The combined influence of micronutrients and fertilizers showed no significant effect on leaf petiole zinc during the two years. The fertilizer dose significantly effected fruit zinc content during the 2 years. Highest fruit zinc (1.43 and 1.46 ppm) was recorded in fertilizer dose F_2 and lowest fruit zinc (1.17 and 1.19ppm) was observed in fertilizer dose F_3 during the two years. This is because heavy nitrogen and phosphorus fertilization significantly reduces the zinc content whereas potassium fertilizers has no effect on zinc (Labanauskas *et al*., 1958 and Kumar and Tomar 1978). Different levels of micronutrients as well as interaction effect of micronutrients and fertilizers exhibited a non-significant effect on fruit zinc content. However these results are contradictory to Ekbic *et al*., (2018) and Gunes *et al.*, (2015), as they reported increase in leaf zinc concentrations with increasing boron doses.

CONCLUSION

Thus it can be concluded from the present investigation that applying the fertilizer dose, F_2 (FYM-50 kg/vine + 2 times recommended dose-NPK: 1110, 454, 940 g/vine) and micronutrient M_1 (solubor -0.1%) were most effective in improving fruit and the leaf mineral status of grape cv. Sahebi. In future fertigation schedules with these recommended doses need to be standardized. Also further research is needed to compare between the efficacy of fertilizers applied through irrigation water (fertigation) with that of conventional method (direct soil application) in grapes.

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