Madras Agric. J. 89 (10-12) : 651-654 October-December 2002

https://doi.org/10.29321/MAJ.10.A00280

Effect of sources, levels and methods of boron application on nutrition of grapes (*Vitis vinifera*) cv. Muscat

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Abstract: A field experiment was conducted at Mathampatti, Coimbatore on Muscat grapes during 2000-2001 to find out the effect of B application on the petiole nutrient content of grapes. The results revealed that soil application of 2.0 kg B ha^{-1} plus 0.2 per cent spray enhanced the content of N, P, K, B, Cu and Zn in the petiole. Among the sources, agribor was prominent in enhancing the N, K, B and Zn content in the petiole.

Key words:* *Grapes, Agribor, Borax, Petiole content.

Introduction

Grape is one of the commercially important fruit crops of the country and occupies an area of 0.4 lakh hectares with a production of 9.4 lakh tonnes in India. Muscat is an important cultivar in Tamil Nadu. Many workers studied the petiole nutrient status of the grapes (Khetawat and Vashishta, 1978; Mielke Eugene, 1980) in seedless varieties. Farmers' practice of taking continuous crop resulted in micro nutrient deficiency. Petiole opposite to flower cluster is used as an index for nutrition analysis. Information regarding the effect of B on the petiole nutrient content is lacking under local conditions in Muscat variety. The present study was undertaken at Tamil Nadu Agricultural University, Combatore to study the effect of B on the petiole nutrient content of grapes at full bloom stage.

Materials and Methods

The present study was carried out in a farmer's field at Mathampathi near Coimbatore during winter season 2000-2001 on the fully grown 3 1/2 year old Muscat grapevine. The soil was sandy loam with pH 8.2, organic carbon 1.1 per cent and available B 0.46 mg kg^{-1}. The experiment was laid out in a split plot design with 2 sources of B *viz.* S1 agribor, S2 borax/boric acid in main plots with 8 treatments in sub plots in each source comprising boron at 4 levels for soil application *viz.* 0.5, 1.0, 1.5 and 2.0 kg B ha^{-1}, two levels for combined application of soil and foliar @ 1.0 kg B + 0.2 % spray and 2.0 kg B + 0.2% spray and one purely foliar spray of 0.2% (three times) apart from control. Spray of boron was carried out using agribor or boric acid. Soil application of B thro' agribor or borax, was made at the time of fertilizer application after pruning while foliar spray was given at three stages *viz.* bud differentiation, full bloom and 15 days after full bloom. The B doses were supplemented with recommended doses of N, P, K at 260:160:600 g vine^{-1} respectively. The spacing adopted was 3.6 x 3 m^2. The petiole samples adjacent to flower cluster were collected at full bloom stage from each treatment and processed for analysis. The petioles were washed with 0.1 N HCl followed by double distilled water, dried and powdered in stainless steel willey mill and the samples were digested in diacid using sulphuric acid and perchloric acid (5:2) for nitrogen estimation by Microkjeldahl method (Humphries, 1956). Triple acid extract using nitric acid, sulphuric acid and perchloric acid (9:2:1) for the estimation of phosphorus by vanado-molybdo-phosphoric acid yellow colour method; K by flamephotometry; (Jackson, 1973); B by colorimetric estimation using Azomethine-H solution (Page *et al.* 1982); Ca by versenate method and micronutrients by atomic absorption spectrophotometer (Lindsay and Norvell, 1978).

Results and Discussion

Major nutrient content in the petiole

Application of boron significantly increased the concentration of all the three major nutrients in the petiole. Application of B in the form of agribor @ 2.0 kg ha^{-1} + 0.2% spray increased the petiole N content at full

Table 1. Effect of sources, levels and methods of B application on the major nutrient concentration (%) of petiole at full bloom stage (Grape-Muscat)

Teratment	N			P			K		
	S_1 Agri-bor	S_2 Borax/ Boric acid	Mean	S_1 Agribor	S_2 Borax/ Boric acid	Mean	S_1 Agribor	S_2 Borax/ Boric acid	Mean
T_1 Control	1.71	1.64	1.68	0.34	0.30	0.31	2.35	2.21	2.28
T_2 0.5 kg B ha^{-1}	1.80	1.72	1.76	0.37	0.32	0.34	2.44	2.27	2.35
T_3 1.0 kg B ha^{-1}	1.89	1.78	1.84	0.42	0.35	0.38	2.52	2.28	2.40
T_4 1.5 kg B ha^{-1}	1.98	1.82	1.90	0.45	0.38	0.41	2.61	2.34	2.47
T_5 2.0 kg B ha^{-1}	2.21	1.98	2.09	0.48	0.38	0.43	2.70	2.27	2.49
T_6 0.2% spray	1.98	1.86	1.92	0.44	0.37	0.40	2.62	2.36	2.49
T_7 1.0 kg B + 0.2% S	2.34	2.24	2.29	0.52	0.53	0.47	2.97	2.52	2.74
T_8 2.0 kg B + 0.2% S	2.37	2.28	2.32	0.54	0.47	0.50	2.98	2.66	2.82
Mean	2.03	1.91	1.97	0.44	0.37	0.41	2.65	2.36	2.51
	S	T	SxT	S	T	SxT	S	T	SxT
SEd	0.029	0.047	0.069	0.023	0.030	0.421	0.018	0.038	0.054
CD (P=0.05)	0.07	0.09	NS	0.07	0.60	NS	0.04	0.08	NS

S = Spray

Table 2. Effect of sources, levels and methods of B application on the Ca, B and Zn content of petiole at full bloom stage (Grapes-Muscat)

Teratment		Ca(%)			B (mg kg^{-1})			Zn (mg kg^{-1})		
		S_1 Agribor	S_2 Borax/ Boric acid	Mean	S_1 Agribor	S_2 Borax/ Boric acid	Mean	S_1 Agribor	S_2 Borax/ Boric acid	Mean
T_1	Control	1.86	1.85	1.85	179	167	173	35.6	34.5	35.0
T_2	0.5 kg B ha^{-1}	1.84	1.83	1.83	198	176	187	40.0	35.6	35.8
T_3	1.0 kg B ha^{-1}	1.80	1.80	1.80	207	185	196	37.4	35.5	36.5
T_4	1.5 kg B ha^{-1}	1.73	1.68	1.70	219	198	208	38.9	38.6	38.7
T_5	2.0 kg B ha^{-1}	1.76	1.77	1.76	224	202	213	40.7	40.8	40.8
T_6	0.2% spray	1.82	1.83	1.83	238	210	224	38.3	37.3	37.8
T_7	1.0 kg B+ 0.2% spray	1.60	1.61	1.60	246	214	230	40.1	39.4	39.9
T_8	2.0 kg B+ 0.2% spray	1.60	1.61	1.61	248	236	242	41.2	40.6	40.9
	Mean	1.75	1.75	1.75	220	199	209	38.5	37.8	38.1
		S	T	SxT	S	T	SxT	S	T	SxT
SEd		0.008	0.016	0.022	2.78	4.00	0.08	0.100	0.260	0.358
CD (P=0.05)		NS	0.03	NS	6.8	8.0	NS	0.25	0.52	NS

Table 3. Effect of sources, levels and methods of B application on Cu, Fe and Mn content (mg kg^{-1}) of petiole at full bloom stage (Grape-Muscat)

	Teratment	Cu (mg kg^{-1})			Fe (mg kg^{-1})			Mn (mg kg^{-1})		
		S_1 Agribor	S_2 Borax/ Boric acid	Mean	S_1 Agribor	S_2 Borax/ Boric acid	Mean	S_1 Agribor	S_2 Borax/ Boric acid	Mean
T_1	Control	110	110	110	197	195	196	54.6	54.5	54.5
T_2	0.5 kg B ha^{-1}	116	116	116	186	188	187	54.7	54.6	54.7
T_3	1.0 kg B ha^{-1}	116	116	116	194	192	193	54.5	54.5	54.5
T_4	1.5 kg B ha^{-1}	120	118	119	198	196	197	54.7	54.8	54.8
T_5	2.0 kg B ha^{-1}	123	124	124	203	201	202	55.8	55.9	55.8
T_6	0.2% spray	116	119	117	197	194	195	54.9	54.5	54.7
T_7	1.0 kg B+ 0.2% spray	124	125	125	201	204	202	56.8	56.2	56.3
T_8	2.0 kg B+ 0.2% spray	130	127	128	205	208	206	56.9	56.9	56.9
	Mean	119	119	119	197	197	197	55.3	55.2	55.3
		S	T	SxT	S	T	SxT	S	T	SxT
SEd		0.26	1.63	2.30	1.64	1.37	2.44	0.219	0.437	0.619
CD (P=0.05)		NS	3.2	NS	NS	2.7	NS	NS	0.87	NS

bloom stage (2.32%) and this might be due to the increased N availability seen in agribor appliction. This result is in accordance with the findings of Ateeque *et al.* (1992). As regards to the P content, the appliction of B in the form of agribor increased the P from 0.34% to 0.44%. Higher P noted in the B applied plants might be due to synergistic action of P and B and which is also evident from the findings of Biswas and Prasad (1991). It is reported that B application alters the permeability of plasmalemma at the root surface and as a result the P absorption by the crop is increased. The increase in the boron levels exercised a successive increase in the K content in the petiole (Table 1). Application of B through soil and foliar spray increased the K level to 2.82% while the control recorded the lowest (2.28%). The synergistic effect of B on K has also been brought out in the present investigation and among the sources, Agribor favoured the increase in petiole K in a larger magnitude compard to borax / boric acid. The results obtained by Yadav and Manchanda (1979) also supports the above finding.

Ca, B and Zn content in the petiole

Boron application significantly altered the petiole Ca, B and Zn content and the data are presented in Table 2. Increase in B levels showed a negative relationship with Ca content in the petiole. Among the treatments, T1 was comparable with T2 and T6. There was a marked reduction in the Ca content in the petiole in T4, T5, T7 and T8 and was lowest in the treatments T7 and T8 (1.61%) This is due to the antagonistic effect of B and Ca in the soil which has been reported by Patel and Golkiya (1986) and Sujatha (2000). Ca and B were reported to be relatively less mobile (Marschner, 1997). The uptake and translocation of B in the plants were reported to be unaffected by Ca supply (Yamanuchi, 1976).

Increasing the levels of B application increased the B content in the petiole. Among the sources, agribor registered higher B content in the petiole than borax / boric acid (Table 2). The highest value was at T8 (242 mg kg^{-1}) while the lowest in T1 (173 mg kg^{-1}) Similar trend of results was reported by Mahorkar and Patel (1987).

Petiole Zn was much influenced by B treatment. Among the levels of B, appliction of 2.0 kg B ha^{-1} as well as 2.0 kg B ha^{-1} along with foliar spray, exhibited higher values of 40.9 mg kg^{-1} while the lowest was recorded in control (35.0 mg kg^{-1}). The positive influence of agribor in registering higher Zn content in the petiole was more pronounced.

Cu, Fe and Mn content in the petiole:

The micronutrient content in the petiole (Table 3) was markedly influenced by the B application. Increasing levels of B application increased the Cu content in the petiole. Similar results were reported by Sabanayagam (1996). The highest value was recorded in T8 (128 mg kg^{-1}) while the lowest in control (110 mg kg^{-1}).

Cu content of the petiole indicated the cumulative effect of fungicide spray because of limited translocation of Cu from the leaf blade to the remaining parts and due to regular addition of fungicides. Increasing levels of B application registered an increase in the copper content in the petiole at both sources.

The iron content in the petiole was significantly increased due to soil application of boron and the differences among the lower levels of applied B with that of control were only marginal. The effect of B on the petiole Mn content was found to be only marginal. The Mn content ranged between 54.5 to 56.9 mg kg^{-1}. The higher dose of B application recorded an increase in the Mn content in the petiole while the lower doses were found comparable with the control.

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(Received : January 2002 ; Revised : June 2002)