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Yield and quality of grape *(Vitis vinifera)* cv. Muscat as affected by boron application

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Abstract : A field experiment was conducted with grapes cv.Muscat at Mathampatti, Coimbatore during summer and winter seasons of the year 2000-2001 to find out the effect of sources, levels and methods of B application on the yield and quality of grapes. The results revealed that combined application of 2.0 kg B plus 0.2 per cent foliar spray registered a maximum yield of 24.6 t ha^{-1} in winter and 26.15 t ha^{-1} in summer season. the B:C ratio was higher in agribor (3.54) while in borax and boric acid it was 3.37. The treatment 2.0 kg B+0.2 per cent spray helped to increase the brix and total sugar value of the berries and at the same time reducing the acidity.

Keywords : Grapes, Agribor, Borax, Yield, Quality.

Introduction

Proper mineral nutrition of a crop is one of the potential means for improving the yeild and quality to sustain crop production and thereby fertility of the soil is maintained. Intensive cultivation of vineyards resulted in micronutrient deficiencies. (Takkar and Randhawa, 1978). Though B is present in sufficient amount in the soil because of high pH, it is not available to plants. Application of Borax / boric acid resulted in a serious damage to the crop when limits are exceeded. Therefore a new product, agribor containing 19% B suited both for soil and foliar spray was used in order to find out the optimum dose both for soil and foliar spray at Coimbatore agroclimatic conditions. Studies on the effect of B on yield and quality of Muscat grapes is lacking in this area. Hence, this study was taken up at Tamil Nadu Agricultural University, Coimbatore to study the effect of boron sources on the yield and quality of grapes.

Materials and Methods

The investigation was carried out during two seasons *viz.* winter and summer of the year 2000-2001 in the farmers field at Mathampathi near Coimbatore on 3 1/2 and 5 year old Muscat grape vines respectively. Muscat variety trained on pandal system received uniform cultural operations. The trial was laid out in a split plot design with main plot consisting of two sources S_1 (agribor) and S_2 (borax/boric acid) sub plot comprising of eight treatments *viz.* T_1- control, T_2-0.5 kg B ha^{-1}, T_3-1.0 kg B ha^{-1}, T_4-1.5 kg B ha^{-1}, T_5-2.0 kg B ha^{-1}, T_6-0.2% spray (3 times), T_7-1.0 kg B ha^{-1} + 0.2% spray (thrice), T_8-2.0 kg B ha^{-1} +0.2% spray (thrice). Each treatment was replicated thrice and the soil application of B was made at the time of pruning and foliar sprays were given thrice at bud differentiation stage, full bloom and 15 days after full bloom. An uniform dose of 260:160:600 g NPK $vine^{-1}$ was given to all the plots. The conventional chemical borax was suited for soil application while boric acid for foliar spray. However, the new chemical agribor suited both for soil as well as foliar spray was used to evaluate in comparison with conventional chemical. The soil was having a pH of 8.2 and available B content of 0.46 mg kg^{-1}. For calculating the yield, the ripened clusters in each vine were harvested and weighed. The quality of the fruit juice of the winter season experiment was assessed. Brix was recorded in hand refractometer, the total sugar as per the procedure given by Somogyi (1952) and acidity of the juice as per the method suggested by A.O.A.C (1980).

Results and Discussion

Total yield

The data revealed that under all the B treatments the yield was better than the control in the two seasons. The data are presented in the Tables 1 and 2. The yield varied from 20.09 to 24.6 t ha^{-1} in T_1 and T_8, respectively in winter season. During summer season also similar trends of results were obtained as that of winter season in which T_8 registered the highest fruit yield (26.15 t ha^{-1}). Treatments involving 0.2% foliar spray of boron had also registered a spectacular increase in the grapes yield over the control and its effect was almost comparable to that

Table 1. Effect of sources, levels and methods of B application on grapes yield (t ha^{-1})

Treatments	Winter season			Summer season		
	S_1 Agribor	S_2-Borax/ Boric acid	Mean	S_1 Agribor	S_2-Borax/ Boric acid	Mean
T_1- Control	19.99	20.09	20.09	19.76	18.00	18.88
T_2- 0.5 kg B ha^{-1}	21.07	22.16	21.62	23.67	20.30	21.98
T_3- 1.0 kg B ha^{-1}	21.13	19.10	20.41	23.09	20.26	21.68
T_4- 1.5 kg B ha^{-1}	21.35	20.92	21.13	24.07	20.70	22.38
T_5- 2.0 kg B ha^{-1}	20.42	24.96	22.69	25.36	23.67	24.51
T_6- 0.2% spray (Boric acid)	22.68	22.10	22.36	25.56	24.03	24.79
T_7- 1.0 kg B+0.2% (Boric acid) spray	24.78	23.95	24.37	26.17	24.20	25.18
T_8- 2.0 kg B+2.0% (Boric acid) spray	24.29	24.91	24.60	26.50	25.80	26.15
Mean	21.96	22.34	22.15	24.27	22.12	23.19
	S	T	SxT	S	T	SxT
SEd	0.88	1.55	2.88	2.88	1.96	1.99
CD (0.05)	NS	3.17	NS	NS	4.01	NS

of the highest dose of soil applied B *viz.* 2.0 kg B ha^{-1}. Combined application of 1 kg of B through agribor with 0.2 per cent spray as well as 2 kg B through borax plus 0.2 per cent spray were found to markedly increase the grape yield. Similar yield improvement due to B spray in the vines was reported by Prabhu (2000), Kumar an Bushan (1978) and Ezzilli (1994). The overall morphophysiological experession of vine due to B application through soil and foliage resulted in better photosynthates supply and translocation with efficient partitioning of assimilates resulting in the higher fruit yield.

Benefit cost ratio

The results on the benefit cost ratio of the pooled data of the both seasons are presented in Table 2. The benefit cost ratio was found to be reltively higher in agribor (3.54) than borax/ boric acid (3.37). Among the treatments, the combined application of 2.0 kg B ha^{-1} + 0.2% spray recorded higher benefit cost ratio in both the sources. In general, gradual increase in B:C ratio was observed with increase in the levels of applied boron under both the sources of B.

Brix, Total sugar and Acidity

It is clear from the Table 3, that the brix value recorded in T_8 and T_7 (24.6 and 24.3 respectively) were the highest over the control. Though the interaction effect was not significant, no consistent trend of results could be observed. This might be due to the favourable effects of B on the translocation of sugars in the fruits. Similar trend of results were reported by Dabas and Jindal (1985).

Total sugar content of the fruit was found to be higher in T_8 (20.16%) while lowest in the control T_1 (16.25%) (Table 3). While comparing the treatment under individual sources, agribor at 1.0 kg plus 0.2 per cent boric acid spray resulted in higher total sugar. This increase in sugar might be due to the fact that boron was known to increase the transportation of sugar and form sugar-borate complex (Gauch and Dugger, 1953). Similar trend of results were reported by Sanjay Kumar and Pathak (1992) and Ravel and Leela (1975).

Agribor application marginally lowered the acidity compared to boric acid. The treatment mean values ranged from 0.70 per cent (T_7) to 1.38 (T_1). Application of boron either through

Table 2. Benefit cost ratio in grapes for boron application

Treatment	Basic cost (Rs.)	Treatment cost (Rs.)	Total cost (Rs.)	Yield (t ha^{-1})	Income (Rs)	Net income (Rs)	Benefit cost ratio
Agribor							
T_1	50000	-	50000	19.88	198800	148800	2.98
T_2	50000	197	50197	22.37	223700	173503	3.46
T_3	50000	394	50394	22.11	221100	170706	3.39
T_4	50000	591	50591	22.71	227100	176509	3.49
T_5	50000	788	50788	23.38	233800	183013	3.60
T_6	50000	952	50952	24.12	241200	190248	3.73
T_7	50000	1346	51346	24.47	244700	193354	3.77
T_8	50000	1740	51740	25.39	253900	202160	3.91
						Average	3.54
Borax / Boric acid							
T_1	50000	-	50000	19.04	190400	140400	2.81
T_2	50000	225	50225	21.23	212300	162075	3.23
T_3	50000	450	50450	19.98	199800	149350	2.96
T_4	50000	680	50680	20.81	208100	157420	3.11
T_5	50000	909	50909	24.31	243100	192191	3.78
T_6	50000	870	50870	23.07	230700	179830	3.54
T_7	50000	1320	51320	24.08	240800	189480	3.96
T_8	50000	1779	51779	25.36	253600	201821	3.90
						Average	3.37

Cost Particulars

Basic cost (pruning, harrowing, fertilizer application, tipping, spraying of pesticides and fungicides and harvesting) = Rs. 50,000

Sale price of grapes fruit @ Rs. 10 kg^{-1}

Cost of Agribor @ Rs. 75 kg^{-1}

Cost of Borax @ Rs. 50 kg^{-1}

Cost of Boric acid @ Rs. 40 kg^{-1}

Benefit-cost ratio = Net income (Rs.) / Total cost (Rs.)

Spray charges

Single time spray = Rs. 250 / spray (for labour and rent of sprayer)

Spray fluid requirement @ 500 litres ha^{-1}

Cost of Agribor @ 0.1% for single spray = Rs. 35/spray

Cost of boric acid @ 0.1% for single spray = Rs. 20/spray

soil or foliar markedly reduced the acidity of the fruit juice. Micronutrient application might have accelerated the process of conversion of organic acids into sugar that is why B application might have resulted in reduced fruit acidity. Similar trend of results were reported by Ravel and Leela (1975).

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Table 3. Effect of sources, levels and methods of boron application on acidity (%), brix value and total sugar (%) of grapes

Treatment		Acidity (%)			Brix value			Total sugar (%)		
		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	Contorl	1.33	1.43	1.38	21.5	21.7	21.6	16.47	16.03	16.25
T_2	0.5 kg B ha^{-1}	0.98	1.23	1.10	22.7	24.4	23.3	17.10	16.93	17.02
T_3	1.0 kg B ha^{-1}	1.18	1.19	1.19	24.0	22.3	23.1	17.4	17.5	17.43
T_4	1.5 kg B ha^{-1}	1.00	1.07	1.04	23.1	22.6	22.8	17.53	16.87	17.20
T_5	2.0% kg B ha^{-1}	0.80	0.73	0.81	21.4	24.9	23.2	18.70	17.93	18.31
T_6	0.2% spray	0.86	0.73	0.80	23.5	24.4	23.8	18.70	18.17	18.43
T_7	1.0 kg+0.2%	0.72	0.68	0.70	24.8	23.9	24.3	20.40	19.36	19.90
T_8	2.0 kg+0.2%	0.75	0.72	0.73	24.2	24.9	24.6	19.60	20.47	20.16
	Mean	0.96	0.98	0.97	23.15	20.76	21.95	18.24	17.19	18.07
		S	T	SxT	S	T	SxT	S	T	SxT
SEd		0.03	0.10	0.15	0.54	1.07	1.51	0.191	0.146	0.271
CD (0.05)		NS	0.2	NS	NS	2.19	3.09	NS	0.29	0.86

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