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Effect of Zinc and Boron on growth and quality of grapes cv. Muscat

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Abstract : Soil and Foliar application of micronutrients viz. Zn and B applied either individually or in combination enhanced the growth and quality of six year old matured muscat grapes under irrigated conditions. Foliar application of $ZnSO_4$ 0.5 per cent + borax 0.2 per cent combination applied twice during vegetative and full bloom stages excelled others in increasing the shoot length number of internodes shoot^{-1}, number of leaves shoot^{-1} and quality characters with highest juice per cent, total soluble solids (TSS), total sugars, sugar / acid ratio and lowest acidity. *(Key Words : Muscat, Zinc, Boron, shootlength, TSS and Acidity)*

Despite the fact that the micronutrients have got definite effect on the growth and quality of grapes, much attention has not so far been given to this aspect of viticulture. Heavy cropping of grapes year after year on the same land has resulted in the removal of a large amount of macro and micronutrients and the soil have become impoverished from plant food. This is particularly true of micronutrients, which are rarely applied to the soil. The soil reserves are thus lowered which resulted in low yields of good quality fruit. Ultimately cropping on such land becomes uneconomical unless sufficient quantity of micronutrients are added to the soil or applied to the plant through foliar sprays. Muscat is the most ideal cultivar in Tamil Nadu. Many workers have reported positive effects of Zinc and Boron on growth and quality of grapes. Application Zn and B increased the growth (Volschenk *et al*, 1999 and Mahorker and Patel, 1987) in Thomson seedless. Application of Zn (0.4%), Mn (0.2%) and/or B (0.2%) increased juice percentage and TSS in Thomson seedless. Spraying of 0.4 per cent $ZnSO_4$ increased reducing and total sugars in cv. Perlette (Sanjaykumar and Pathak, 1992). Information regarding the effect of Zn and B nutrition on growth and quality are lacking under local conditions as far as Muscant grapes is concerned. Hence the present study was undertaken at Tamil Nadu Agricultural University, Coimbatore to study the effect of Zn and B nutrition on the growth and quality of grapes.

Materials and Methods

The present investigation was carried out in a farmer's field at Mathampatti during the year 1999-2000 on fully grown six-year-old Muscat grape vines. The vines are planted at 3 X 4.5 m on sandy loam soil with pH 8.1, organic carbon 0.52%, DTPA Zn 1.05 ppm and hotwatr soluble B 0.23 ppm. The experiment was laid out in a randomized block design having 12 treatments each replicated three times. The treatment details are as follows:

Treatment

T_1	Control
T_2	$ZnSO_4$ soil application 10 g vine^{-1}
T_3	$ZnSO_4$ soil application 20 g vine^{-1}
T_4	Borax soil application 4 g vine^{-1}
T_5	Borax soil application 8 g vine^{-1}
T_6	$ZnSO_4$ 10 g + Borax 4 g vine^{-1} soil application
T_7	$ZnSO_4$ 10 g + Borax 8 g vine^{-1} soil application
T_8	$ZnSO_4$ 20 g + Borax 4 g vine^{-1} soil application
T_9	$ZnSO_4$ 20 g + Borax 8 g vine^{-1} soil application
T_{10}	Foliar spray $ZnSO_4$ 0.5% - Two times
T_{11}	Foliar spray Borax 0.2% - Two times
T_{12}	$ZnSO_4$ 0.5% + Borax 0.2% foliar spray - Two times

In treatment T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, and T_9 the nutrients were applied in soil as basal dose and in treatments T_{10}, T_{11} and T_{12}, the nutrients were applied as foliar sprays twice during vegetative (20 days after pruning) and again at full bloom stage. Foliar spray was given in the morning hours between 6.00 to 9.00 A.M. using a rocket sprayer. The doses were supplemented with recommended doses of NPK 250,160 and 600 g vine^{-1} respectively. Growth observations were recorded in three stages as 30 days after pruning, 60 days after pruning and 90 days after pruning. Shoot length, number of internodes and number of leaves shoot^{-1} were recorded. For that five shoots in each treatment were selected at random and the measurements on shoot length were recorded duirng 30,60 and 90 days after pruning and expressed in centimeters. Yield of vines was recorded an actual weight basis. The ripened clusters were harvested, weighed and expressed in g. Ten clusters were selected randomly for recording various physical (bunch weight and berry weight) and chemical (TSS, reducing sugars and acidity) characteristics following the standard procedure of A.O.A.C. (1980).

Results and Discussion

Growth Characteristics

Shoot Length

Shoot length was observed 30 days after

pruning (DAP), 60 DAP and 90 DAP. The data are presented in Table-1. There was a significant increase in the shoot length with advancement from 30 DAP (44.71) to 90 DAP (74.64). Application of Zn and B either as soil or foliage significantly influenced the shoot length. The combined foliar application of $ZnSO_4$ 0.5 per cent and Borax 0.2 per cent (T_{12}) recorded the highest shoot length (66.32 cm). The control recorded the lowest shoot length (56.74). The interaction between stags and treatments was also significant at all the three stages.

Number of internodes

Significant differences in number of internodes shoot^{-1} couldbe established among the stages (Table-1). The number of internodes at stage III was more (24.15) than stage II (23.11) and stage I (14.98). There was much variation between stage I and stage II and there was slight variation between stage II and stage III in respect to number of internodes shoot^{-1}. But the variations among the stages were significantly differing from each other. Application of Zn and B either through soil or foliage, with or without combination significantly influenced the number of internodes shoot^{-1}. The higher number of internodes shoot^{-1} was recorded in T_{12} (21.98) followed by T_8 (21.85) and T_{10} (21.57). This might be due to the increased shoot length. The interaction between stages and treatments were found to be significant.

Number of leaves

The number of leaves as influenced by Zn and B application was evaluated and the data are presented in Table-1. There was a significant difference in number of leaves shoot^{-1} established among the stages. The trend was similar that of number of internodes shoot^{-1}. The number of leaves shoot^{-1} at stage III was more (26.61) than stage II (25.26) and stage I (17.30). Within the treatments, T_{12} recorded the highest number of leaves shoot^{-1} (24.32). There was a sisgnificant interaction between stages and treatments. The treatment T_{12} recorded the highest number of leaves shoot^{-1} (28.34) at stage III, whereas as the control recorded lowst number of leavs (16.76) at stage I. This results are in close agreement with the findings of Kumar and Bhusan (1978) and Volschenk *et al* (1999) who found that application of Zn and B increased the vigour and growth of grapevines.

Quality Characters

Juice percentage

Regarding juice percentage a significant increase was noted under all treatments than control (Table-2). Among the treatments, T_{12} gave the highest juice percentage (68%) and it was significantly better than all other treatments. According to Manchanda *et al* (1982) higher juice content could be obtained by micronutrient application and deficiency cause decrease in juice content.

Total soluble solids (TSS)

TSS content of fruits, which is considered as one of the important quality attributes exhibited a significantly positive effect due to application of Zn and B nutrition through foliage. The treatment (T_{12}) had the highst TSS (15.80° Brix) accounting 21.53 per cent increase over control. The control recorded the lowest TSS (13.00° Brix) which was significantly lower than all the treatments. This was supported by Daulta *et al* (1983) who obtained berries with high TSS content due to foliar spray of Zn (0.2 to 0.6%). Fe (0.1 to 0.4%) and/or boron (0.05 to 0.1%) at full bloom stage.

Reducing and Non-reducing sugars

The data on reducing sugar content in the fruits clearly indicated that Zn and B supplements altered the reducing sugars in fruits. The reducing sugar was significantly higher in T_{12} (8.95%) thus increasing the quality of the fruit further. The lowest reducing sugar was recorded in the treatment T_1. The high reducing sugar predominantly glucose rcorded due to Zn and B application might have been influenced by the micronutrients Zn, B, Fe and Mn which probably activated the enzyme responsible for photosynthesis thus resulting in synthesis and accumulation o monosaccharides particularly of glucose. Non-reducing sugars predominantly the sucrose conten increased significantly in the experiment by Zn and B application.

Total sugars

The data on total sugar content revealed a pattern similar to reducing sugar content. The treatment T_{12} registered higher values (11.92%) than the control (9.95%). This finding is in accordance with the results obtained by Yamdagni *et al* (1979) and by Sanjay Kumar and Pathak (1992).

Acidity

Application of Zn and B to grapevines significantly reduce the acidity and increase th quality. The acidity of the fruit was significantly reduced in treatment T_{12} (1.10%) with a reduction of 8.3 per cent over control. The highest acidity percentage was recorded in T_1 (1.20%). Similarly significant reduction in acidity recorded in this study was well supported by the work of Yamdagni *et al* (1979) and Bacha *et al* (1997).

Sugar / acid radio

Significant differences in sugar / acid ratio were observed due to Zn and B application through soil and foliage either alone or in combinations. Among the treatments, T_{12} recorded as the most effective in producing good quality fruits with increase in sugar / acid ratio (10.84). This produced 30.75 per cent increase in sugar / acid ratio over the control.

Table. 1 Effect of Zinc and Boron on shoot length, number of internodes and number of leaves

Treatments	Shoot length				No. of internodes				No.of.leaves			
	30 DAP	60 DAP	90 DAP	Mean	30 DAP	60 DAP	90 DAP	Mean	30 DAP	60 DAP	90 DAP	Mean
T_1-Control	41.6	60.9	67.5	56.7	16.7	22.2	23.2	20.7	14.5	20.3	21.0	18.6
T_2-ZnSO4 10 g vine^{-1}	45.0	69.3	73.1	62.5	17.8	25.6	26.5	23.3	14.9	23.1	24.0	20.6
T_3-ZnSO4 20 g vine^{-1}	45.1	68.5	73.6	62.4	17.2	25.0	26.3	22.8	14.9	23.0	23.5	20.5
T_4-Borax 4 g vine^{-1}	44.9	68.1	73.5	62.1	17.0	24.9	25.6	22.5	14.5	22.6	23.4	20.2
T_5-Borax 8 g vine^{-1}	43.9	65.9	70.9	60.2	16.8	23.9	25.2	22.0	14.6	21.9	23.1	19.8
T_6-T_2+T_4	45.1	70.1	75.9	63.7	17.5	25.7	27.6	23.6	15.0	23.4	24.3	20.9
T_7-T_2+T_5	44.5	69.1	75.2	62.9	17.5	25.1	26.6	23.1	15.1	23.1	23.6	20.6
T_8-T_3+T_4	47.8	70.9	78.0	65.6	18.0	26.0	28.2	24.0	16.0	23.9	25.5	21.8
T_9-T_3+T_5	45.3	68.2	73.8	62.4	17.7	24.9	26.3	22.9	15.6	22.7	23.9	20.7
T_{10}-Foliar spray $ZnSO_4$ 0.5%	44.2	71.9	78.1	65.0	17.0	25.9	28.6	23.6	14.7	23.9	25.9	21.5
T11-Foliar spray borax 0.2%	44.0	70.9	76.1	63.7	17.0	25.8	27.2	23.3	14.7	23.9	25.0	21.2
T_{12}-T_{10}+T_{11}	44.5	74.9	79.4	66.3	16.9	27.6	28.4	24.3	14.925.0	26.0	21.9	
Mean	44.7	69.1	74.6	17.3	25.2	26.1	14.9	23.1	24.1			

(DAP-Days after Pruning)

SEd	CD (0.05)					
Treatments (T)	0447	0.89	0.196	0.39	0.261	0.52
Stages (S)	0.223	0.44	0.098	0.19	0.130	0.26
T x S	0.724	1.54	0.340	0.67	0.452	0.90

Table.2. Effect of Zinc and Boron on quality characters of grapes

Treatments	Juice %	TSS	Reducing sugar	Non reducing sugar	Total Sugar	Acidity %	Sugar/ Acid Ratio
T_1-Control	53.0	13.0	7.84	2.11	9.95	1.20	8.29
T_2-$ZnSO_4$ 10 g vine-1	56.5	14.2	7.88	2.35	10.23	1.15	8.81
T_3-$ZnSO_4$ 20 g vine-1	57.0	14.8	8.47	2.48	10.95	1.15	9.52
T^4-Borax 4 g vine-1	57.5	14.2	7.90	2.23	10.13	1.14	8.89
T_5- Borax 8 g vine-1	56.5	14.5	7.93	2.39	10.32	1.15	8.97
T_6-T_2+T_4	58.0	14.9	8.47	2.51	10.98	1.13	9.72
T_7-T_2+T_5	57.0	14.5	8.01	2.31	10.32	1.15	8.98
T_8-T_3+T_4	64.0	15.7	8.63	2.95	11.58	1.11	10.33
T_9-T_3+T_5	56.5	14.2	7.92	2.33	10.25	1.14	8.99
T_{10}-Foliar spray $ZnSO_4$ 0.5%	59.0	15.5	8.11	2.44	10.55	1.12	9.50
T_{11}-Foliar spray borax 0.2%	58.0	14.8	8.21	2.48	10.69	1.12	9.54
T_{12}-T_{10}+T_{11}	68.0	15.8	8.95	2.97	11.92	1.10	10.84
SEd	1.532	0.09	0.039	0.021	0.075	0.025	0.215
CD(0.05)	3.17	019	0.08	0.04	0.15	0.05	0.44

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