Proportion of genes ($H^2/4H_1$) with positive and negative alleles was less than 0.25 for all characters except total soluble solids indicating asymmetrical distribution of positive and negative alleles in parents. The KD/KR ratio for number of clusters per plant, number of locules per fruit, pericarp thickness, total soluble solids and pH of the juice was more than one indicating the preponderance of dominant alleles.

The h^2/H_2 estimates detected one effetive factor for days to first flower, plant height, number of laterals per plant, number of clusters per plant, fruit weight, number of locules per fruit, pericarp thickness and pH of the juice. More than one effective factor was observed in number of clusters per plant, number of fruits per plant, yield per plant and total soluble solids.

The estimates of heritability (in narrow sense) varied from 0.17 per cent (yield per plant) to 0.88 per cent (number of clusters per plant). High heritability was observed for days to first flower, plant height, number of laterals per plant, number of clusters per plant, fruit weight and TSS. The high heritability noted was supported by earlier workers (Rattan and Saini, 1976 ; Dudi *et al.* 1983).

Additive as well as non-additive gene effects were prevalent for days to first flowering, plant height, number of laterals per plant, fruit weight and number of locules per fruit. These effects can most efficiently be used by way of intermating the most desirable segregants followed by selection. Keeping in view the low heritability estimate for yield, breeding approaches like biparental crossing, triple test cross followed by modified recurrent selection would result in greater genetic improvement in the segregating generations.

References

Dudi, B.S., Dixit, J., and Pratap, P.S. (1983). Components of variability, heritability and genetic advance studies in tomato. *Haryana Agril. Univ. J. Res.* **13** : 135-139.

Harkirat Singh and Nandpuri, K.S. (1975). The genetic analysis of acidity and total soluble solids in tomato. *Punjab Agril. Univ. J. Res.* **12** : 367-372.

Hayman, B.I. (1954). Theory and analysis of diallel crosses. *Genetics,* 39 : 789-809.

Jawaharlal, M. (1994). Genetic studies for fruit yield and quality characteristics in Tomato (*Lycopersicon esculentum* Mill.). Ph.D. Thesis, Tamil Nadu Agricultural University, Coimbatore, India.

Peter, K.V. and Rai, B. (1980). Combining ability in tomato. *Indian J. Genet. Pl. Breed.* **40** : 1-7.

Rattan, R.S. and Saini, S.S. (1976). Genetic analysis for yield and number of fruits in tomato. *Veg. Sci.* **3** : 123-127.

Sidhu, A.S., Dixit, J., Kalloo and Bhutani, R.D. (1981). Heterosis and combining ability in Pear-shaped tomato (*Lycopersicon esculentum* Mill.) *Haryana Agril.Univ.J.Res* **11** : 1-7.

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Effect of micronutrients (zinc and boron) on growth and yield of grapes (*Vitis vinifera* L.) cv. Muscat

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Abstract : An experiment was conducted with grapes (*Vitis vinifera* L.) cv. Muscat at Mathampatti, Coimbatore during 2000, to find out the effect of micronutrients namely Zn and B applied either individually or in combination through soil or foliage on the growth and yield characters of grapes. The results revealed that foliar application of $ZnSO_4$ 0.5 per cent + borax 0.2 per cent combination excelled others in increasing the shoot length, number of internodes shoot^{-1}, number of leaves shoot^{-1} and yield. *(Key words : Muscat, Zinc, Boron, Shootlength, Yield)*

Grape is a subtropical fruit but adapted to tropical conditons. Fifty per cent of the total production of fruits in the world is contributed by grapes. The climatic conditions are favourable in parts of Tamil Nadu and it is grown with an area of nearly 2475 ha, with an annual production of 0.5 lakh tonnes. As the cultivation of grapes is fast expanding, it is being taken up on a wide range of soils and agroclimatic situations, especially in Madurai, Theni, Dindigul, Dharmapuri and Coimbatore districts of Tamil Nadu state. Muscat is the most ideal cultivar in Tamil Nadu. Many workers have reported positive effects of Zinc (Zn) and Boron (B) on growth and yield of grapes. Application Zn and B increased the growth (Volschenk *et al.* 1999 and Mahorker and Patil, 1987) bunch number and yield (Kumar and Bhushan, 1978) in Thomson seedless. Information regarding the effect of Zn and B nutrition on growth and yield are lacking under local conditions as far as Muscat 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 yield of grapes.

Materials and Methods

The present study was carried out in a farmer's field at Mathampatti during the year 1999-2000 on fully grown six-year-old Muscat grapevine. The soil tested sandy loam with pH 8.1, organic carbon 0.52 per cent, DTPA Zn 1.05 ppm and hotwater soluble B 0.23 ppm. The experiment was laid out in a randomized block design with 12 treatments each replicated three times. $ZnSO_4$ at two levels (10 g and 20 g vine^{-1}), borax at two levels (4g and 8 g) and combination of these two nutrients were applied in soil after pruning. Foliar application of $ZnSO_4$ 0.5 per cent, borax 0.2 per cent and combination of these two nutrients were done at vegetative (20 days after pruning) and full bloom stages. The doses were supplemented with recommended doses of N, P and K at 250, 160 and 600 g vine^{-1} respectively. Growth observations (shoot length, number of internodes and number of leaves shoot^{-1}) were recorded in three stages at 30, 60 and 90 days after pruning. For that five shoots in each treatment were selected at random and the measurements on shoot length were recorded during 30, 60 and 90 days after pruning. For calculating the yield the ripened clusters were harvested and weighed. Ten clusters were selected randomly for recording various physical (cluster weight, volume, berry weight and berry volume) characteristics.

Results and Discussion

Growth Characteristics

Shoot length

The shoot length increased significantly with advancement from 30 DAP (44.7 cm) to 90 DAP (74.6 cm). Application of Zn and B either as soil or foliar sprays significantly influenced the shoot length. The combined foliar application of $ZnSO_4$ 0.5 per cent an Borax 0.2 per cent (T_{12}) recorded the highest sho length (66.3 cm). The control recorded the lowe shoot length (56.7 cm). The interaction between stag and treatments was also significant at all the thre stages.

Number of internodes

Significant differences in number of internode shoot^{-1} could be established among the stages (Tabl 1). The number of internodes at stage III was mor (24.15) than stage II (23.11) and stage I (14.98). Ther was a significant variation between stage I and stag II and there was slight variation between stage I and stage III in respect to number of internodes shoo^{-1}. Application of Zn and B either through soil c foliage, with or without combination significantl influenced the number of internodes shoot^{-1}. Th higher number of internodes shoot^{-1} was recorded i T_{12} (21.98) followed by T_8 (21.85) and T_{10} (21.57) This might be due to the increased shoot length. Th interaction between stages and treatments were foun to be significant.

Number of leaves

The number of leaves as influenced by Zn an B application was evaluated and the data are presente in Table 1. There was a significant difference i number of leaves shoot^{-1} established among the stages The trend was similar as that of number o internodes shoot^{-1}. The number of leaves shoot^{-1} a stage III was more (26.61) than stage II (25.26) an stage I (17.30). Within the treatments, T_{12} recorde the highest number of leaves shoot^{-1} (24.32). Ther was a significant interaction between stages an treatments. The treatment T_{12} recorded the highes number of leaves shoot^{-1} (28.34) at stage III, wher as the control recorded lowest number of leaves (16.76 at stage I. This results are in close agreement wit the findings of Kumar and Bhusan (1978) an Volschenk *et al.* (1999).

Yield Characteristics

Cluster weight and volume

Cluster weight, the most important yield determining factor was significantly influenced by Zn and B application. The weight of the cluster was significantly highest (245 g) in T_{12} followed by T_8 (220 g), T_{10} (198 g) and T_{11} (175 g). (Table 2). The minimum weight of the bunch (115 g) was recorded under the treatment (T_1). It was significantly lower than the other treatments as observed by Bindra and Brar (1979), and they reported that 0.4 per cent $ZnSO_4$

Table 1. Effect of Zinc and Boron on Shoot Length, number of internodes and number of leaves

Treatments	Shoot Length (cm)				No. of finternodes				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-$ZnSO_4$ 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-$ZnSO_4$ 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
T_{11}-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	14.9	25.0	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)

	CD (0.5)	CD (0.05)	CD (0.05)
Treatments (T)	0.89	0.39	0.52
Stages (S)	0.44	0.19	0.26
T x S	1.54	0.67	0.90

Table 2. Effect of Zinc and Boron on Weight of cluster, Volume of cluster, Weight of berry, Volume of berry and yield.

Treatments	Weight of cluster (g)	Volume of Cluster (ml)	Weight of berry (g)	Volume of berry (ml)	Yield Kg Vine^{-1}
T_1-Control	115	45	2.54	1.80	2.86
T_2-$ZnSO_4$ 10 g vine^{-1}	130	62	2.56	1.80	3.28
T_3-$ZnSO_4$ 20 g vine^{-1}	135	61	2.58	1.90	3.81
T_4-Borax 4 g vine^{-1}	131	62	2.59	2.00	3.71
T_5-Borax 8 g vine^{-1}	125	55	2.57	1.90	3.21
T_6-T_2+T_4	152	80	2.60	2.00	4.41
T_7-T_2+T_5	142	71	2.59	1.90	3.29
T_8-T_3+T_4	220	150	2.90	2.20	5.80
T_9-T_3+T_5	132	63	2.56	1.90	3.30
T_{10}-Foliar spray $ZnSO_4$ 0.5%	198	124	2.72	2.10	5.35
T_{11}-Foliar spray borax 0.2%	175	101	2.61	2.00	4.94
T_{12}-T_{10}+T_{11}	245	173	3.01	2.30	6.30
CD (0.05)	4.42	5.61	0.11	0.06	0.32

spray increased the bunch weight in Thompson seedless grapes. Mansour (1998) who found that application of 0.1 per cent boric acid and mepiquat chloride at 250 to 1500 ppm either alone or combination improved the average cluster wiehgt as compared with the control. The volume of the cluster was significantly influenced by the application of Zn and B either alone or in combination through soil or foliage. The increase in cluster volume was a consequence of increased cluster weight with increased cluster width and breadth. Similar result was obtained by Sanjay Kumar and Pathak (1992) who got increased cluster volume by spraying 0.2 per cent $ZnSO_4$ and 0.4 per cent boric acid resulted in increased cluster length and breadth and thereby ultimate increase in cluster volume.

Berry weight and volume

It is clear from the data in Table 2 that the berry weight increased under all the treatments except control during the period of study. The berry with significantly higher weight than control was observed in treatment T_{12} (3.01 g). It was followed by the treatments T_8 (2.90 g) and T_9 (2.72 g) which were recorded significantly higher weight than control. The control recorded the lowest weight of berry (2.54 g). Similar results have been reported by Kumar and Bhushan (1978) and Bacha *et al.* (1997) Considering the volume of berry, significant influence was obtained by the application of Zn and B either alone or in combination through soil or foliage. This might be due to spray of Zn and B at two stages that resulted in increased berry volume in the treatment T_{12} followed by T_{10} and T_8. Thus the increased berry volume which is a desirable attribute indicate that bigger size berry with increased berry weight was favoured due to Zn and B application either through foliage or through soil. The increase in fruit volume was a consequence of increased berry length and circumference, observed in these treatments. Similar increase in fruit volume was observed by Sanjay Kumar and Pathak (1992) who obtained higher fruit volume by the increased length and breadth of the berry with 0.4 per cent $ZnSO_4$ spray and 0.4 per cent boric acid spray.

Total Yield

The data revealed that under all the treatments the yield was better than the control. The treatment T_{12} produced the highest yield (6.30 kg vine^{-1}). The lowest yield was recorded in the treatment T_1 (2.84 kg vine^{-1}) which was followed by the treatment T_5 (3.20 kg vine^{-1}). Similar yield improvement due to Zn and B spray in vine was reported by Kumar and Bhushan (1978), Tesu *et al.* (1988) and Ezzili (1994). The increase in yield in case of Zn and B treated vines may be due to the fact that in these vines fruit set was more and berry drop was less.

References

Bacha, M.A., Sabbah, S.M. and Hamady, M.A. (1997). Effect of foliar application of Fe, Zn and Mn on yield , quality and leaf mineral composition of Thompson seed less and Roumy red grape cultivars. *J. King Saud Univ.Agric.Sci.9:127-140.*

Bindra, A.S. and Brar, R.S. (1979). Effect of different nutrient sprays on 'Coulure' fruit quality and nutrient status of Thompson seedless grapevines *Indian J. Hort.* **36** : 394-398.

Ezzili, B. (1994). Effect of pinching back and trace elements on fertility and mineral element content of leaves in Alicante grenache noir variety. *Bulletin de l' OIV,* **67** : 757-758.

Kumar, S. and Bhusan, S. (1978). Effect of applying zinc, manganese and boron to the vines of cultivar Thompson seedless on their vigour, yield and nutrient status, *J. Res. India.* **15** : 43-48.

Mahorkar, V.K. and Patil, V.K. (1987). Effects of boron on the growth of three cultivars of grapes. *J. Maharastra. Agric. Univ.* **12** : 394-395.

Mansour, A.E.E.M. (1998). The benefits of using mepiquat chloride with boron for roumy red vines. *Egyptiam J. Hort.* **25** : 17-27.

Sanjay Kumar and Pathak, R.A. (1992). Effect of foliar application of nutrients on the yield and quality of grapes (*Vitis vinifera* L.) cv. Perlette. *Prog. Hort.* **24** : 13-16.

Tesu, V., Jianu, L., Muraru, V. Iuroaie, T. and Arghir, G. (1988). Response of some grape vine to foliar nutrition with trace elements and a ioactive substances. *Hort. Abstr.* **58** : 6562.

Volschenk, C.G., Hunter, J.J. Roux, D.J. and Watts, J.E. (1999). Effect of graft combination and position of application on assimilation and translocation zinc in grapevines. *J. Plant Nutri.* **22** : 115-119.

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Performance of sunflower (*Helianthus annuus*) with intercrops under various planting pattern

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Abstract : A two year field study on sunflower (*Helianthus annuus* L.) based inter cropping systems conducted at Regional Research Station, Aruppukottai revealed that planting of component crops at 3:1 ratio under replacement series was optimum for better growth, increased sunflower grain yield equivalent (1019 kg ha^{-1}) and higher net income (Rs. 6392 kg ha^{-1}) with higher benefit cost ratio (2.69). The yield of sunflower component increased from 718.7 to 805.9 kg ha^{-1} as planting row ratio gets widened from 2:1 to 4:1 ratio. The yield of intercrops reduced by 17.7 and 33.8 per cent in 3:1 ratio and 4:1 ratio as compared to 2:1 ratio. Among the intercropping systems, sunflower + sesame had recorded the highest mean grain yield equivalent (1082.6 kg ha^{-1}), mean net income (Rs. 6942 kg ha^{-1}) coupled with maximum benefit cost ratio (2.87) compared to other intercropping systems. The yield advantage in sunflower + sesame intercropping system was mainly due to efficient utilizaiton of water under rainfed situation. (*Keywords : Sunflower, Red gram, Sesame, Bengal gram, Intercropping system*)

Importing large quantity of edible oils is mainly because the productivity of oilseeds is largely determined by the moonsoons since bulk of their area is under rainfed condition. One of the ways to achieve higher yields of oilseeds would be intercropping. Higher productivity and returns in intercropping systems depend on the selection of compatible, complementary crops and their planting density and geometry. Intercropping sunflower with pigeon pea brings stability in yield and improves total productivity. It also ensures adequate yields of one of the component crops (Rao and Willey, 1983 ; Subba