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EFFECT OF BORON ON THE FLOWERING AND FRUITING OF TOMATO

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ABSTRACT

Experiment was conducted to study the effect of Boron (B) on the growth and yield of Rio Grand and Rio Figue cultivar of tomato at Horticultural Research Farm, NWFP Agricultural University, Peshawar during 2008-2009. Different doses of B (0, 0.5, 1.0, 2.0, 3.0 and 5.0kg ha^{-1}) with constant doses of nitrogen, phosphorus and potash was incorporated at the rate of 150, 100, 60 kg ha^{-1}.The experiment was laid out in Randomized Complete Block Design with 2 factors. Boron showed a significant effect on the growth and yield of tomato. However, 2 kg B ha^{-1} resulted in maximum number of flower clusters per plant, fruit set percentage, total yield, fruit weight loss and total soluble solid. Rio Grand cultivar of tomato showed significant effect on all parameters. Maximum number of flower clusters per plant, fruit set percentage and total yield were recorded with Rio Grand cultivar of tomato. Generally it can be concluded that 2 kg B ha^{-1} significantly affected flowering and fruiting of Rio Grand cultivar.

Key Words: ***Lycopersicon esculentum*** **, Boron, Flowering, Fruiting.**

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INTRODUCTION

Tomato *(Lycopersicon esculentum Mill)* belongs to the family *Solanaceae* and is one of the most popular, important and widely used vegetable crops. In Pakistan two crops are produced, one is the spring crop and the other is the autumn crop. The yield potential and quality can be improved by maintaining proper fertilizer application. Nutrition plays an important role in tomato production. Tomato crop requires heavy manure and sufficient amount of fertilizers for heavy yield. For improving plant growth and development, use of organic and inorganic manure or fertilizers is essential. It is well established fact that chemical fertilizers improve plant growth directly (Splittstoesser,1990). Like other nutrients, boron has a pronounced effect on the production and quality of tomato. Boron is needed by the crop plants for cell division, nucleic acid synthesis, uptake of calcium and transport of carbohydrates (Bose and Tripathi,1996). Boron also plays an important role in flowering and fruit formation (Nonnecke, 1989). Boron deficiency affects the growing points of roots and youngest leaves. The leaves become wrinkled and curled with light green colour. Its deficiency affects translocation of sugar, starches, nitrogen and phosphorus, synthesis of amino acids and proteins (Stanley *et al*., 1995). In boron deficient plants the youngest leaves become pale green, losing more colour at the base then at the tip. Boron deficiency symptoms will often appear in the form of thickened wilted, or curled leaves, a thickened, cracked, or water soaked condition of petioles and stems, and discoloration, cracking or rotting of fruit, tubers or roots. (Tisdale *et al.*, 1985). In order to correct the above mentioned problem in tomato production this piece of research work was under taken.

MATERIALS AND METHODS

This research project was conducted at Horticultural Research Farm, NWFP Agricultural University, Peshawar Pakistan during 2008-2009. A field block measuring 224 m^2 was selected and ploughed thoroughly. Recommended doses of nitrogen (Urea), phosphorus (Single Super Phosphate) and potash (Sulphate of Potash) was incorporated at the rate of 150, 100, 60 kg ha^{-1} respectively. Soil samples were collected from experimental area at a depth of 0-20 cm for analyzing Boron. The results showed deficient Boron with 0.4 ppm and 7.9 pH. Boron (0, 0.5, 1.0, 2.0, 3.0 and 5.0kg ha^1) was applied at final bed preparation mixing with the soil. The experiment was laid out in Randomized Complete Block Design with two factors. Thirty six beds measuring 2 m in length and 2 m in width were raised. Two varieties *Rio Grand* and *Rio Figue* were selected for study. Seed was sown in January for raising nursery plants in raised beds prepared with a growing media of farm yard manure, soil and sand with 1:1:1 ratio and the bed was covered with a thin polyethylene sheet against the bad weather. Seedlings were prepared for transplanting in first week of March. Transplantation was done on both the sides of raised bed at 45 cm plant to plant distance and 1.5 m between rows. The plots were irrigated immediately after transplantation (Stanley *et al*., 1995). Uniform cultural practices were followed throughout the growing season. Data were recorded on the number of flower cluster per plant, fruit set percentage, total yield, fruit weight loss and total soluble solid.

RESULTS AND DISCUSSION

Number of Flower Cluster Plant^{-1}

It is evident from Table I that maximum number of flower cluster plant^{-1} (27.73) were observed in plants receiving 2 kg B ha^{-1} while minimum number of flower cluster plant^{-1} (16.75) were noticed in control treatments. The means of different cultivars revealed that maximum number of flower cluster plant^{-1} (24.48) were noticed in *Rio Grand* cultivar, while minimum (22.69) were found in *Rio Figue* cultivar. The higher number of flower cluster plant^{-1} might be due to optimum supply of B. Dey (2000) reported that optimum supply of boron stimulated the uptake of phosphorus by plant roots and might have promoted more flower clusters formation, as phosphorus directly promotes flowering Balley(1999) also obtained similar results.

Table I ***Effect of different concentrations of B on number of flower Cluster Plant^{-1} of Rio Grand and Rio Figue cultivars of Tomato***

	Cultivars		
B kg ha^{-1}	**Rio Grand**	**Rio Figue**	**Mean**
Control	17.13	16.37	16.75 c
0.5	23.69	22.24	22.97 b
1.0	25.83	23.16	24.50 b
2.0	30.70	24.77	27.73 a
3.0	24.17	26.43	25.30 ab
5.0	25.35	23.16	24.25 b
Mean	24.48	22.69	

Means with differrent letter (s) in columns are significantly different at $P < 0.05$.

Fruit Set Percentage

Maximum fruit set percentage (55.83) was obtained with 2.0 kg B ha^{-1}, while minimum fruit set percentage (39.77) was recorded with control treatments. The mean of different cultivars revealed that highest fruit set percentage (51.13) was noticed with *Rio Grand* cultivar while lowest fruit set percentage (48.85) was found with *Rio Figue* cultivar. In the interaction of treatments and cultivars maximum fruit set percentage (59.34) was recorded in 2.0 kg B ha^{-1} in *Rio Grand* cultivars, while lowest fruit set percentage (37.91) was noticed with control treatments in *Rio Figue* cultivar. The results clearly indicated that B plays a vital role in fruit set of tomato plants. The highest fruit set percentage might be due to optimum boron application, as boron plays important role in maintaining cell integrity, improving respiration, enhancing metabolic activities and uptake of nutrients. Nonnecke (1989) also obtained similar results.

Table 1I ***Effect of different concentrations of B on fruit set percentage of Rio Grand and Rio Figue cultivars of tomato***

	Cultivars		
B kg ha^{-1}	**Rio Grand**	**Rio Figue**	**Mean**
Control	41.64 d	37.91 e	39.77 c
0.5	54.11 b	51.18 bc	52.64 ab
1.0	49.63 c	52.14 bc	50.88 b
2.0	59.34 a	52.32 bc	55.83 a
3.0	51.52 c	49.57 c	50.54 b
5.0	50.54 c	50.01 c	50.27 b
Mean	51.13	48.85	

Means with differrent letter (s) in columns are significantly different at $P < 0.05$.

Total Yield

Maximum yield (34840 kg.ha^{-1}) was obtained with 2.0 kg B and lowest yield (21210 kg ha^{-1}) was obtained with untreated treatment. Comparing the means of cultivars it is clear from the Table III that maximum yield (29516 kg ha^{-1}) were observed in the *Rio Grand* cultivars, while least yield of (28085 kg ha^{-1}) was obtained with *Rio Figue* cultivar. The interaction effect was also significant. Maximum yield (36160 kg ha^{-1}) were noticed with 2.0 kg B ha^{-1} *Rio Grand* cultivar, while minimum yield (20250 ha^{-1}) were recorded in *Rio Figue* cultivar whit no B application. Boron 2.0 kg per hectare gave maximum yield of (34840 kg ha^{-1}) as compared to minimum of 21210 kg ha^{-1} in control. Oyinlola and Chude (2004) also obtained similar results.

Table III ***Effect of different concentrations of B on total yield (kg ha^{-1}) of Rio Grand and Rio Figue cultivars of tomato***

	Cultivars		
B kg ha^{-1}	**Rio Grand**	**Rio Figue**	**Mean**
Control	22170 i	20250 j	21210 f
0.5	27450 g	24570 h	27010 e
1.0	32560 c	30450 d	31510 b
2.0	36160 a	33520 b	34840 a
3.0	30550 d	29310 e	29930 c
5.0	28210 fg	28410 f	28310 d
Mean	29516 a	28085 b	

Means with differrent letter (s) in columns are significantly different at $P < 0.05$.

Fruit Weight Loss

Maximum (4 g) weight loss was observed with control treatments. While minimum weight loss (2 g) was observed with 2.0 kg B ha^{-1}. The interaction effect was also significant. Maximum fruit weight loss (4 g) was observed in control treatments with *Rio Figure* cultivar. Boron plays an important role in uptake of calcium and transport of carbohydrates. In case of B deficiency the rate of respiration increases and thus more water loss. In boron deficient plants enzymatic activity increases which increases the loss of water from the fruit surface. Boron availability increases calcium synthesis which reduces respiration, that might decreased amount of moisture loss from the fruit surface Stanley *et al*., (1995) also obtained similar results.

Table IV ***Effect of different concentrations of B on the average fruit weight loss (g) of Rio Grand and Rio Figue cultivars of Tomato.***

	Cultivars		
B kg ha^{-1}	**Rio Grand**	**Rio Figue**	**Mean**
Control	4.00 a	4.22 a	4.11 a
0.5	3.188 c	3.26 bc	3.22 b
1.0	2.60 d	2.25 e	2.42 c
2.0	1.62 f	1.81 f	1.71 d
3.0	3.55 b	2.57 d	3.06 b
5.0	2.50 de	2.71 d	2.61 c
Mean	2.91	2.80	

Means with differrent letter (s) in columns are significantly different at $P < 0.05$.

Total Soluble Solids

Maximum total soluble solids (5^0 Brix.) were produced with control, while, minimum total soluble solids 3^0 Brix were observed with 1.0 kg B ha^{-1} Maximum total soluble solids (5^0 Brix) were recorded in the *Rio Figue* cultivar, whereas minimum total soluble solids 2 ^{0}Brix were observed in the cultivars *Rio Grand* cultivar. The interaction effect was also significant. Maximum total soluble solids (5^0 Brix) were noticed with control in *Rio Figue* cultivar, while minimum total soluble solids (1^0 Brix) were recorded with 2.0 kg B ha $^{-1}$ of *Rio Grand* cultivars. Boron deficiency usually results in calcium deficiency. Calcium and boron deficiency results in faster fruit ripening. Thus, the un-treated fruits have higher sugar contents than the treated fruits which might be resulted in more total soluble solids. Mahajan and Sharma (2000) also obtained the same results.

Table V ***Effect of different concentrations of B on Total Soluble Solids ^{0} Brix of Rio Grand and Rio Figue cultivars of Tomato.***

	Cultivars		
B kg ha^{-1}	**Rio Grand**	**Rio Figue**	**Mean**
Control	4.17 f	5.90 a	5.03 a
0.5	3.47 g	4.81 d	4.14 b
1.0	1.73 j	4.91 c	3.32 e
2.0	1.66 j	5.03 b	3.34 e
3.0	2.60 i	4.63 e	3.61 d
5.0	2.71 h	4.73 d	3.72 c
Mean	2.72 b	5.00 a	

Means with differrent letter (s) in columns are significantly different at $P < 0.05$.

CONCLUSION AND RECOMMENDATIONS

It is clearly established from the above given discussion that B is an essentional nutrient for growth and flowering in tomatoes. On the basis of results recorded from this trial, the following recommendations can be generalized; among various treatments used, 2 kg B ha^{-1} showed better results regarding most of the parameters.

Between the two cultivars *(Rio Grand and Rio Figue)*, more significant affects of B regarding growth and flowering were observed with *Rio Grand* which is a processing type cultivar.

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