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VARIETAL RESPONSE OF CAPSICUM TO DIFFERENT LEVELS OF SALINITY CULTIVATED IN THE FARM LAND AREAS OF MYMENSINGH, BANGLADESH

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ABSTRACT

An experiment was carried out to evaluate the effect of salinity and three varieties of capsicum on their growth and yield under poly house condition at Horticulture farm, Bangladesh Agricultural University, Mymensingh during the period from November, 2023 to March, 2024. The experiment consisted of four level of salinity viz., S_0: 0 ds/m (control), S_1: 4 ds/m, S_2: 8 ds/m and S_3: 12 ds/m and three capsicum varieties viz., V_1: BARI Capsicum-1, V_2: BARI Capscum-2 and V_3: Sweet Beauty F_1. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The growth and yield parameters of capsicum were significantly influenced by salinity levels while the varietal difference was not significant on most of the growth parameters except for yield parameters where significant variation among varieties was observed. Different salinity levels showed significant effects on growth and yield parameters of capsicum. Growth parameters and yield of capsicum decreased with the increase of salinity levels. The control treatment S_0 (0 dS/m) gave the highest capsicum yield (294.51 g per plant and 8.84 ton/ha) followed by S_1 (3 dS/m) treatment, which provided 203.08 g per plant and 6.10 ton/ha yield; whereas S_3 (12 dS/m) treatment produced lowest yield (85.74 g per plant and 2.57 ton/ha). The variety Sweet Beauty F_1 was found superior to BARI Capsicum-1 and BARI Capsicum-2 in case of yield parameter. Sweet Beauty F_1 produced highest yield of 231.34 g per plant and 6.94 ton/ha respectively, while the lowest yield was obtained from BARI Capsicum-2 which was 161.15g per plant and 4.83 ton/ha. Treatment combination of S_0 (0 ds/m) with V_3 (Sweet Beauty F_1) produced higher yield (374.73 g per plant and 11.24 ton/ha) followed by treatment combinations of S_0 (0 ds/m) with V_1 (BARI Capsicum-1) with 260.34 g per plant and 7.81 ton/ha. While the lowest yield (81.76 g per plant and 2.45 ton/ha) was obtained from treatment combinations of S_3 (12 ds/m) and V_2 (BARI Capsicum-2).

Key words: Salinity levels, BARI Capsicum-1, varieties.

Introduction

Capsicum annuum L. widely recognized as bell pepper or misty marich (in Bengali), is a member of the *Solanaceae* family. It is cultivated globally as an annual crop. This crop serves as a significant spice and vegetable, with both ripe and unripe fruits utilized for culinary, salad, and processing applications. In the country, chilli crops occupied 188.88 thousand hectares of land with a production of 507.20 thousand metric tons (BBS, 2022-23). One such environmental issue that is anticipated to get worse in the future due to climate change and sea level rise is salinity. Concerns over saline intrusion resulting from decreased freshwater flow from upstream, sanitization of groundwater, and variations in soil salinity are the main issues facing the nation's coastal regions. High salinity causes membrane instability and inhibits exposed photosynthetic capacity in plants. Plant experts, particularly those in the fields of physiology and genetics, are still faced with the issue of selecting salt-tolerant lines. Due to its lengthy growing season and high energy content, chilies need to be properly manured, fertilized in a balanced manner, and given secondary nutrients in order to produce a greater quality and yield of product (Prasad *et al.*, 2009). According to Kaymakanova (2009), it is one of the major stresses that crop plants must withstand, and it significantly reduces crop productivity. The coastal zone and offshore island in Bangladesh are very flat with height less than 3 m above the Mean Sea Level (MSL). Climatic factors, albeit others, such as sea level rise is

considered as the imperative cause of salinity in coastal areas. The predominant salinity intrusion due to global climate change has been dreadfully affecting the crop productivity within the saline regions of Bangladesh (Rahman *et al.,* 2000). This example demands an expeditious response to elevate the crop productivity. The salt tolerance of pepper plants varies depending on the cultivar, and recent commercial varieties are more sensitive to saltwater than older ones (Navarro *et al.,* 2002). To overcome the negative effect of salinity, capsicum plants develop some mechanism by altering its morphological, physiological and other traits. Changes of morphological, physiological and nutritional traits of capsicum due to the genotypes- stress interaction as an indicator of stress tolerant mechanisms, Plant Breeders have experimented to develop stress tolerant variety. As capsicum is one among the foremost important cash crop and may be cultivated under some lower extent of salinity it is time demanding to develop medium to high level of salinity tolerant variety. With conceiving the above scheme in mind, the present research work has been undertaken so as to release the subsequent objectives to evaluate the effect of the different levels of salinity on growth and yield of three capsicum varieties and to select the suitable capsicum variety for cultivation is saline prone region of Bangladesh.

Materials and Methods

The experiment was conducted at the Poly house and Horticulture farm, Department of Horticulture of Bangladesh Agricultural University, Mymensingh-2202, Bangladesh during the period from November 2023 to March 2024 to study the effect of salinity on growth and yield of three capsicum varieties. The climate of experimental site was subtropical, characterized by three distinct seasons, the winter from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October (Edris *et al.,* 1979). The experiment was carried out on a medium high land belonging to the soil series of Old Brahmaputra Flood Plain Alluvial Tract (UNDP, 1988) of AEZ-9. The texture of the soil was silty loam with pH 6.6. Three hybrid capsicum varieties were used for this experiment named BARI Capsicum 1, BARI Capsicum 2 and Sweet Beauty. Two of BARI varieties were collected from Bangladesh Agriculture Research Institute and Sweet Beauty F_1variety was collected from local market. Capsicum seeds were soaked in water for 15 hours before sowing. Two (2) grams of seeds were sown in each seed bed on 16 November, 2023. Complete germination of the seeds took place within 5 days after seed sowing. The experiment was done with two factors as listed below: Factor A: Three capsicum verities: V_1 = BARI Capsicum 1, V_2 = BARI Capsicum 2, V_3 = Sweet Beauty F_1. Factor B: 4 Levels of salinity, S_0 = 0 dS/m^2, S_1 = 4 dS/m^2, S_2= 8 dS/m^2, S_3 = 12 dS/m^2.The experiment was laid out in Randomized Complete Block Design (RCRD) with three replications and 12 treatment combinations. There were 72 pots each containing two capsicum seedlings. There by 4 plants per treatment. The N, P, K, S and Zn fertilizers were applied according to Krishi Projukti Hath Boi (BARI, 2019). The required number of polythene bag having 18 cm top and bottom diameter and 24 cm depth were collected from the local market. Healthy and uniform 60 days old seedlings from seed bed were transplanted in the experimental poly bag in the afternoon on 17 January 2024. After establishment of seedlings, various intercultural operations were accomplished for better growth and development of the capsicum plant. Fruits were harvested two times at 10 days intervals during maturity to ripening stage. The collected data obtained for different characters were statistically analyzed to observe the significant differences among the treatments by using the STATISTIX 10 computer package program. The significance of the difference among the treatments means was estimated by the Least Significant Difference Test (LSD) at 5% and 1% level of probability (Gomez and Gomez, 1984).

Results and Discussion

The study was conducted with three capsicum varieties and four levels of salinity. Three capsicum varieties mostly did not have significant effect on their performance except in case of average fruit weight and yield. Mostly all growth parameter and yield contributing parameters did not varied significantly for those varieties but fruit weight flash thickness and fruit diameter were differed significantly.

Combined effect of variety and salinity: The treatment combinations of variety and salinity had highly significant effect on plant height of capsicum at different growth stages except 15 DAT (Table 1). After 30, 45 and 75 DAT, the highest plant heights (20.21, 26.62 and 37.25 inch respectively) were recorded from the treatment combination of V_3S_0. While at 60 DAT the highest plant (31.22 cm) height was obtained from V_1S_0. While at 30 DAT the lowest plant height (5.5 inch) was obtained from V_1S_3 treatment and at 45 and 75 DAT the lowest plant height (16.65 and 21.548 cm) was obtained from V_2S_3 treatment combinations.

Table 1. Combined effect of different salinity levels on plant height of different capsicum varieties

Treatments combination	Plant height (Inch)				
	15DAT	30DAT	45DAT	60DAT	75DAT
V_1S_0	12.510	19.473	26.543	31.221	36.597
V_2S_0	12.340	19.494	25.400	31.200	37.245
V_3S_0	12.764	20.214	26.628	31.073	37.084
V_1S_1	12.234	19.008	22.246	26.353	33.443
V_2S_1	11.917	18.711	23.008	26.297	32.872
V_3S_1	12.319	18.690	23.516	26.564	33.740
V_1S_2	11.409	15.557	20.680	21.950	27.877
V_2S_2	11.769	15.875	20.722	21.738	28.025
V_3S_2	11.726	15.981	20.549	22.077	27.961
V_1S_3	11.324	14.055	17.208	18.606	22.479
V_2S_3	11.282	14.457	16.658	18.479	21.548
V_3S_3	10.985	15.261	17.928	18.309	22.458
Level of Significance	ns	**	**	**	**

** = Significance at 1% level of probability, * = Significance at 5% level of probability, ns = non-significant
V_1 = BARI capsicum-1 F_1, V_2 = BARI capsicum-2 V_3 = Sweet Beauty F1
S_0 = 0 dS/m, S_1 = 4 dS/m, S_2 = 8 dS/m, S_3 = 12 dS/m.

Combined effect of variety and salinity: Different levels of salinity and varieties had highly significant effect on number of leaves per plant of capsicum at different growth stages except at 15 DAT (Table 2). At 15 and 30 DAT the highest leaves number were statistically similar for V_1S_0, V_2S_0 and V_3S_0 treatment combinations. On the other hand, at 30 and 60 DAT the lowest plant leaves (12.42 and 16.58 respectively) were obtained from V_3S_3 treatment combination. At 45 DAT the lowest plant leaves (14.75) was obtained from V_1S_3 treatment combination which was statistically similar with V_2S_3, V_3S_3, V_1S_2 V_2S_2 and V_3S_2. At 75 DAT the lowest plant leaves (17.6670 was obtained from V_2S_3 treatment combination which was statistically similar with V_1S_3 and V_3S_3 treatment combinations.

Table 2. Combined effect of different variety and salinity levels on number of leaves per plant

Treatments combination	Number of Leaves				
	15DAT	30DAT	45DAT	60DAT	75DAT
V_1S_0	13.167	16.5	23.583	35.667	35.833
V_2S_0	12.483	16.667	23	34.583	36.917
V_3S_0	12.583	17.083	22.917	35.917	35.417
V_1S_1	12.5	14.833	18.583	26	30.25
V_2S_1	12.417	15.083	18	26.617	30.917
V_3S_1	12.833	15.167	17.933	26.083	31.667
V_1S_2	12.367	13.583	15.5	21	21.5
V_2S_2	12.917	13.75	15.833	21.667	22.667
V_3S_2	12.8	13.683	16.4	21.917	23.833
V_1S_3	12.183	12.917	14.75	17.25	18.833
V_2S_3	12.083	12.667	14.833	16.667	17.667
V_3S_3	11.883	12.42	15.093	16.583	17.833
Level of Significance	ns	**	**	**	**

Variety V_3 (Sweet Beauty F_1) had flower and fruiting earlier (31.46 and 41.37 days) where the higher days (31.93 and 41.68 days) was needed by V_1 (BARI capsicum-1). Higher fruit length (60.33 mm) was recorded from the variety V_3 (Sweet Beauty F_1) and that was lower (55.41 mm) in variety V_2 (BARI Capsicum-2). The fruit diameter (63.98mm) was higher in the variety V_3 (Sweet Beauty F_1) and it was lower (59.79 mm) in the variety V_1 (BARI capsicum-1). The highest flesh thickness (5.12 mm) was observed in the variety V_3 (Sweet Beauty F_1). And it was lowest (5.02 mm) in the variety V_1 (BARI capsicum-1). The Average fruit weight (68.30 g) was higher in the variety V_3 (Sweet Beauty F_1) whereas lower Average fruit weight (49.81 g) was in the variety V_2 (BARI capsicum-2). The number of per fruits (4.81) was recorded higher in variety V_3 (Sweet Beauty F_1) and it was lower (4.31) in variety V_2 (BARI capsicum-2). The fruit yield per plant (231.34 g) was higher in the variety V_3 (Sweet Beauty F_1) and it was lower (161.15 g) in the variety V_2 (BARI capsicum-2). The fruit yield per hectare (6.9401 ton) was higher in the variety V_3 (Sweet Beauty F_1) and it was lower (4.83 ton) in the variety V_2 (BARI capsicum-2) as shown in Table 3.

Table 3. Effect of variety on flower blooming and fruit bearing performances of capsicum

Treatments	Days to first flowering	Days to first fruiting	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (mm)	Average fruit weight (g)	Number of fruits per plant	Fruit yield per plant
V_1	31.94	41.69	56.23	59.80	5.03	52.340	4.5208	163.09
V_2	31.71	41.46	55.41	61.75	5.04	49.817	4.3125	161.15
V_3	31.47	41.37	60.33	63.98	5.12	68.301	4.8125	231.34
Level of Significance	ns	ns	ns	*	*	**	ns	**

The control treatment S_0 (0 dS/m) required less days (27.59 and 37.53 days) for flowering and fruiting while salinity S_3 (12 dS/m) took 36.38 and 46.55 days. The highest fruit length (79.60 mm) was recorded from the control treatment S_0 (0 dS/m) and the lowest fruit length (32.67 mm) was recorded from the treatment S_3which was 12 dS/m. The highest fruit diameter (83.04 mm) was recorded from the control treatment S_0 (0 dS/m) whereas the treatment S_3 (12 dS/m) showed the lowest fruit diameter (37.74 mm). Control treatment S_0 (0 dS/m) provided the highest flesh thickness (6.81 mm) whereas the lowest fruit diameter (2.61 mm) was recorded from the treatment S_3 (12 dS/m). The highest Average fruit weight (100.61 g) was recorded from the control treatment S_0 (0 dS/m) and that way the lowest average fruit weight (12.31 g) was recorded from the treatment S_3 (12 dS/m). Treatment S_3 (12 dS/m) provided the highest number of fruits per plant (6.92) while the lowest number of fruits per plant (3.44) was recorded from the treatment S_0 (0 dS/m). The highest fruit yield per plant (294.51 g) was recorded from the control treatment S_0 which was 0 dS/m and the lowest fruit yield per plant (85.74 g) was recorded from the treatment S_3 (12 dS/m). The highest fruit yield per hectare (8.84 ton) was recorded from the control treatment S_0 as well which is 0 dS/m and the lowest fruit yield per hectare (2.57 ton) was recorded from the treatment S_3 (12 dS/m) as shown in Table 4.

Table 4. Effect of salinity on flower blooming and fruit bearing performances of capsicum

Treatments	Days to first flowering	Days to first fruiting	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (mm)	Average fruit weight (g)	Number of fruits per plant	Fruit yield per plant
S_0	27.59	37.53	79.60	83.04	6.81	100.61	3.44	294.51
S_1	30.08	39.58	70.34	69.14	6.22	70.42	3.53	203.08
S_2	32.75	42.36	46.68	57.43	4.61	43.94	4.30	157.43
S_3	36.39	46.56	32.67	37.75	2.62	12.31	6.92	85.74
Level of Significance	**	**	**	**	**	**	**	**

Treatment combinations mostly did not have significant variations among them except Average fruit weight and yield. Treatment combination V_3S_0 took lowest days (26.69 and 36.16 days) to flower and fruit while V_1S_3 took higher (37.08 and 46.91 days). The highest fruit length (84.88 mm) and diameter (85.30 mm) was recorded from the treatment combination of V_3S_0 while the lowest fruit length (31.75 mm) and fruit diameter (36.61 mm) was recorded from the V_2S_3. The highest flesh thickness (6.83 mm) was recorded from V_3S_0 treatment combination and the lowest flesh thickness (2.59 mm) was from the treatment combination of V_1S_3. The highest average fruit weight (129.44 g) was recorded from V_3S_0 treatment combination and the lowest average fruit weight (11.94 g) was recorded from the treatment combination of V_1S_3. The highest number of fruits per plant (7.17) was recorded from V_3S_3treatment combination and the lowest number of fruits per plant (3.17) was recorded from the treatment combination V_2S_0. The highest fruit yield per plant (374.73 g) was recorded from V_3S_0 treatment combination. The lowest fruit yield per plant (81.76 g) was recorded from the treatment combination of V_2S_3. The highest fruit yield per hectare (11.24 ton) was recorded from the treatment combination of V_3S_0 and the lowest fruit yield per hectare (2.46 ton) was recorded from the treatment combination of V_2S_3 as shown in Table 5.

Table 5. Combined effect of varieties and salinity on flower blooming and fruit bearing performances of capsicum

Treatments	Days to first flowering	Days to first fruiting	Fruit length (cm)	Fruit diameter (cm)	Flesh thickness (mm)	Average fruit weight (g)	Number of fruits per plant	Fruit yield per plant
V_1S_0	28.50	39.00	77.68	80.43	6.79	88.82	3.50	260.34
V_2S_0	27.58	37.41	76.24	83.39	6.81	83.56	3.33	248.45
V_3S_0	26.69	36.16	84.87	85.30	6.82	129.44	3.50	374.73
V_1S_1	29.50	39.33	69.21	67.09	6.18	65.38	3.33	175.48
V_2S_1	30.50	39.67	70.06	70.90	6.21	63.17	3.16	175.61
V_3S_1	30.25	39.75	71.75	69.42	6.26	82.69	4.08	258.17
V_1S_2	32.67	41.50	45.00	55.03	4.56	43.21	4.50	134.47
V_2S_2	32.67	42.83	43.60	56.09	4.55	40.53	3.91	138.78
V_3S_2	32.92	42.75	51.43	61.17	4.72	48.08	4.50	199.05
V_1S_3	37.08	46.92	33.02	36.62	2.58	11.94	6.750	82.05
V_2S_3	36.08	45.91	31.75	36.62	2.59	12.00	6.83	81.76
V_3S_3	36.00	46.83	33.23	40.01	2.67	12.99	7.16	93.41
Level of Significance	**	**	**	**	**	**	**	**

Conclusion

Three capsicum varieties viz. BARI Capsicum-1, BARI Capsicum-2 and Sweet Beauty F_1 were cultivated in pots with 4 levels of salinity viz. S_0 = 0 dS/m, S_1 = 4 dS/m, S_2 = 4 dS/m, S_3 = 12 dS/m. And from their interaction the following conclusion can be drawn:

1) The variety V_3 (Sweet Beauty F_1) can be considered as the best regarding growth, yield contributing parameters, yield and nutrient content of capsicum compared to the variety V_2 (BARI capsicum-1) and V_2 (BARI capsicum-2).
2) The control treatment S_0 (0 dS/m) showed the best performance on growth, yield contributing parameters, yield and nutrient content of capsicum followed by S_1 (4 dS/m). Yield contributing parameters and yield performance was decreased with increasing of salinity and the highest salinity treatment S_3 (12 dS/m) showed least performance on yield contributing parameters and yield of capsicum.
3) Among 12 treatment combinations of variety and salinity, V_3S_0 (Sweet Beauty F_1 with no salinity) was best regarding higher results on growth, yield contributing parameters and yield whereas V_2S_4 (BARI capsicum-2 with 12 dS/m) gave least performance.

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