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Effect of salinity on agro-morphogenic traits of tomatillo genotypes

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ABSTRACT

A pot experiment was conducted in the net house of Department of Genetics and Plant Breeding, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh, during the period of November, 2017 to March, 2018 to observe the performance of four tomatillo genotypes under three salinity (NaCl) treatments based on their agro-morphogenic traits. A two factorial experiment was conducted which included four tomatillo genotypes (Factor A) *viz.* G_1 (SAU tomatillo 1), G_2 (SAU tomatillo 2), G_3 (PI003), G_4 (PI004) and two salinity (NaCl) treatments with a control (Factor B) *viz.* T_1 (Control), T_2 (8 dS/m), T_3 (12 dS/m) and was outlined in Completely Randomized Design (CRD) with three replications. The observed results showed that, both of four tomatillo genotypes (G) and three salinity treatments (T) had their independent significant influence and also had significant influence in their G×T interaction between different agro-morphogenic traits. Almost all traits responded negatively (%reduction) under the increased level of salinity treatments. Considering the minimum %reduction in yield and its contributing traits under both slightly (T_2: 8 dS/m) and moderately (T_3: 12 dS/m) salinity condition, genotype G_1 and G_3 could be recommended for cultivation and further trial in the salinity affected southern region of Bangladesh. The maximum reduction in days to maturity was found in genotype G_1 and G_4 and could be served as parent materials for further hybridization or genetic transformation program.

Introduction

The tomatillo, *Physalis ixocarpa* Brot. or *P. philadelphica* Lam. (2n=2x=24), is an important crop in Mexico, and now-a-days both cultivated and weedy annuals have been introduced and appreciated worldwide. It is an allogamous, annual plant of Solanaceae family under the angiosperm genus *Physalis*. Tomatillo plants bear small, spherical and bright green (*Physalis philadelphica* Lam.) or green-purple (*Physalis ixocarpa* Brot.) fruits surrounded by an inedible, paper-like husk formed from the calyx (Morton, 1987). Thus, it is also known as the "Mexican husk tomato". Tomatillos are slightly acidic true berries with many tiny seeds. Fruits are harvested when the fruits fill the calyx. It is a highly nutritious fruit with a combination of vitamins and minerals. Edible fruit contains high dietary fiber, pectin, vitamin-A, vitamin-C, vitamin-K, niacin, riboflavin, thiamin, β-carotenes (zeaxanthin and lutein), calcium (Ca), iron (Fe), magnesium (Mg), manganese (Mn), phosphorous (P), potassium (K) and copper (Cu) (Yamaguchi,

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1983). Fruits are rich in antioxidants, like withanolides (ixocarpalactone A, ixocarpalactone B, philadelphicalactone B, and withaphysacarpin). Withanolides (e.g. IxoA) are potent inducers of quinone reductase, which is more powerful in preventing colon cancer than chemotherapy (Choi *et al*., 2006). Tomatillos are the key ingredient of Mexican cuisine, particularly salsa verde (Escobar *et al*., 2014; Waterfall, 1958). Fruits are often used in jams, preserves, stews, soups, salads, curries, stir-fries, baking, cooking with meats, marmalade, and desserts (Morton, 1987).

Though tomatillos are native to Mexico and Central America, and they are presently one of the most important crops in Mexico (Cantwell *et al.,* 1992), being the fourth vegetable in production surface with an area of 47,473 ha in 2009 (Borja-Bravo *et al*., 2013). Nowadays it is also cultivated in India, Australia, South Africa, USA and even in Bangladesh. Tomatillo has been recently introduced in our country as a vegetable crop by the Department of Genetics and Plant Breeding, Sher-e-Bangla Agricultural University, Dhaka in 2013. Even two varieties of tomatillo have been released named SAU tomatillo 1 and SAU tomatillo 2 in 2016 (Reza, 2016). Previous several researches exhibited that tomatillo is a high yielding crop in our country's aspect than its origin, Mexico (Karim, 2016). Our Rabi season atmosphere has found to be highly favorable for growing tomatillo. Now, further efforts are obligatory to observe the performance of tomatillo under different biotic and abiotic stress condition.

Salinity is one of the major problem of coastal regions of our country, like Jessore, Narail, Gopalganj, Shariatpur, Chandpur, Satkhira, Khulna, Bagerhat, Pirozpur, Jhalakati, Barguna, Barisal, Patuakhali, Bhola, Lakshmipur, Noakhali, Feni, Chittagong, and Cox's Bazar. Coastal area covers about 20% of Bangladesh and over 30% of the net cultivable area. The cultivable areas in coastal districts are affected with varying degrees of soil salinity because lands are characterized by tides and salinity from the Bay of Bengal. The higher salinity levels have adverse impacts on agriculture. To overcome this problem, saline soils can be used to grow salt tolerant crop plants. Thus development of salinity stress tolerant crops is a key to global agricultural goal. As a newly introduced crop, tomatillo needs many further research in terms of its yield and yield contributing traits and whether it shows any particular resistance or tolerance for biotic and abiotic stresses in respect of our country's atmosphere. This current study was conducted directing to observe the growth and yield of tomatillo genotypes under different salinity condition and to determine the response of genotype × treatment interaction based on their agro-morphogenic traits in order to select the best recommendable salt tolerant tomatillo genotypes for growing in the salinity affected southern region and coastal belt of Bangladesh.

Materials and Methods

***Duration of the experiment*:** The experiment was conducted in the net house of Department of Genetics and Plant Breeding of Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh during the period of November, 2017 to March, 2018 (Rabi season).

***Experimental site*:** The location of the site was 23°74' N latitude and 90°35' E longitude with an elevation of 8.6 meter from sea level in Agro-ecological zone of "Madhupur Tract" (AEZ-28).

***Climate and soil*:** Experimental site was located in the subtropical climatic zone, set aparted by plenty of sunshine and moderately low temperature prevails during October to March (Rabi season) which is suitable for growing crops in Bangladesh. The soil was sandy loam in texture having pH of 5.46 to 5.62 and EC of 0.60 dS/m with 0.82% of organic carbon content.

***Experimental materials*:** Tomatillo genotypes used in the study were collected from the Department of Genetics and Plant Breeding, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh on

October, 2017. A two factorial experiment was conducted which included **Factor A:** four tomatillo genotypes (Table 1) and **Factor B:** two salinity (NaCl) treatments with a control (Table 2) as experimental materials. Salinity treatments were chosen by the classification of saline area given by Soil Research Development Institute, Bangladesh (Report, 2010).

Table 1. List of four tomatillo genotypes (Factor A) used in the experiment.

Sl. No.	Genotypes	Name/ Accession No.	Source of Collection
1.	G_1	SAU tomatillo 1	GEPB, SAU
2.	G_2	SAU tomatillo 2	GEPB, SAU
3.	G_3	PI003	GEPB, SAU
4.	G_4	PI004	GEPB, SAU

GEPB=Department of Genetics and Plant Breeding, SAU = Sher-e-Bangla Agricultural University

Table 2. List of salinity treatments (Factor B) of NaCl used in the experiment.

Sl. No.	Salinity Treatments	Electrical Conductivity (dS/m)	Types of Salinity
1.	T_1	Control	Non-saline
2.	T_2	8.0	Slightly saline
3.	T_3	12.0	Moderately saline

***Design and layout*:** The experiment was outlined in Completely Randomized Design (CRD) with three replications using two factors. Factor A included four tomatillo genotypes and Factor B included two salinity treatments with a control. The experiment was conducted in three replications and total 36 plastic pots were used for the study.

***Seed sowing, pot preparation and transplantation*:** The seed sowing was carried out on November 9, 2017 in the well prepared seedbed of Research Farm of Sher-e-Bangla Agricultural University. Seeds were sown in rows spaced at 10 cm apart. Recommended cultural practices were taken up before and after seed sowing. When the seedlings became 21 days old on December 1, 2017, the seedlings were transplanted into the main plastic pots. The size of the main pot was of 20 cm of height with top diameter of 30 cm and bottom diameter of 20 cm. Pots were filled up with soil on November 28, 2017, two days before of the transplantation. Soil of the main pots was well prepared according to the Fertilizer Recommendation Guide released by BARC in 2012. Each plastic pot was filled up with 10 kg of soil containing 100 g of well decomposed cow dung (as 10 tons/ha).

***Salinity treatment*:** Saline water application was started to the selected pots at 7 days after transplanting (DAT) to help the well establishment of young seedlings. Plants in control were not exposed to salinity and were always irrigated with fresh (non-saline) water; whereas plants of salinity treatments were treated with 8 dS/m and 12 dS/m level of salinity in irrigation water. Electrical conductivity (EC) of different salinity levels in soil was adjusted by a direct reading conductivity meter (EC-meter). Salt solution (calculated) was applied 1 litre/pot in 3 to 4 days interval to maintain the exact salinity level in the soil. When soil in the pots was seemed to reach in water logging condition, then saline water was given after the soil was reached near in dried condition (visual observation).

***Intercultural operation and harvesting*:** All necessary intercultural operations were done as per requirement. Harvesting of fruits was done after reaching to its maturity (greenish to light greenish or yellowish in color). Harvesting was started from February 17, 2018 and completed by March 10, 2018.

***Statistical analysis*:** All the collected data were statistically analyzed by using MSTAT-C computer package program. Means for every treatment were calculated and analysis of variance (ANOVA) was performed for each character which was analyzed by F-test (Variance Ratio). Comparison between treatment means (all pair comparison) was assessed by Least

Significant Difference (LSD) test at 5% level of significance (Gomez and Gomez, 1984).

Results and Discussions

The experimental data were recorded based on different agro-morphogenic traits of tomatillo *viz.*, days to first flowering, plant height (cm), days required to maturity, number of fruits per plant, average fruit length (mm) per plant, average fruit diameter (mm) per plant, average fruit weight (g) per plant and yield (kg) per plant. From the analysis of variance (ANOVA) (Table 3), it was observed that genotypic effects were significant for all the characters under this study which indicate the presence of variation among the genotypes for these traits. The salinity treatments were also significantly influenced these characters. The genotype × treatment interaction showed significant variation for most of the characters.

Table 3. Analysis of variance of different agro-morphogenic traits of tomatillo.

SV	df	MSS							
		DFF	**PH**	**DM**	**NFP**	**AVL**	**AFD**	**AFW**	**YP**
A	3	21.741*	33.785*	79.185**	77.657**	210.711**	294.321**	679.396**	0.242**
B	2	128.111**	38.715*	526.750**	75.028**	332.202**	387.963**	174.807**	0.164**
A×B	6	1.741^{NS}	27.549*	40.935*	3.880**	9.152**	16.553**	2.763**	0.012**
Error	22	5.679	9.967	10.303	0.498	1.613	1.426	0.482	0.001

**Significant at 0.01 level of probability, *Significant at 0.05 level of probability, ^{NS}Non-significant, A= Genotype, B= Salinity, SV= Source of variation, df= Degrees of freedom, MSS= Mean sum square of, DFF= days to first flowering, PH= plant height (cm), DM= days required to maturity, NFP= number of fruits per plant, AVL= average fruit length (mm) per plant, AFD= average fruit diameter (mm) per plant, AFW= average fruit weight (g) per plant, YP= yield (kg) per plant.

Days to first flowering**:** Research findings showed statistically significant variation among the tomatillo genotypes in respect of days to first flowering after transplantation (Table 3). The longest period required for first flowering was found in genotype G_4 (36.11 days) which was statistically identical with G_2 (35.00 days) while the shortest required period was in G_3 (32.78 days) which was statistically identical with G_1 (33.22 days) (Table 4).

Table 4. Performance of tomatillo genotypes on agro-morphogenic traits.

Genotype	DFF	PH	DM	NFP	AVL	AFD	AFW	YP
G_1	33.22 b	65.00 b	87.44 ab	13.22 c	25.69 a	29.52 a	30.57 a	0.404 b
G_2	35.00 a	67.55 a	86.67 b	11.33 d	20.20 b	24.28 b	18.67 c	0.212 c
G_3	32.78 b	65.67 b	90.56 a	18.22 a	25.42 a	30.48 a	28.71 b	0.523 a
G_4	36.11 a	68.50 a	83.33 c	15.11 b	15.52 c	18.04 c	12.10 d	0.183 d
CV%	6.95	4.73	3.69	4.87	5.85	4.67	3.08	6.59
LSD 0.05	1.33	1.09	2.14	0.69	1.24	1.17	0.68	0.02

Note: Values with the same letter are not significantly different.

Statistically highly significant variation was found among salinity treatments; T_1 (Control), T_2 (8 dS/m) and T_3 (12 dS/m) in terms of days to first flowering (Table 3). The longest period required for first flowering was in T_1 (37.33 days) and the shortest required period was in T_3 (30.84 days) (Table 5). This result showed that days required for first flowering was earlier in T_3 (12 dS/m) than T_1 (control). Interaction effect between tomatillo genotypes and salinity treatments was found statistically non-significant for days to first flowering (Table 3). Interaction G_4T_1 (40.00 days) required the maximum period for first flowering whereas interaction G_1T_3 (29.67 days) required the minimum period (Table 6).

Table 5. Performance of salinity treatments on agro-morphogenic traits.

Salinity Treatment	DFF	PH	DM	NFP	AVL	AFD	AFW	YP
T_1 (control)	37.33 a	68.63 a	93.58 a	16.67 a	27.05 a	31.44 a	26.34 a	0.439 a
T_2 (8dS/m)	34.67 b	65.08 b	87.08 b	15.00 b	21.57 b	25.21 b	22.49 b	0.337 b
T_3 (12dS/m)	30.83 c	66.33 b	80.33 c	11.75 c	16.52 c	20.08 c	18.71 c	0.220 c
CV%	6.95	4.73	3.69	4.87	5.85	4.67	3.08	6.59
LSD 0.05	2.02	1.67	2.72	0.60	1.08	1.01	0.59	0.02

Note: Values with the same letter are not significantly different.

Table 6. Interaction effect of tomatillo genotypes and salinity treatments on agro-morphogenic traits.

Interaction	DFF	PH	DM	NFP	AVL	AFD	AFW	YP
G_1T_1	36.33	66.00 bc	95.33 ab	16.33 c	34.01 a	38.81 a	35.29 a	0.576 b
G_1T_2	33.67	64.00 bc	87.67 cde	13.67 ef	24.33 c	28.23 d	30.53 c	0.417 d
G_1T_3	29.67	65.00 bc	79.33 gh	9.67 h	18.74 e	21.51 fg	25.88 e	0.250 g
G_2T_1	37.67	74.33 a	92.67 bc	13.33 f	24.85 c	30.07 cd	22.25 g	0.297 f
G_2T_2	35.67	64.50 bc	87.00 de	11.67 g	20.26 de	22.58 f	18.92 h	0.221 gh
G_2T_3	31.67	63.83 c	80.33 fgh	9.00 h	15.50 f	20.18 gh	14.85 i	0.134 i
G_3T_1	35.33	66.50 bc	96.00 a	21.33 a	29.43 b	34.99 b	33.17 b	0.708 a
G_3T_2	32.67	63.33 c	90.00 bcd	18.67 b	25.88 c	31.64 c	28.41 d	0.530 c
G_3T_3	30.33	67.17 bc	85.67 def	14.67 de	20.96 d	24.81 e	24.55 f	0.360 e
G_4T_1	40.00	67.67 bc	90.33 bcd	15.67 cd	19.89 de	21.89 fg	14.64 i	0.229 gh
G_4T_2	36.67	68.50 bc	83.67 efg	16.00 c	15.79 f	18.39 h	12.11 j	0.194 h
G_4T_3	31.67	69.33 ab	76.00 h	13.67 ef	10.89 g	13.83 i	9.54 k	0.130 i
CV %	6.95	4.73	3.69	4.87	5.85	4.67	3.08	6.59
LSD 0.05	---	5.35	5.44	1.19	2.15	2.02	1.18	0.04

Note: Values with the same letter are not significantly different.

The time required for first flowering of four tomatillo genotypes decreased gradually with the increase of salinity levels (%reduction). The maximum reduction in days to first flowering was observed in G_4 in both cases, at T_2 (8 dS/m) and T_3 (12 dS/m) treatments (8.33% and 20.83% respectively). The minimum reduction was observed in G_2 (5.31%) at slightly salinity (8 dS/m) whereas in G_3 (14.15%) at moderate salinity (12 dS/m) condition (Table 7).

***Plant height (cm)*:** In this experiment, statistically significant variation was existed among the tomatillo genotypes in case of plant height (cm) (Table 3). The tallest plant was obtained from G_4 (68.50 cm) which was statistically identical with G_2 (67.55 cm) whereas the shortest one was found from G_1 (65.00 cm) which was statistically identical with G_3 (65.67 cm) (Table 4). Tomatillo genotypes showed statistically significant variation to salinity treatments for plant height (cm)

(Table 3). The tallest plant was found in T_1 (68.63 cm) whereas the shortest plant was from T_2 (65.08 cm) which was statistically identical with T_3 (66.33 cm) (Table 5). Interaction effect between tomatillo genotypes and salinity treatments performed significant variation in respect of plant height (cm) (Table 3). The tallest plant was found in G_2T_1 (74.33 cm) which was statistically identical with G_4T_3 (69.33 cm) while the shortest plant was found in G_3T_2 (63.33 cm) which was statistically identical with G_2T_3 (63.83 cm) (Table 6). The plant height of four tomatillo genotypes was decreased gradually with the increase of salinity treatment levels (%reduction).

Table 7. Reduction percentage in agro-morphogenic traits of tomatillo under increasing salinity.

	DFF		PH		DM		NFP		AVL		AFD		AFW		YP	
	T_2	**T_3**	**T_2**	**T_3**	**T_2**	**T_3**	**T_2**	**T_3**	**T_2**	**T_3**	**T_2**	**T_3**	**T_2**	**T_3**	**T_2**	**T_3**
G_1	7.32	18.33	3.03	1.52	8.04	16.78	16.29	40.78	28.46	44.90	27.26	44.58	13.49	26.66	27.60	56.60
G_2	5.31	15.93	13.22	14.13	6.12	13.32	12.45	32.48	18.47	37.63	24.91	32.89	14.97	33.26	25.59	54.88
G_3	7.53	14.15	4.77	-1.01	6.25	10.76	12.47	31.22	12.06	28.78	9.57	29.09	14.35	25.99	25.14	49.15
G_4	8.33	20.83	-1.23	-2.45	7.37	15.86	-2.11	12.76	20.61	45.25	15.99	36.82	17.28	34.84	15.28	43.23

The maximum reduction in plant height was observed in G_2 in both cases, at T_2 (8 dS/m) and T_3 (12 dS/m) salinity (13.22% and 14.13% respectively) and the minimum reduction was observed in G_1 in both cases, at slightly (8 dS/m) and moderately (12 dS/m) salinity (3.03% and 1.52% respectively). Plant height was found to decrease gradually with the increase of salinity levels. Salinity was attributed to the reduction in water content and water potential of plant tissues, which resulted in internal water deficit to plants (Hishida *et al.*, 2013). Accumulation of Na^+, Cl^- and retardation in the uptake of macronutrients especially Na^+ and Ca^{2+} cause reduction in plant growth (Juan *et al*., 2005; Dasgan *et al*., 2002). Whereas, genotype G_4 showed increase in plant height at T_2 (8 dS/m) and T_3 (12 dS/m) salinity (-1.23% and -2.45% respectively) (Table 7). According to Naidoo *et al.* (1995), the stimulatory effect of moderate salinity on growth of some plants can improve their growth and it may be due to the improved shoot osmotic status as a result of increasing ions uptake. The obtained results were matched with those obtained by Achilea, 2002; Agong *et al*., 2004; Zaki *et al*., 1987.

***Days to maturity*:** Findings showed statistically highly significant variation among different tomatillo genotypes for days required to maturity (from days after transplanting to days of first harvesting) (Table 3).

The longest maturity (first harvesting) period was required in G_3 (90.56 days) which was statistically identical with G_1 (87.44 days) whereas the shortest maturity period was required for G_4 (83.33 days) (Table 4). Tomatillo genotypes showed statistically highly significant variation to salinity treatments; T_1 (Control), T_2 (8 dS/m) and T_3 (12 dS/m) in terms of days to maturity (Table 3). The earliest fruit harvesting was performed in T_3 (80.33 days) and the most delayed harvesting was performed in T_1 (93.58 days) (Table 5). This result showed that maturity time of tomatillo plant was decreased under the increased level of salinity. Similar results were also found by Agarwal *et al*., 2005 and Ghadiri *et al*., 2005. Interaction between tomatillo genotypes and salinity treatments was found statistically significant in respect of days to maturity (Table 3). The earliest fruit harvesting period was observed in G_4T_3 (76.00 days) which was statistically identical with G_1T_3 (79.33 days) and G_2T_3 (80.33 days) whereas G_3T_1 (96.00 days) was the most delayed one which was statistically identical with G_1T_1 (95.33 days) (Table 6). The time required for days to maturity of tomatillo genotypes was decreased gradually with the increase of salinity treatment (%reduction). The maximum reduction was observed in the G_1 in both cases, at T_2 (8 dS/m) and T_3 (12 dS/m) (8.04% and 16.78% respectively) and the minimum reduction was observed in G_2 (6.12%) at T_2 (8 dS/m) whereas in G_3 (10.76%) at T_3 (12 dS/m) salinity stress (Table 7).

Number of fruits per plant**:** This experiment showed statistically highly significant variation among different tomatillo genotypes in case of number of fruits per plant (Table 3). The maximum number of fruits was obtained from G_3 (18.22 fruits/plant) whereas the minimum number of fruits was found in G_2 (11.33 fruits/plant) (Table 4). Tomatillo genotypes showed statistically highly significant variation to salinity treatment levels for number of fruits per plant (Table 3). The highest number of fruits per plant was found in T_1 (16.67 fruits/plant) and the lowest number of fruits was found in T_3 (11.75 fruits/plant) (Table 5). This result showed that number of tomatillo fruits per plant was decreased under the increase of salinity level. According to Islam *et al*. (2011), the maximum number of fruits per plant was found in control and the number was decreased gradually with the increase of salinity stress. Similar results were also found by Siddiky *et al*. (2012) and Al-Yahyai *et al*. (2010). Interaction between tomatillo genotypes and salinity treatments was found statistically highly significant for number of fruits per plant (Table 3). The highest number of fruits was obtained from G_3T_1 (21.33 fruits/plant) whereas the lowest number of fruits was obtained from G_2T_3 (9.00 fruits/plant) which was statistically identical with G_1T_3 (9.67 fruits/plant) (Table 6). Number of fruits obtained from per plant of four tomatillo genotypes was decreased gradually with the increase of salinity level (%reduction). The maximum reduction in number of fruits per plant was found in G_1 in both cases, at T_2 (8 dS/m) and T_3 (12 dS/m) (16.29% and 40.78% respectively) whereas the minimum reduction was found in G_2 (12.45%) at T_2 (8 dS/m) and in G_4 (12.76%) at T_3 (12 dS/m) salinity level (Table 7). Here, genotype G_4 (-2.11%) showed increased number of fruits per plant at slightly (8 dS/m) salinity level. Such stimulatory effect of low salinity levels on yield and its components were mentioned by Babu and Thirumurugan (2001) who noted that yield components were increased under low salinity level; further increase in salinity, decreased the yield parameters. The obtained results were also matched with those reported by Maggio *et al.*, 2007; Al-Harbi *et al*., 2009; Al-Omran *et al*., 2010 and Al-Harbi *et al*., 2015.

Average fruit length (mm)**:** The observed result showed statistically highly significant variation for average fruit length (mm) per plant among tomatillo genotypes (Table 3). The longest fruit was found from G_1 (25.69 mm) which was statistically identical with G_3 (25.42 mm) while the shortest one was found from G_4 (15.52 mm) (Table 4). Tomatillo genotypes also showed statistically highly significant variation to different salinity treatment; T_1 (Control), T_2 (8 dS/m) and T_3 (12 dS/m) for average fruit length (mm) per plant (Table 3). The longest fruit was found in T_1 (27.05 mm) while the shortest fruit was found in T_3 (16.52 mm) (Table 5). This result showed that average fruit length of tomatillo was decreased under the increase of salinity levels because salinity has a deleterious effect on cell expansion phase due to low water content in the fruit (Hao *et al*., 2000, Edris *et al*., 2012 and Magan *et al*., 2008). Supply of water into the fruit under saline conditions is restricted by lower water potential in the plant (Johnson *et al*., 1992). Interaction between tomatillo genotypes and salinity treatments was found statistically highly significant for average fruit length (mm) per plant (Table 3). The longest fruit was found from G_1T_1 (34.01 mm) whereas the shortest fruit was found from G_4T_3 (10.89 mm) (Table 6). The average fruit length (mm) of four tomatillo genotypes decreased gradually with the increase of salinity treatment (%reduction). The maximum reduction in average fruit length per plant was observed in G_1 (28.46%) at T_2 (8 dS/m) and in G_4 (45.25%) at T_3 (12 dS/m) whereas the minimum reduction was observed in G_3 in both cases, at slightly (8 dS/m) and moderately (12 dS/m) salinity (12.06% and 28.78% respectively) (Table 7).

***Average fruit diameter (mm)*:** Statistically highly significant variation was found in the study for average fruit diameter (mm) per plant among four tomatillo genotypes (Table 3). The maximum diameter of fruit was found in G_3 (30.48 mm) which was statistically identical with G_1 (29.52 mm) while the minimum fruit diameter was found in G_4 (18.04 mm) (Table 4). Statistically highly significant variation was found in tomatillo genotypes exposed to different salinity treatments; T_1 (Control), T_2 (8 dS/m) and T_3 (12 dS/m) in respect of average fruit diameter (mm) per plant (Table 3). The widest fruit was found in T_1 (31.44 mm) while the narrowest fruit was found in T_3 (20.08 mm) (Table 5). Reduction in fruit diameter due to the increase of salinity levels was also found by Edris *et al*. (2012). Interaction between tomatillo genotypes and salinity treatment showed highly significant variation for average fruit diameter (mm) per plant (Table 3). The maximum diameter of fruit was obtained from G_1T_1 (38.81 mm) whereas the minimum fruit diameter was from G_4T_3 (13.83 mm) (Table 6). Results showed that average fruit diameter of tomatillo was decreased gradually under the increasing salinity levels (%reduction). The maximum reduction in average fruit diameter (mm) per plant was observed in G_1 in both cases, T_2 (8 dS/m) and T_3 (12 dS/m) (27.26% and 44.58% respectively) whereas the minimum reduction was observed in G_3 in both cases, at T_2 (8 dS/m) and T_3 (12 dS/m) (9.57% and 29.09% respectively) (Table 7).

***Average fruit weight (g)*:** This experiment showed statistically highly significant variation for average fruit weight (g) per plant among the tomatillo genotypes (Table 3). The maximum weight of tomatillo fruit was found in G_1 (30.57 g) and the minimum fruit weight was found in G_4 (12.10 g) (Table 4). Statistically highly significant variation was also found in tomatillo genotypes exposed to different salinity treatments; T_1 (Control), T_2 (8 dS/m) and T_3 (12 dS/m) in respect of average fruit weight (g) per plant (Table 3). The maximum weight of fruit was found in T_1 (26.34 g) while the minimum fruit weight was found in T_3 (18.71 g) (Table 5). Reduction in single fruit weight per plant due to the increase of salinity levels was found by Al-Yahyai *et al*. (2010) and Islam *et al*. (2011). Supply of water into the fruit under saline conditions is restricted by a lower water potential due to excessive accumulation of toxic ions. Less water flow in the fruit causes reduction in fruit size and weight (Munns, 2002). Interaction of tomatillo genotypes and salinity treatments was found statistically highly significant for average fruit weight (g) per plant (Table 3). The maximum weight of fruit was found from G_1T_1 (35.29 g) whereas the minimum fruit weight was found from G_4T_3 (9.54 g) (Table 6). The average fruit weight (g) per plant of four tomatillo genotypes was decreased gradually with the increase of salinity levels (%reduction). The maximum reduction in average fruit weight per plant was observed in G_4 in both cases, at T_2 (8 dS/m) and T_3 (12 dS/m) salinity level (17.28% and 34.84% respectively) whereas the minimum reduction was observed in G_1 (13.49%) at T_2 (8 dS/m) and in G_3 (25.99%) at T_3 (12 dS/m) salinity (Table 7).

***Yield per plant (kg)*:** In this experiment, statistically highly significant variation was found for yield of (mature) fruit per plant among the tomatillo genotypes (Table 3). The highest yield per plant of tomatillo was obtained from G_3 (0.523 kg/plant) and the lowest yield per plant was from G_4 (0.183 kg/plant) (Table 4). Statistically highly significant variation was found in tomatillo genotypes exposed to different salinity treatments; T_1 (Control), T_2 (8 dS/m) and T_3 (12 dS/m) in respect of yield of fruit (kg) per plant (Table 3). The highest yield of fruit was found in T_1 (0.439 kg/plant) while the lowest fruit yield was found in T_3 (0.220 kg/plant) (Table 5). This result showed that yield of fruit per plant was decreased under the increasing salinity levels. Salinity stress can reduce the fruit number and average fruit weight per plant and thus, in case of high salinity levels the total fruit weight per plant can be reduced (Siddiky *et al*., 2012; Islam *et al*., 2011). Interaction between tomatillo genotypes and salinity treatments was found statistically highly significant for yield of fruit (kg) per plant (Table 3). The highest yield of fruit was found in G_3T_1 (0.708 kg/plant) whereas the lowest fruit yield was found in G_4T_3 (0.130 kg/plant) which was statistically identical with G_2T_3 (0.134 kg/plant) (Table 6). The yield of fruit (kg) per plant of four tomatillo genotypes decreased gradually with the increase of salinity levels (%reduction). The maximum reduction in yield of fruit per plant was observed in G_1 in both cases, at T_2 (8 dS/m) and T_3 (12 dS/m) (27.60% and 56.60% respectively) whereas the minimum reduction was observed in G_4 at both slightly (8 dS/m) and moderately (12 dS/m) salinity (15.28% and 43.23% respectively) (Table 7).

Conclusion

A large amount of area in the southern region of Bangladesh still remains uncultivated due to the high level of soil salinity. Alarmingly salinity affected areas are increasing rapidly due to the global climate change. On the other hand, the rapid growth of population needs an increase in food production. For sustainable solution of this problem, cultivation of modern high yielding salt tolerant variety and to bring the uncultivable saline lands under cultivation is apparent. Thus, screening and selection as well as introduction and development of new salt tolerant crops and genotypes are major goal of global agriculture now-a-days. As a newly introduced crop of our country, tomatillo was taken to consideration for this experiment to observe its tolerance to salinity stress and whether it is possible to recommend this crop for cultivation in our salinity affected southern regions. The analyzing data of the present study demonstrates that genotype G_1 and G_3 showed minimum reduction in yield contributing traits *viz*., fruit numbers, fruits length, fruit diameter, fruit weight and yield under T_2 (8 dS/m) and T_3 (12 dS/m) salinity condition. Thus, G_1 and G_3 could be recommended for cultivation (G_1) and further trial (G_3) in the Southern region of Bangladesh. Maximum reduction in days to maturity was observed in G_1 followed by G_4 under slightly (8 dS/m) and moderately (12 dS/m) salinity, thus indicating it's owing of short duration behavior and could be served as parent materials for further hybridization or genetic transformation program.

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