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SCREENING OF MANGO ROOTSTOCK FOR SALINE TOLERANCE

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ABSTRACT

An experiment was conducted at Fruit Tree Improvement Project, Fruit Tree Improvement Programme, Bangladesh Agricultural University-Germplasm Center (FTIP, BAU-GPC), Bangladesh Agricultural University (BAU), Mymensingh during the period of April 2020 to June 2020 to study the performance of selected mango rootstocks for the saline area. The two-factor experiment consisted of four mango rootstock varieties such as V1 = BAU Aam-9, V2 = BAU Aam-6, V3 = BAU Aam-4 and V4 = Amropali and six salinity treatments namely control S1 = 0 dSm^{-1}, S2 = 4 dSm^{-1}, S3 = 8 dSm^{-1}, S4 = 10 dSm^{-1}, S5 = 12 dSm^{-1} and S6 = 14 dSm^{-1}. The experiment was conducted following randomized complete block design with three replications. Results revealed that rootstock line and salinity levels had significant influences on various rootstock characters viz. length of rootstocks, number of leaves and percent rootstocks success and survivability. In case of varietal effect, the highest number of leaves (32.44) found in BAU Aam-6 and the lowest number of leaves was recorded in Amropali (22.55) at 90 days after transplanting. The longest rootstock length observed in 90 DAT which (54.83 cm) found in BAU Aam-9and shortest rootstock recorded in Amropali (47.94 cm). The highest survivability (51.44%) was recorded in BAU Aam-9 and the lowest survivability recorded in Amropali (33.88%). In case of salinity treatments, the highest survivability (95.83%) was recorded in control and the lowest survivability (0.00%) recorded in 14 dsm^{-1} at 90 DAT. Interaction of rootstock varieties and different salinity treatments showed significant variation on the length leave and survivability of rootstocks at 90 DAT. The maximum number of rootstock leaves recorded in V2S2 (46.33) and lowest number of leave recorded in V4S6 (7.66). The highest rootstock length was found in V1S3 (78.00 cm) and lowest in V1S2 (21.66 cm). The highest Survivability (100 %) observed in V1S1, V1S2, V2S1, V2S2 and V4S1. From the above mentioned it can be said BAU Aam - 9 and BAU Aam – 6 rootstock varieties performed best from 0-8 dSm-1 salinity. The overall salinity tolerance was graded as follows: BAU Aam - 9>BAU Aam – 6> BAU Aam-4>Amropali rootstock line.

Keywords: Mango, Rootstock, Salinity, Screening

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INTRODUCTION

Mango (*Mangifera indica* L.), a tropical and sub-tropical fruit belongs to the family Anacardiaceae which was originated in the Eastern India, Asam, Myanmar or in the Malayan region (Mukherjee, 1997). Bangladesh has achieved significant progress in mango production, only 1165804 M. tons from an area of 44365 hectares with an average yield of 26.27 t ha^{-1} (BBS, 2018) which is very high compared to that of other mango growing countries like India (8.95 t ha^{-1}), the Philippines (9.41 t ha^{-1}) (Ghosh, 1998; Espino and Javier, 1989). Mango has a unique position in respect of nutritional quality, taste and consumer's performance etc. It grows in almost all p arts of Bangladesh but commercial and good quality of mangoes are mostly grown in the North-western districts due to the favorable soil and climate conditions and mangoes of unknown varieties (seedling mango) are mostly grown in the south -Eastern other parts of the country.

In Bangladesh, mango is mainly grown by smallholder farmers as a source of food to meet their dietary (vitamins and minerals) needs, household income for resource poor farmers and earns foreign exchange as an export crop. Mango is delicious, nutritionally superior and very rich source of vitamins and minerals which make it as a most valuable fruits in the world. Ripe mango contains high amount of carotene & vit-c and provides energy as much as 74 kcal per 100g edible portion that is nearly the equals' energy values of boiled rice of similar quantity by weight (Hossain, 1989a). Though mango is the leading seasonal cash crop of the country's northwestern region and dominates its economy but the existing production of mango falls appreciably short to fulfill the national demand. Fruits are always an important part of human diet. In Bangladesh, the minimum dietary requirement of 85g per head per day, whereas present availability is 30-35 g (Anonymous, 1995). In another report showed that the present availability of fruits is only 70-75 gas against the minimum dietary requirement of 120g per head per day (BBS, 2010).

For quality mango production in Bangladesh, there are a lot of problems such as saline, drought pests attack, insufficient knowledge for application of organic manures & pesticides, post-harvest loss reduction techniques, proper irrigation proper orchard sanitation etc. The production and marketing of mango are affected by a variety of factors of which pests and diseases are regarded to be one of the major constraints. In Bangladesh, a general decreasing trend in area and production of mango is observing during 1994-95 to 2003-04 (BBS, 2004). All mango rootstock did not grow well in saline prone area. Salinity is one of the major abiotic stress factors, which restricts plant growth and yield, and is a major threat to agriculture sustainability. It has been estimated that 20% of the irrigated land in the world is presently affected by the salinity (Yamaguchi and Blumwald 2005). The need for information concerning the tolerance and mineral nutrition of the mango rootstocks in the saline zones, and thus concerning the impact of salinity on fruit yield, has direct economic implications. In addition, mango is considered sensitive to saline

conditions (Maas, 1986), leading to scorched leaf tips and margins, leaf curling, and in severe cases reduced growth, abscission of leaves, and death of trees (Jindal et al., 1976 a).

The information or research work with mango in saline area of southern belt is very limited. Mango production is hampered due to restricted growth of the plant, root expansion hampered, low success and survivability due to high salinity. Considering the above facts, the present research work was undertaken to observe the mango rootstock performance for saline areas and to evaluate the salinity level of selected mango rootstock.

MATERIALS AND METHODS

The experiments were conducted at FTIP, BAU-GPC, Bangladesh Agricultural University (BAU), Mymensingh during the period of April 2020 to June 2020. The experimental area of FTIP, BAU-GPC was under a subtropical climate, which is characterized by heavy rainfall during the months from April to September and scanty rainfall during the rest of the time of the year. The soil of the experimental area belongs to the Old Brahmaputra Floodplain under AEZ 9 of Bangladesh and well-drained high land with sandy loam in soil texture. The soil pH of the experimental site was 6.8. The experiment consisted of two factors i.e. Factor-A: four type of mango rootstocks viz., V1 = BAU Aam -9, V2 = BAU Aam -6, V2 = BAU Aam- 4 and Amropali. Factor-B: six level of soil salinity viz. S1 = Control (0 dSm^{-1}), S2 =4 dSm^{-1} , S3 = 8 dSm^{-1} , S4 = (10 dSm^{-1}), S5 = 12 dSm^{-1} and S6 = 14 dSm^{-1}.A two factor experiment was conducted in a Factorial Randomized Complete Block Design with four replications.

Healthy and heavy stones of four mango varieties were collected and placed in a bucket of water. Only those stones that sunk and touched the bottom of bucket (containing water) were selected. The stones were placed in polybags containing a mixture of soil and cowdung at the ratio of 1:1. One stone was placed in one polybag. After placing the seeds were germinated within 15 to 30 days. The experimental pots are used as half cut plastic drum containing 2-3 aeration holes at bottom for removal of excess water. Total 18 experimental pots were filled by soil; well decompose cowdung, sand & small pitches of broken stones at the ratio of 1:1:1:1. Then we have made artificial saline soil by using lab grade NACL such as 4 dSm^{-1} =55gm, 8 dSm^{-1} = 112gm, 10 dSm^{-1} = 140 gm, 12 dSm^{-1} = 168 gm and 14 dSm^{-1} = 198 gm NACL mixing with 20-liter water for individual treatment respectively and put into drum to saturated soil. Nearly one year mango rootstocks collected from four different types of mango cultivar which were raised in polybags previously & transplanted to the experimental pots. The healthy, vigorous, uniform in size and growth, pest and disease free rootstocks was selected for the experiment. Pots containing healthy and uniform size rootstocks were raised in each rootstock line. Intercultural operations like irrigation, weeding, application of fertilizer, spraying of insecticides and

fungicide were given whenever needed for the good health of stock plant. At first rootstocks were separated from different types of rootstock by their proper identity through individual tagging. Four rootstock lines were arranged according to their identical number for properly data collection as well as performance review of different rootstock lines. All necessary measures were adopted to make the pot free from weeds and create a favorable environment to ensure proper growth and development of grafted plants. Weeding and mulching were done whenever necessary during the period of investigation. As a preventive measure against insect, pest and disease, spraying with insecticide and fungicides were done following a routine schedule. For this, Diazinon and Diathane M-45 @ 2ml liter-1 of water were applied at 7-10 days interval. The recorded data viz. number of leave, length of rootstock and survivability were taken at 30, 60 and 90 DAT (Days After Transplanting) on different parameters of the experiment was tabulated and analyzed. The means of all the treatments were calculated and compared by Least Significant Difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Main effect of rootstock

Results revealed that rootstock line and salinity levels had significant influences on various characters viz. length of rootstocks, number of leaves and percent rootstocks success and survivability. Effect of rootstock significant variation was noticed in the growth of rootstocks from 30 to 90 days after transplanting

Number of leaves on per rootstock

At 30 DAT the highest number of leaves (19.05) found in BAU Aam-6 followed by BAU Aam-9 (18.88) and the lowest number of leaves was recorded in Amropali (15.33) (Table 1). Similar trend was recorded at 60 DAT and 90 DAT. There was trend to increase length with the advancement of days (Table 1).

Rootstock height

At 30 DAT, BAU Aam-9 rootstock length was higher (39.44cm) followed by Amropali (38.94cm). (Table 1). At 60 DAT, the longest rootstock length (47.05cm) found in BAU Aam - 9 followed by BAU Aam-4 (44.11cm), the shortest rootstock length found in BAU Aam – 6 (41.38cm). The longest rootstock length observed in 90 DAT which (54.83cm) found in BAU Aam-9 followed by BAU Aam-6 (49.77) and shortest rootstock recorded in Amropali (47.94). (Table 1).

Rootstock survivability

At 30 DAT, the highest survivability (59.72%) was recorded in BAU Aam - 9 followed by BAU Aam – 6 (58.61%) and the lowest survivability recorded in Amropali (37.16%). At 60 DAT, the highest survivability (55.83%) was recorded in BAU Aam - 9 followed by BAU Aam – 6 (54.05 %) and the lowest survivability recorded in Amropali (30.27%). (Table 1). There was trend to decrease survivability

rate with the advancement of days. At 90 DAT, the highest survivability (51.44%) was recorded in BAU Aam - 9 followed by BAU Aam – 6 (47.44%) and the lowest survivability recorded in Amropali (33.88%) (Table 1).

Table 1. Main effect of rootstock varieties on the length of rootstocks, leaves number and rootstock survivability (%) at different days after transplanting

Treatments	No. of leaves at different days after transplanting			Length of rootstocks at different days after transplanting(cm)			Rootstock survivability (%) at different days after transplanting		
	30	60	90	30	60	90	30	60	90
BAU Aam-9	18.88	24.88	31.16	39.44	47.05	54.83	59.72	55.83	51.44
BAU Aam-6	19.05	25.55	32.44	34.55	41.38	49.77	58.61	54.05	47.44
BAU Aam-4	18.38	22.44	27.77	38.16	44.11	48.44	45.55	43.72	38.33
Amropali	15.33	18.77	22.55	38.94	43.89	47.94	37.16	30.27	33.88
CV (%)	15.50	17.23	19.88	16.81	17.60	20.90	26.80	28.39	32.03
LSD (0.05)	1.86	2.64	3.79	4.26	5.21	7.04	9.05	8.75	9.18

Main effect of salinity

Number of leaves per rootstock

At 30 DAT, the highest number of leaves (23.58) found in control followed by4 dsm^{-1} (20.25) and the lowest number of leaves was recorded in 14 dsm^{-1} (11.83). (Table 2). At 60 DAT the highest number of leaves (31.33) found in control followed by4 dsm^{-1} (28.83) and the lowest number of leaves was recorded in 14 dsm^{-1} (11.83). At 90 DAT the highest number of leaves (41.33) found in control followed by4 dsm^{-1} (39.75) and the lowest number of leaves was recorded in 14 dsm^{-1} (11.83). Here noticed that increase rate of salinity concentration the growth rate of leaves was minimum (Table 2).

Rootstock height

At 30 DAT, Control treatment gave the highest rootstock length (48.08 cm) followed by 4 dsm^{-1} (46.50 cm). The shortest rootstock recorded in 14 dsm^{-1} (28.00 cm) (Table 2). At 60 DAT, the longest rootstock length (59.83 cm) found in Control followed by 4 dsm^{-1} (56.41cm), the shortest rootstock length found in 14 dsm^{-1} (28.16cm). The longest rootstock length observed in 90 DAT which (70.58 cm) found in Control treatment followed by 4 dsm^{-1} (67.50 cm) and the shortest rootstock recorded in 14 dsm^{-1} (25.50 cm) (Table 2).

Rootstock survivability

At 30 DAT, the highest survivability (97.41%) was recorded in control followed by 4 dsm^{-} (95.83%) the lowest was 14 dsm^{-1} (0.00%) (Table 2). At 60 DAT, maximum survivability (95.83%) recorded in control treatment followed by 4 dsm^{-1} (92.50%). and lowest survivability (0.00 %) recorded in 14 dsm^{-1}. At 90 DAT the highest

survivability (95.83 %) was recorded in control followed by 4 dsm^{-1} (92.50%) and lowest survivability (0.00 %) recorded in 14 dsm^{-1}. Srivastava et al. (1989) reported that increases the salinity treatment decreases the rate of survivability of mango. (Table 2).

Table 2. Main effect salinity treatment on the length of rootstocks, number of leaves and rootstock survivability at different days after transplanting

Treatments	No. of leaves at different days after transplanting			Length of rootstocks at different days after transplanting (cm)			rootstock survivability (%) at different days after transplanting		
	30	60	90	30	60	90	30	60	90
Control	23.58	31.33	41.33	46.50	56.41	67.50	97.41	95.83	95.83
4 dsm^{-1}	19.75	28.83	39.75	48.08	59.83	70.58	95.83	92.50	92.50
8 dsm^{-1}	20.25	28.00	35.33	40.66	48.58	58.33	63.75	55.41	54.83
10 dsm^{-1}	18.25	22.00	25.41	32.41	38.75	44.20	32.91	25.83	10.41
12 dsm^{-1}	13.83	15.50	17.25	31.00	32.91	35.33	11.66	6.25	2.916
14 dsm^{-1}	11.83	11.83	11.83	28.00	28.16	25.50	0.00	0.00	0.00
CV(%)	15.50	17.23	19.88	16.81	17.60	20.90	26.80	28.39	32.03
LSD (0.05)	2.28	3.24	4.65	5.21	6.58	8.63	11.09	10.72	11.25

Combined effect of rootstocks and salinity

Interaction of rootstock lines and different salinity treatments showed significant variation on the length, leave and survivability of rootstocks are described below.

Number of leaves per rootstock

Result reveled that highest number of leaves at 30 DAT was found in V1S2 (26.67) followed by V4S1 (26.33) and lowest number of leaves recorded in V4S6 (7.66) (Table 3). Similar trend was observed at 60 DAT. The highest number of leaves was found in V1S2 (35.00) followed by V4S1 (34.00) and lowest number of leaves recorded in V4S6 (7.66). When we observed at the time of 90 DAT maximum leave was recorded in V2S2 (46.33) followed by V1S2 (46.00) (Table 3).

Rootstock length

In case of height at 30 DAT, the highest length was recorded in V4S2 (56.33 cm) followed by V1S2 (55.33 cm) minimum length was recorded in V1S6 (23.33 cm) (Table 3). In case of 60 DAT, the highest length was found in V1S2 (68.33 cm) followed by V4S2 (68.00 cm)) minimum length was recorded in V1S6 (23.33 cm). At the time of 90 DAT the tallest rootstock was observed in V4S2 (78.00 cm) followed by (76.33 cm) and the shortest rootstock was found in V3S6 (21.66 cm) (Table 3).

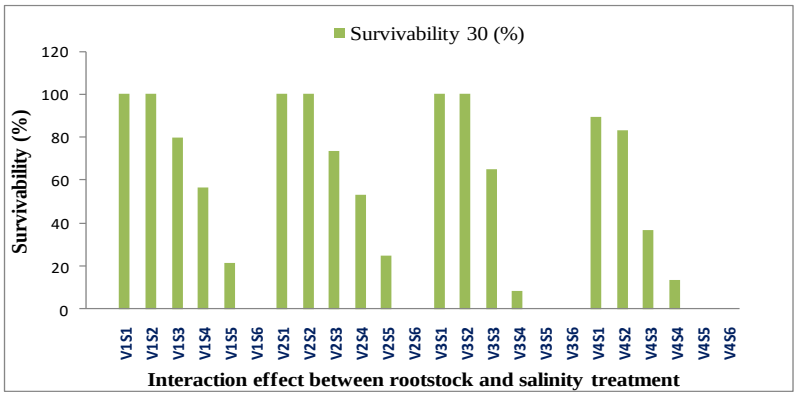
Table 3. Combined effect of rootstocks and salinity treatments on the number of leaves & plant height at different DAT.

Treatments	No. of leaves at different days after transplanting			Length of rootstocks at different days after transplanting (cm)		
	30	60	90	30	60	90
V1S1	20.66	27.66	38.66	50.00	61.00	73.00
V1S2	26.67	35.00	46.00	55.33	68.33	76.00
V1S3	21.33	32.66	41.66	46.00	58.66	76.33
V1S4	17.66	24.00	28.00	35.33	40.33	43.00
V1S5	14.33	17.33	20.00	26.66	30.66	37.33
V1S6	12.66	12.66	12.66	23.33	23.33	23.33
V2S1	22.66	33.66	45.00	41.67	51.00	62.66
V2S2	22.00	34.00	46.33	33.66	44.33	57.00
V2S3	17.66	25.33	34.00	38.66	46.66	56.33
V2S4	22.00	26.66	31.33	37.00	46.33	59.66
V2S5	17.33	21.00	25.33	30.66	34.33	37.55
V2S6	12.66	12.66	12.66	25.66	25.66	25.66
V3S1	24.66	33.00	43.00	45.33	54.33	66.00
V3S2	14.33	21.33	32.66	47.00	58.66	71.33
V3S3	24.33	30.66	38.00	41.33	48.00	55.66
V3S4	17.66	20.33	23.66	31.66	40.00	44.00
V3S5	15.00	15.00	15.00	32.00	32.00	32.00
V3S6	14.33	14.33	14.33	31.66	31.66	21.66
V4S1	26.33	31.00	38.66	49.00	59.33	68.33
V4S2	16.00	25.00	34.00	56.33	68.00	78.00
V4S3	17.66	23.33	27.66	36.66	41.00	45.00
V4S4	15.66	17.00	18.66	25.66	28.33	30.33
V4S5	8.66	8.66	8.66	34.66	34.66	34.66
V4S6	7.66	7.66	7.66	31.33	32.07	31.33
CV(%)	15.50	17.23	19.88	16.81	17.60	20.90
LSD (0.05)	4.56	6.49	9.30	10.44	12.76	17.26

Rootstock survivability

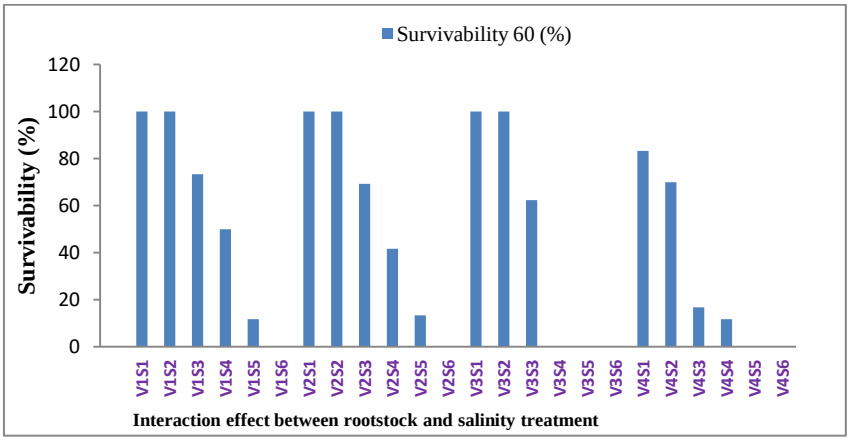
This parameter is very important to conclude the experiment. 100% survivability recorded in six combination which on is- V1S1, V1S2, V2S1, V2S2, V3S1 and V3S2

followed by V4S2 (83.33%) and V1S6, V2S6, V3S5, V3S6, V4S5 and V4S6 performed zero (0) % survivability (Fig.1). Similar result gave at 60 DAT (Fig. 2). At final stage i.e., 90 DAT, the highest Survivability (100%) observed in V1S1, V1S2, V2S1, V2S2 and V4S1 followed by V1S3 (72.00%) and V1S6, V2S5, V2S6, V3S4, V3S5, V3S6, V4S4, V4S5 and V4S6 performed zero (0)% survivability (Fig. 3 and 4).



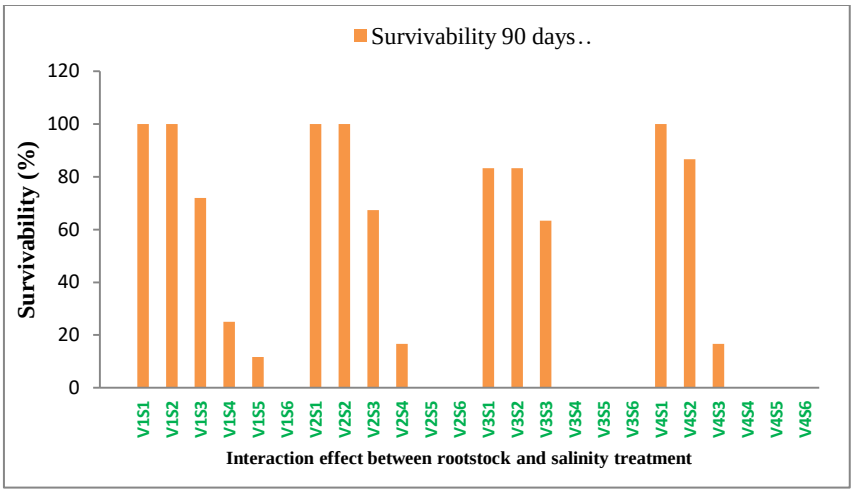
V1= BAU Aam-9, V2= BAU Aam-6, V3= BAU Aam-4, V4= Amropali,
S1= control, S2= 4 dSm^{-1}, S3= 8 dSm^{-1}, S4= 10 dSm^{-1},S5= 12 dSm^{-1}, S6= 14 dSm^{-1}

Figure 1. Combined effect of rootstocks and salinity treatments on the survivability (%) at 30 DAT.



V1= BAU Aam-9, V2= BAU Aam-6, V3= BAU Aam-4, V4= Amropali,
S1= control, S2= 4 dSm^{-1}, S3= 8 dSm^{-1}, S4= 10 dSm^{-1}, S5= 12 dSm^{-1}, S6= 14 dSm^{-1}

Figure 2. Combined effect of rootstocks and salinity treatments on the survivability (%) at 60 DAT.



V1= BAU Aam-9, V2= BAU Aam-6, V3= BAU Aam-4, V4= Amropali,

S1= control, S2= 4 dSm-^{1}, S3= 8 dSm-^{1}, S4= 10 dSm-^{1}, S5= 12 dSm-^{1}, S6= 14 dSm-^{1}

Figure 3. Combined effect of rootstocks and salinity treatments on the survivability (%) at 90 DAT.

Figure 4. Pictorial view of the experiment

CONCLUSION

An inverse relationship was observed between the salt concentration and rootstock survivability, height and leaves, etc. Survivability rate decreased with the increasing levels of salinity of different rootstock. In conclusion, tree tolerance to soil salinity can be said BAU Aam - 9 and BAU Aam – 6 rootstock line performed best from 0 - 8 dSm-1 salinity. The overall salinity tolerance was graded as follows: BAU Aam - 9>BAU Aam – 6> BAU Aam-4>Amropali rootstock line.

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