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ASSESSING THE PERFORMANCE OF TWO PROMISING M_9 MUTANTS AND F_{10} GROUNDNUT (*Arachis hypogaea* L.) LINES ON SALINE AND NON SALINE AREAS OF BANGLADESH

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ABSTRACT

Kamruzzaman M, Yasmine F, Azad MAK (2015) Assessing the performance of two promising M_9 mutants and F_{10} groundnut (*Arachis hypogaea* L.) lines on saline and non saline areas of Bangladesh. *Int. J. Expt. Agric.* 5(2), 18-23.

This study was performed to investigate the performance of two M_9 mutants and F_{10} lines of groundnut at three saline and five non-saline areas of Bangladesh following RCB design with three replications. Dacca-1 and Zhingabadam were included as the check varieties. Of the three saline locations, performance at Subarnachar, Noakhali was better than that of Patuakhali and Bhola for most of the traits because of lower salinity during the growing period. In contrast, of the two non-saline locations, performance at Ishurdi was the best of all for most of the traits including pod yield ha^{-1}. The two mutants and the two F_{10} lines mostly had significantly dwarf height than both the check varieties at all studied locations. The mutant D_1/20/17-1 had significantly higher number of pods $plant^{-1}$ at Lalmonirhat, Natore and Bhola. In contrast, the other mutant RS/25/3-1 had significantly higher number of pods $plant^{-1}$ at Ishurdi and Patuakhali. Of the two F_{10} lines, the line GC(1)-24-1-1-2 had significantly higher number of pod at Jhenaidah and Patuakhali. At Lamonirhat, RS/25/3-1; at Jhenaidah, Zhingabadam, and at Bhola D_1/20/17-1 had higher pod yield $plant^{-1}$, respectively. D_1/20/17-1 had significantly higher pod yield ha^{-1} than its parent Dacca-1 at Rangpur, Lalmonirhat, Patuakhali and Bhola, RS/25/3-1 at Rangpur, Lalmonirhat, Ishurdi, Jhenaidah, Noakhali and Bhola, and GC(1)-24-1-1-2 at Lalmonirhat, Jhenaidah, Noakhali and Bhola. However, on the basis of the better yield in both saline and normal conditions and farmers' preference, two mutants D_1/20/17-1 and RS/25/3-1 and one F_{10} line, GC(1)-24-1-1-2 might be selected for registration as salt tolerant varieties.

Key words: *Groundnut (Arachis hypogaea* L.*), M_9 mutants, F_{10} lines, pod yield ha^{-1}, higher pod yield $plant^{-1}$*

INTRODUCTION

Salinity is a major problem in agricultural production in many parts of the world especially in coastal regions, which are badly affected. In Bangladesh we have 1.02 million hectares of land which is affected by different degrees of salinity, ranging from 2.0 to >16 dS/m (Amin 2011). The salt-affected area in Bangladesh has increased from about 0.83 million ha in 1973 to 1.02 million ha in 2000, and 1.05 million ha in 2009 (SRDI 2010). These saline soils are spreading over 91 Upazillas of 18 districts in the coastal belt. The areas and concentration of salinity is increasing day by day at an alarming rate. Most of the crops are not suitable for growing in salt affected soils (Amin 2011). Due to scarcity of quality irrigation during dry season, limited scope of ground water upliftment and less availability of river water, limited crop varieties can be grown during Rabi and Kharif-1 in saline areas of our country. As a result we have low cropping intensity (Haque 2006) in areas with salinity. So, it's an existing challenge to overcome to ensure better agricultural production in our coastal areas. Development of salinity tolerant groundnut genotypes with high yield potential could supplement successfully with existing crops to enrich cropping pattern, thus, could contribute in agriculture of Bangladesh. Groundnut is a nutritious oilseed crop in Bangladesh. Moreover, it's a good source of vegetable oil (Ahmed and Mohammed, 2009) and protein for human diet and the green leaves are used as fodder for animals. The seed is a good source of antioxidants which protect cells from damage linked to heart disease and cancer, contains 48-52 % oil and 24-26% proteins and oilcake contain 45-50% protein (BBC News 2005). Being a legume, it can fix atmospheric N_2 through its nodule bacteria and thus reduces use of nitrogenous fertilizer and keeps the environment friendly. As groundnut can easily be grown under rainfed condition, therefore, it has an opportunity to grow if suitable salt tolerant variety can be developed. This study was conducted to evaluate the performance of two promising M_9 mutants and F_{10} lines of groundnut on saline and non-saline areas of Bangladesh. The proposed research was projected to assess the saline tolerance potential of the studied genotypes.

MATERIALS AND METHODS

The study was conducted as an on farm and on station yield trial over different locations with two promising M_9 mutants and F_{10} lines and two popular groundnut varieties, Dacca-1 and Zhingabadam, as checks. Two mutants, RS/25/3-1 and D_1/20/17-1 were derived from the population of 250 Gy and 200 Gy, respectively of the varieties, PK-1 and Dacca-1 respectively. Two F_{10} lines, GC(1)-32-3-1-1 and GC(1)-24-1-1-2 were derived from the progenies of hybridizing between the Valencia type variety Zhingabadam and the Spanish type variety Dacca-1. Seeds were sown on 18 and 24 December 2013 in the sub-station farm of Bangladesh Institute of Nuclear Agriculture (BINA) at Rangpur and Ishurdi, respectively, and in farmers' field at Jhenaidah, Lalmonirhat and Natore on 8 and 13 February, and 02 March 2014, respectively. While in saline areas seeds were sown on 29th December 2013 at Patuakhali, Bhola and 11th January 2014 at Noakhali respectively. The experiment followed RCB design with three replications having unit plot size of 5.0 m × 4.0 m. Recommended doses of fertilizers were applied together with recommended cultural and intercultural practices. Soil salinity recorded at Noakhali, Patuakhali and Bhola were gathered during sowing, vegetative and flowering stages from the top (0 cm) and at depth of 15 cm (Table 1). Data on plant height (cm), mature pods plant^{-1}(no.) and shelling % were recorded after harvest from randomly selected 10 competitive plants while pod weight plant^{-1}(g) and 100-pod weight (g) were recorded after proper sun drying. Pod yield (t ha^{-1}) was recorded from the plot area of 20 m^2 which was later converted to t ha^{-1}. Oil and fatty acid content of the selected mutants was determined following standard protocols. Finally, the recorded data were subjected to proper statistical analyses in MS office excel, 2007.

RESULTS AND DISCUSSION

Heterogeneity of soil salinity was observed across the trial fields of saline areas. Amin (2011) found moderate salt tolerance (6-12 dS/m) ability of groundnut. In our study though the salinity of the top soil (0 cm) was varied but it was reached to the moderate salinity level (6-12 dS/m) at Bhola and Noakhali valued of 7.7 and 7.16 dS/m, respectively (Table 1).

Table 1. Salinity records of the experimental plots at different locations on different dates

Date	Depth (cm)	Salinity (dS/m)
Patuakhali		
01 December 2014	0	0.38
	15	0.41
19 January 2014	0	0.82
	15	0.44
04 March 2014	0	1.24
	15	0.46
04 April 2014	0	1.77
	15	0.49
04 May 2014	0	0.46
	15	0.51
04 June 2014	0	2.38
	15	0.51
Bhola		
29 December 2014	0	1.08
	15	0.78
05 March 2014	0	1.96
	15	0.78
05 April 2014	0	6.43
	15	0.89
03 May 2014	0	7.16
	15	0.70
30 May 2014	0	1.78
	15	1.50
Noakhali		
19 January 2014	0	0.53
	15	0.52
04 March 2014	0	7.7
	15	2.3
05 June 2014	0	0.60
	15	0.55

The yield and related attributes had significantly lower scores in the saline area than that of non-saline area (Table 2). Of the three saline locations, performance at Noakhali was better than that of Patuakhali and Bhola for most of the traits (Table 3).

Table 2. Pod yield and some related attributes of two M_9 mutant lines and F_{10} lines of groundnut at non-saline areas

Mutant/lines/ varieties	Plant height (cm)	Pods plant^{-1} (no.)	Pod weight (g)	100-Pod weight (g)	100-Kernel weight (g)	Pod yield (t ha^{-1})	Shelling (%)
Rangpur							
D_1/20/17-1	32.20	30.10	20.23	69.3	30.37	3.69	60.20
RS/25/3-1	34.60	35.90	18.80	77.67	32.77	4.14	76.17
GC(1)-32-3-1-1	32.53	35.90	35.03	78.1	38.60	2.89	54.53
GC(1)-24-1-1-2	28.33	29.27	15.80	67.33	27.50	3.47	70.30
Dacca-1	40.53	31.30	16.53	71.13	30.67	3.60	73.07
Zhingabadam	40.20	43.37	17.20	82.8	24.60	3.77	57.37
LSD $_{(0.05)}$	0.99	0.60	0.52	1.04	0.65	0.06	0.77
Lalmonirhat							
D_1/20/17-1	59.67	25.93	14.93	62.20	27.73	3.32	79.47
RS/25/3-1	56.83	21.17	15.57	74.60	33.70	3.34	76.43
GC(1)-32-3-1-1	47.30	21.47	12.87	122.10	45.77	3.13	66.73
GC(1)-24-1-1-2	56.10	17.73	13.30	75.70	31.60	3.00	74.33
Dacca-1	64.83	18.03	11.77	70.43	32.60	2.59	77.10
Zhingabadam	79.63	19.00	11.13	98.90	34.23	2.45	68.73
LSD $_{(0.05)}$	0.62	0.55	0.83	1.60	0.97	0.07	0.69
Ishurdi							
D_1/20/17-1	42.97	28.53	13.90	53.60	22.20	3.06	74.07
RS/25/3-1	39.40	38.10	21.50	60.90	28.30	4.73	71.53
GC(1)-32-3-1-1	35.47	23.37	23.00	110.67	40.47	5.13	65.05
GC(1)-24-1-1-2	32.00	23.53	17.00	59.07	24.77	3.76	64.37
Dacca-1	47.10	29.37	17.17	54.77	23.93	3.71	72.70
Zhinga badam	50.47	20.70	19.03	90.07	28.80	4.19	63.00
LSD $_{(0.05)}$	0.62	0.68	0.48	0.43	0.46	0.13	1.02
Natore							
D_1/20/17-1	40.27	20.90	8.63	58.77	26.30	2.69	78.17
RS/25/3-1	32.33	20.73	13.80	69.30	31.53	2.84	73.30
GC(1)-32-3-1-1	35.90	15.50	15.83	107.80	41.60	3.43	68.77
GC(1)-24-1-1-2	32.93	14.33	9.33	67.27	26.57	2.31	72.60
Dacca-1	45.63	18.60	12.93	73.53	33.93	2.88	73.90
Zhingabadam	51.27	14.00	15.03	109.93	32.73	2.92	69.77
LSD $_{(0.05)}$	0.99	0.68	0.98	1.60	0.88	0.11	0.38
Jhenaidah							
D_1/20/17-1	49.90	27.67	17.27	73.87	26.60	3.23	77.17
RS/25/3-1	42.53	27.27	19.67	74.40	33.17	4.08	76.93
GC(1)-32-3-1-1	31.53	22.70	25.03	126.4	41.33	4.54	61.00
GC(1)-24-1-1-2	38.57	28.87	20.73	69.80	28.53	3.59	74.80
Dacca-1	50.23	22.60	15.87	70.43	29.90	3.18	75.87
Zhinga badam	48.43	25.733	26.00	108.18	30.43	3.90	68.63
LSD $_{(0.05)}$	1.06	0.86	0.49	2.66	0.69	0.15	0.92

Table 3. Pod yield and some related attributes of two M_9 mutant lines and F_{10} lines of groundnut at saline areas

Mutant/lines/ varieties	**Plant height (cm)**	**Pods plant^{-1} (no.)**	**Pod weight (g)**	**100-Pod weight (g)**	**100-Kernel weight (g)**	**Pod yield (t ha^{-1})**	**Shelling (%)**
Noakhali							
D_1/20/17-1	33.47	17.80	10.30	54.50	28.10	2.31	71.2
RS/25/3-1	41.40	18.43	11.23	71.57	32.63	2.48	69.03
GC(1)-32-3-1-1	50.90	15.07	12.83	93.17	37.13	2.34	59.17
GC(1)-24-1-1-2	32.50	19.07	12.93	66.33	25.80	2.85	61.23
Dacca-1	48.13	18.47	11.07	70.77	32.33	2.51	66.53
Zhingabadam	61.27	17.43	11.00	78.00	22.73	2.40	46.43
$LSD_{(0.05)}$	0.99	0.73	0.75	0.62	0.60	0.05	0.69
Patuakhali							
D_1/20/17-1	16.93	21.50	9.23	49.03	22.87	1.66	66.07
RS/25/3-1	19.80	20.87	9.83	56.93	25.87	2.05	62.13
GC(1)-32-3-1-1	19.77	19.83	13.17	80.97	31.33	2.62	53.03
GC(1)-24-1-1-2	16.50	15.57	7.70	46.33	21.63	1.37	52.20
Dacca-1	22.93	16.03	6.03	43.30	19.60	1.49	65.53
Zhingabadam	31.33	19.80	9.30	64.67	19.47	1.67	36.33
$LSD_{(0.05)}$	1.87	1.14	0.50	1.26	0.65	0.11	1.08
Bhola							
D_1/20/17-1	15.73	18.37	7.20	47.77	21.57	1.28	66.63
RS/25/3-1	12.87	12.90	5.97	49.80	21.63	1.20	59.03
GC(1)-32-3-1-1	11.60	8.80	4.05	71.70	28.30	0.91	45.90
GC(1)-24-1-1-2	10.40	14.30	6.30	46.20	23.70	1.24	60.37
Dacca-1	12.87	14.83	4.70	39.30	21.87	0.99	54.03
Zhingabadam	12.57	9.33	3.00	45.17	22.00	0.58	49.37
$LSD_{(0.05)}$	0.66	0.66	0.71	1.80	0.34	0.14	0.74

In contrast, of the two non-saline locations, performance at Ishurdi was the best for most of the traits including pod yield ha^{-1} (Table 2). The advanced mutants/F_{10} lines/check varieties showed significant differences for all the traits at all locations (Table 2). The two mutants and the two F_{10} lines mostly had significantly dwarf height than both the check varieties at all locations. Of the two check varieties, Zhingabadam mostly had significantly taller height than Dacca-1 at all locations.

The mutant D_1/20/17-1 had significantly higher number of pod at Lalmonirhat, Natore and Bhola. In contrast, the other mutant RS/25/3-1 had significantly higher number of pod at Ishurdi and Patuakhali. Of the two F_{10} lines, the line GC(1)-24-1-1-2 significantly higher number of pod at Jhenaidah and Patuakhali. Pod yield/plant was mostly higher in GC(1)-32-3-1-1 except Lalmonirhat, Jhenaidah and Bhola (Table 3). At Lamonirhat, RS/25/3-1; at Jhenaidah Zhingabadam and at Bhola D_1/20/17-1 had higher pod yield plant^{-1}.

Pod size, expressed here as 100-pod weight, was significantly lower in D_1/20/17-1, RS/25/3-1 and GC(1)-24-1-1-2 than Zhingabadam together with higher shelling percentages (Table 2). In contrast, the F_{11} line, GC(1)-32-3-1-1 had bigger pods, kernels but mostly lower shelling percentage. Finally, D_1/20/17-1 had significantly higher pod yield ha^{-1} than Dacca-1 at Rangpur, Lalmonirhat, Patuakhali and Bhola, RS/25/3-1 at Rangpur, Lalmonirhat, Ishurdi, Jhenaidah, Noakhali and Bhola, and GC(1)-24-1-1-2 at Lalmonirhat, Jhenaidah, Noakhali and Bhola.

Table 4. Protein and oil contents of few selected mutants, F_{10} lines and cultivar of groundnut

Sl. No.	**Mutant/F_{10} line/Check variety**	**Oil content (%)**	**Protein content (%)**
1.	RS/25/3-1	48.00	28.03
2.	PK-1	47.15	23.75
3.	GC(1)-24-1-1-2	46.90	29.05
4.	Zhingabadam	47.00	28.05
5.	D_1/20/17-1	48.30	28.00
6.	Dacca-1	48.35	27.43
	$LSD_{(0.05)}$	0.20	0.75

Seed oil content of mutant RS/25/3-1 had higher than two check varieties PK-1 and Zhingabadam and protein content was also higher than the check varieties PK-1 and Dacca-1. In contrast, the other mutant D_1/20/17-1 had lesser oil content than that of its parent Dacca-1 but higher than the other two check cultivars PK-1 and Zhingabadam. But the protein content was higher than that of its parent and one check PK-1. On the other hand, the F_{10} line GC(1)-24-1-1-2 had the highest protein content among its parent, other checks and all mutants also though the oil content was insignificantly lesser than its parent (Table 4).

Fig. 1. Increase in large seed of two selected mutants and F_{10} lines compared to their parents (control). A. Dacca-1 (bottom) and D_1/20/17-1 (top); B. Zhingabadam (bottom) and GC(1)-24-1-1-2 (top); C. PK-1 (bottom) and RS/25/3-1 (top) and D. Zhingabadam (bottom) and GC(1)-32-3-1-1 (top)

Through on farm and on station yield trials of selected mutants and hybrid lines, combined analysis of them showed that oil and protein content were insignificant to their parents but yield was significantly higher. These two mutants and the hybrid had the similar performance in the zonal and advanced yield trial also (data are not shown here). These results indicate that, the selected mutants and hybrid lines were stable and true bred for most of the traits studied. Ahmed and Mohammed (2009) also reported the similar results in mutants through preliminary yield trial. Furthermore, it could be seen clearly that not all mutants and the hybrid lines had consistently high yield in preliminary yield trials (data have not shown). Ahmed and Mohammed (2009) and Hamid *et al.* (2006) have also reported similar results in groundnut mutants. The higher yields of the mutants and hybrid lines are due to increase in large seed size which emphasized by 100-seed wt. of them compared to their check parents. Sorour *et al.* (1999), Mouli and Kale (1989) and Sorour (1989) have obtained similar results for groundnut mutants. The findings of oil content of selected mutants and hybrid lines were negatively correlated with the seed size which is logical and was in agreement to the reports by Gadgil and Mirta (1983) and Ahmed and Mohammed (2009). Heterogeneity of soil salinity in the saline affected areas was observed during different growing stages of groundnut. It was due to the spatial and temporal differences in crop growth and phonological differences. Amin (2011) also reported similar results in his investigation. Performance of the mutants and hybrid lines for most of the were consistent over zonal and advance yield trials in different locations, indicating these are stable and true bred for these traits.

CONCLUSION

With the findings of the present study and based on comprehensive consideration of farmers' preference, the shorter plant height and medium pod size with high yielding ability under salinity condition and stability during advance and zonal yield trial followed by on farm and on station yield trial two mutants and one hybrid line were selected for registration as varieties. Application has been submitted to National Seed Board for registration of D1/20/17-1, RS/25/3-1 and GC(1)-24-1-1-2 as Binachinabadam-7, Binachinabadam-8 and Binachinabadam-9, respectively.

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