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Bangladesh J. Agril. Res. 40(3): 513-519, September 2015 **Short Communication**

SCREENING OF MUNGBEAN GENOTYPES FOR TOLERANCE TO WATERLOGGING UNDER FIELD CONDITION

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Mungbean [*Vigna radiata* (L.) Wilczek] is the second most important pulse crop grown in Bangladesh with an area of 27,440 hectares and production of 19,445 metric tons during 2010-2011 (BBS, 2011). Being a rich source of protein, it maintains soil fertility through biological nitrogen fixation in soil and thus plays a vital role in sustainable agriculture (Kannaiyan, 1999). Mungbean can be grown both under rainfed and irrigated conditions depending on the availability of irrigation facilities. Since it is sensitive to waterlogging, the land should have well drainage system. Mungbean is generally susceptible to excess water, although genotypic variation in the tolerance to waterlogging has also been reported (Islam *et al.*, 2007; Hamid *et al.*, 1991; Miah *et al.*, 1991). Apart from genetic factors, waterlogging stress stands prominent that attributed to low yields of mungbean. The study was therefore carried out to observe the genotypic differences of mungbean cultivars and to identify their ability to tolerate to the waterlogged stress under field condition.

Forty mungbean genotypes (Table 1) were evaluated in the field of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh during April to June, 2010. The experiment was set up in split plot design with three replications. The plants were subjected to 3-5 cm standing water for 7-days at 22 days after sowing above the soil surface. At the same time the optimal soil moisture was provided to the plants retained as control to observe the difference of growth and convenient for data collection. The depth of water in the experimental plots was maintained by using polythene sheet in the border of each main plot along with continuous supply of water. Drain in between two main plots was 1m so that water cannot soak to the neighboring experimental plots. The performance of the selected mungbean genotypes were compared with that of control. A blanket rate of fertilizers 40-25-35 kg ha^{-1} of N-P-K and 10 t ha^{-1} cowdung was applied and thoroughly incorporated into the soil of each plot at the time of final land preparation. Seeds of uniform size and shape of mungbean genotypes were sorted from their stock and treated with Vitavex 200 at 1g per kg seed. The seeds were soaked in water for 4 hours before sowing and imbibed seeds were selected for sowing. Seedlings were thinned out after one week of

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emergence keeping one healthy seedlings per hill. Management practices and plant protection measures were taken as and when necessary. Five plants both from control and waterlogging treatments were harvested after 28 and 38 days from their corresponding emergence dates and data were collected. Height of individual plants was measured from the base to the top of main shoot. After harvesting, the seedlings of both waterlogged and controls were segmented into components i.e. stem, leaf, petiole, and reproductive organs. The segmented parts were oven dried at 80^0C for 72 hours to a constant weight and dry weights were recorded separately. Total dry weight was calculated by summing up the dry weights of stem, leaf, petiole, and reproductive parts of plants. Leaf area was measured using automatic leaf area meter (Model AAM-8. Hayashi Denkoh Co. Ltd., Tokyo, Japan). The screening criterion of the genotypes was based on survival % after removal of the flooding stress. Their survival percentage was recorded on the 28 DAE, 38 DAE and 48 DAE after termination of flooding. Plant survival percentage of each genotype was calculated by the following formula,

$$\text{Survival (\%)} = \frac{\text{The no. of plants of each genotype survived after 7-day waterlogging}}{\text{Total plants of each genotype present at the beginning of waterlogging}} \times 100$$

The screening criterion of the genotypes was based on survival rate and recovery of plants after termination of waterlogging as suggested by Nawata (1989). After termination of waterlogging (28 DAE), a significant number of plants of each genotypes were found to survive. During 10-days recovery period (38 DAE), the number of plants of each genotype greatly reduced due to seedling mortality. Finally, a number of plants of each mungbean genotype were survived till maturity. The percentage of plant survival was calculated (Table 1). Among the total number of genotypes, only 15 genotypes namely, IPSA-13 (entry no.26), IPSA-15 (entry no.27), VC-3173 (B-10) (entry no.28), VC-6367 (44-55-2) (entry no.29), ACC-12890054 (entry no.30), ACC-12890085 (entry no.31), GK-1(entry no.32), GK-3 (entry no.33), GK-63 (entry no.34), GK-48 (entry no.35), GK-65 (entry no.36), BU mug 2 (entry no.37), CO-3 (entry no.38), VC-6173A (entry no.39), VC-3160(A-89) (entry no.40) showed 20-34% survival, and the rest 25 genotypes had survival of <20%. Lawn and Russel (1978) reported that after emergence, the stand establishment of the mungbean crop may reduce to 65-100% for eight days waterlogging at second trifoliate leaf stage.

The variability in plant characters of the mungbean genotypes at the end of waterlogging (28 DAE) and during 10 days recovery period (38 DAE) have been shown in Table 2. Some plants were taller viz. IPK-1040-94 (entry no.3), ML-613 (entry no.5), GK-46 (entry no.11), PDM-11 (entry no.23), ACC-12890054 (entry no.30), ACC-12890085 (entry no.31), GK-63 (entry no.34), GK-48 (entry no.35), CO-3 (entry no.38) and some were shorter viz. GK-29 (entry no.19), GK-

55 (entry no.20), VC-6367 (44-55-2) (entry no.29), GK-1 (entry no.32), GK-48 (entry no.35) under control condition but significant reduction in plant height of all the waterlogged treated genotypes was observed. The difference in plant height of waterlogged plants were increased to a great extent during 10 days recovery period and less reduction in plant height over the control was recorded 35.59 % in BARI mung 6, 76 % in BARI mung 5, 29.33 %, in GK-6 and 3.85 % in BU mug 2. The relative elongation rate of plant height is a morphological mechanism of waterlogged tolerance of plants as reported by Futakuchi *et al*., (2001).

Table 1. List of mungbean genotypes and percentage of plant survived at 28, 38 and 48 days after emergence of seedlings

Sl. no.	Genotypes	% of plant survival at 28 DAE	% of plant survival at 38DAE	% of plant survival at 48DAE
1	BINA-6	65.21	13.04	4.34
2	BINA-7	66.66	17.77	6.66
3	IPK-1040-94	83.33	14.28	9.52
4	IPSA -18	63.15	21.05	7.89
5	ML-613	74.41	20.93	6.97
6	GK-6	55.88	11.76	2.94
7	GK-7	57.57	12.12	3.03
8	GK-32	55.88	17.64	8.82
9	GK-36	65.90	13.63	6.81
10	GK-37	63.88	13.88	8.33
11	GK-46	62.22	13.33	6.66
12	VC-3950-88	76.74	13.95	2.32
13	BARI mung 5	69.44	22.22	19.44
14	BARI mung 6	76.31	21.05	10.52
15	IPSA-12	35.00	25.00	17.50
16	IPSA-19	57.77	22.22	13.33
17	GK-5	58.33	16.66	11.11
18	GK14	58.13	16.27	13.95
19	GK-29	60.52	21.05	19.44
20	GK-55	61.53	20.51	15.38
21	GK-56	63.15	18.42	10.52
22	ML-267	71.42	23.80	16.66
23	PDM-11	75.00	18.18	11.36

Table 1. Continued.

Sl. no.	Genotypes	% of plant survival at 28 DAE	% of plant survival at 38DAE	% of plant survival at 48DAE
24	VC-6379 (23-11)	70.21	21.27	10.63
25	VC-3173 (B-6)	80.95	19.04	11.90
26	IPSA-13	76.92	23.07	20.51
27	IPSA-15	61.90	28.57	21.42
28	VC-3173 (B-10)	68.18	36.36	29.54
29	VC-6367(44-55-2)	77.77	31.11	26.66
30	ACC-12890054	66.66	28.57	23.80
31	ACC-12890085	73.33	28.88	22.22
32	GK-1	65.78	23.68	21.05
33	GK-3	66.66	25.64	25.64
34	GK-63	60.52	26.31	21.05
35	GK-48	66.66	27.27	24.24
36	GK-65	65.00	25.00	22.50
37	BU mug 2	81.81	43.18	34.09
38	CO-3	85.71	33.33	30.95
39	VC-6173 A	81.25	46.87	31.25
40	VC-3160 (A-89)	71.42	33.33	30.95

Leaf area (cm^2 $plant^{-1}$) increased significantly in control plants over time and decreased significantly in flooded plants at the end of waterlogging (28 DAE). The reduction in leaf area over control ranged from 6% to 80% in different genotypes among which comparatively higher recovery in leaf area was recorded in (BINA-7) 27% (entry no.2), (IPSA-19) 38% (entry no.16), (GK-29) 26% (entry no.29), (GK-56) 36% (entry no.21), {VC-6379 (23-11)} 6% (entry no.24), {VC-3173 (B-10)} 1% (entry no.28), {VC-6367 (44-55-2)}29% (entry no.29), (VC3950-88) 34% (entry no.12), (ACC-12890085) 11% (entry no.31). While higher leaf area during the recovery period (28 DAE) indicated greater foliage development ability of some mungbean genotypes overcoming waterlogging stress reported by Islam (2005).

Plant components such as stem, leaf, and petiole and pod dry weight varied in between the control and waterlogged plants. A wide range of genetic variation in waterlogging induced changes in dry matter accumulation in the plant component observed by Islam *et al.,* (2007). The dry matter weight of plant parts in different mungbean genotypes reduced greatly after waterlogging and increased considerably during 10 days recovery period. Some genotypes produced pods which contributed to increase dry weight viz. GK-6 (entry no.6), GK-7 (entry no.7), GK-37 (entry no.10), BARI mung 5 (entry no.13), BARI mung 6 (entry no.14), GK-5 (entry no.17), GK-14 (entry no.18), GK-55 (entry no.20), ML-267 (entry no.22), PDM-11 (entry no.23), VC-6379(23-11) (entry no.24), VC-3173(B-6) (entry no.25).

Table 2. Dry weight (g plant^{-1}) of plant components of 40 mungbean genotypes grown under waterlogged and non-waterlogged control condition.

Changes in plant characters	Waterlogging level	At the end of waterlogging (28 DAE)	At the end of 10 days recovery period (38 DAE)
		Mean ± SD	Mean ± SD
Plant height (cm)	Control	20.69 ± 3.18	53.37 ± 8.15
	Waterlogging	11.65 ± 1.66	26.06 ± 6.73
Leaf area (cm^2 plant^{-1})	Control	404.28 ±94.76	549.64±188.52
	Waterlogging	220.86 ±79.39	283.02±130.08
Components DW (g plant^{-1})			
Stem	Control	1.14 ± 0.33	4.95 ± 1.42
	Waterlogging	0.88 ± 0.41	1.37 ± 0.41
Leaf	Control	2.06 ± 0.49	5.60 ± 1.37
	Waterlogging	1.32 ± 0.57	1.82 ± 0.57
Petiole	Control	0.53 ± 0.14	1.60 ± 0.54
	Waterlogging	0.31± 0.14	0.81 ± 0.14
Pod	Control	-	3.53 ± 1.88
	Waterlogging	-	0.64 ± 0.18
Total dry matter (g plant^{-1})	Control	3.73 ± 0.76	15.68 ± 3.59
	Waterlogging	2.51 ± 0.96	3.15 ± 0.98

Total dry matter (TDM) accumulation at the end of 7-day waterlogging and during 10 days recovery period (28-38 DAE) was markedly affected and a wide range of genotypic variation was observed (Table 2). On an average, waterlogging induced reduction in TDM by 33% at the end of waterlogging. Among the 40 mungbean genotypes, total dry matter in some genotypes were higher at the end of waterlogging and those were BINA-7 (entry no.2), BARI mug 5 (entry no.13), IPSA-19 (entry no.16), GK-65 (entry no.36), BU mug 2 (entry no.37), VC-6137A (entry no.39), VC-3160(A-89) (entry no.40) (Fig.1). During 10 days recovery period, some of the genotypes accumulated fairly higher amount of TDM over non-waterlogged control (Fig. 2). The rate of reduction in TDM in waterlogged plants over the control ranged from 43% to 84% depending on the genotypes. Lower reduction in TDM over the control was recorded in BARI mung 5 (65%), IPSA-12 (61%), IPSA-13 (61%), IPSA-15 (47%), VC-3173(B-10) (65%), VC-6367(44-55-2) (51%), ACC-12890054 (51%), ACC-128900850 (43%), VC-6173A (61%). Accumulation of higher TDM in waterlogged plants over the control was observed in some mungbean genotypes which might tolerate soil flooding to a great extent. Yadav and Saxena (1998) found decreased production of total dry matter in waterlogged mungbean.

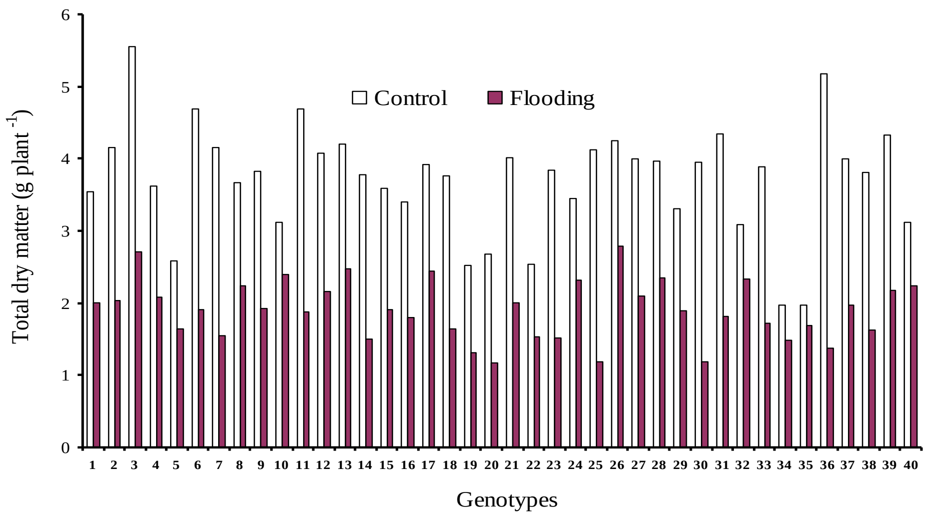

Fig.1. Total dry matter of mungbean genotypes at the end of 7-day waterlogging

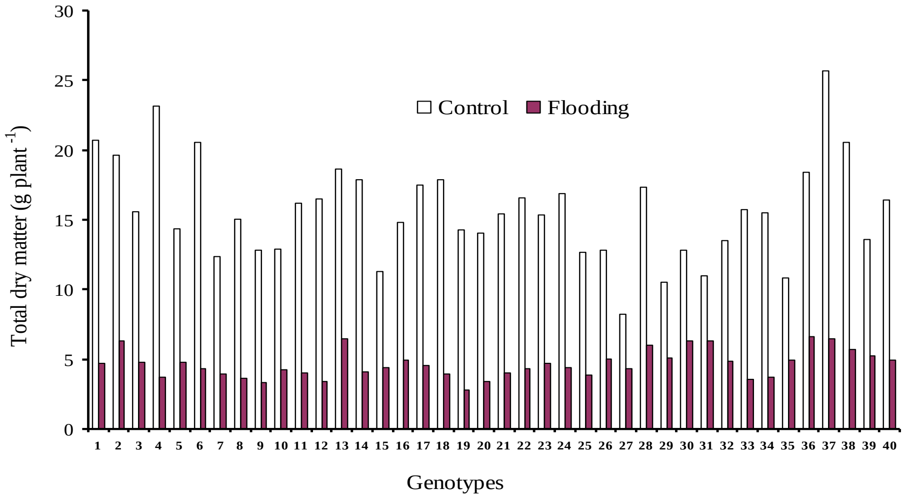

Fig. 2. Total dry matter of mungbean genotypes at the end of 10 days recovery period

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