ISSN-1991-3036 (Online) & ISSN-2075-1621 (Optical)
Int. J. Sustain. Crop Prod. 5(2):8-11(May 2010)

GERMINATION, GROWTH AND NODULATION OF MUNGBEAN (*Vigna radiata* L.*)* AS AFFECTED BY SODIUM CHLORIDE

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Accepted for publication on 15 May 2010

ABSTRACT

Naher N, Alam AKMM (2010) Germination, growth and nodulation of mungbean (*Vigna radiata* L.) as affected by sodium chloride. *Int. J. Sustain. Crop Prod.* 5(2), 8-11.

A pot experiment was conducted to study the effect of salinity on germination, growth and nodulation of Mungbean. Seed germination, shoot and root growth and nodulation of three Mungbean (*Vigna radiata* L.) varieties (BARI Mung 4, BARI Mung 5 and BARI Mung 6) were tested at four salinity levels e.g. 0, 0.1%, 0.2%, 0.3% and 0.4% of NaCl concentrations. Salinity affects imbibition, germination and root elongation. Highest germination % was observed in control treatment of all the varieties. Root growth was significantly reduced with higher NaCl concentrations, and BARI Mung 4 showed better performances than other varieties. All the varieties showed similar performances at higher NaCl concentration considering yield contributing character. Among the varieties BARI Mung 5 did not showed any nodulation at higher (0.4% of NaCl conc.). Nodule/plant was decreased with the increase of salinity but nodule size increased with the increase of salinity.

Key words: *mungbean, salinity, nodulation and growth*

INTRODUCTION

Salinity became a serious problem for agriculture all over the world. In Bangladesh, more than 30% of the cultivable area is in the coast. Out of it, 2.88 million hectares are affected by varying degrees of salinity (Karim *et al.* 1990). Salinity is known to reduce the growth of salt sensitive species i.e. glycophytes. Mungbean is an important glycophytes legume crop in Bangladesh. Salinity is one of the environmental factors that have a critical influence on the germination of halophyte seeds and plant establishment. In favorable condition Mungbean can fix atmospheric nitrogen by symbiotic process with the help of microorganism, rhizobium. Legume plants secrets some substance probably lectin which attract root rhizobium and infected root to produce nodules. Mungbean can improve soil nitrogen status in cereal legume crop rotation. Saline condition may effects the Legume-Rhizobium symbiosis in nodulation because of its osmotic and ionic effects. The Salinity reduces the survival of rhizoidal inhibiting the infection process affecting nodule development and function or reducing plant growth (Singleton and Bohlool 1984). The effect of salinity on growth of Mungbean plants has been reported sporadically (Asraf and Rasul 1988; Raptan 2001; Islam 2001; Faruquei 2002). It is reported that salinity reduces nitrogen fixation (Hafeez *et al.* 1988; Idris *et al.* 1990). Considering the importance of nitrogen fixation and effect of salinity on nitrogen fixation the present study was therefore conducted to study the effects of salinity on germination, growth and nodulation of an oriental legume crop, viz. *Vigna radiata* varieties.

MATERIALS AND METHODS

The experiment was done in Agricultural Botany Department, Patuakhali Science and Technology University in 2007-8. Seed of three varieties of Mungbean (BARI Mung 4, BARI Mung 5 and BARI Mung 6) were collected from PRSS, BARI, Gazipur. Germination percentage and root & shoot length were recorded from the treatment of range salinity (0, 0.1, 0.2, 0.3 and 0.4% NaCl conc.). Seeds were sown in plastic pots size 34cm X 24cm containing garden soil ECe = 1.07 dSm^{-1} at 25^0C. Two weeks after sowing that range of salinity treatments added to the soil, w/w basis, was applied to the plants. For this purpose the salt was first dissolved in 1 L water that was sufficient to soak the soil in each pot. Each pot contains ten seedlings. The pots were watered as and when required and care was taken not to leach the salt by excess watering. There were 3 replications for each treatment and the experiment was arranged in a complete randomized design. Pots were harvested 7 and 11 weeks after the commencement of salinity treatment when the mungbean plants were at the beginning of pod growth and middle of pod growth stages, respectively. Electrical conductivity (ECe) of soil samples from the root zone, at the first harvest, was measured by using a conductivity meter (Field scout soil and water EC meter). The electrical conductivities at 25^0C for the soil amended with 0, 0.1, 0.2, 0.3 and 0.4% NaCl were 1.05, 1.25, 1.81, 2.40 and 3.20 dSm^{-1} respectively.

RESULTS AND DISCUSSION

The response of mungbean at different dates showed remarkable variation among the varieties. Figure-1 showed the effect of NaCl concentration on germination of mungbean varieties at different dates. Among the varieties BARI Mung 5 did not show any remarkable variation among the different dates. BARI Mung 4 and BARI Mung 6 showed significant different at different dates. The highest germination (%) was observed at control treatment and which was fallowed by 0.1%, 0.2%, 0.3% and 0.4(%). NaCl concentration inhibits germination of Mungbean. Germination

was significantly reduced when electrical conductivity increased in case of cowpea (Wests and Francios 2004). The effect of salinity on germinating seeds in many species is not only on lowering the percentage of germination, but also on lengthening the time needed to complete germination (Ayers 1952).

Table 1. Effect of NaCl concentration on root growth (cm) of mungbean varieties at different dates

NaCl Conc. (%)	BARI Mung 4			BARI Mung 5			BARI Mung 6		
	3 DAE (cm)	4 DAE (cm)	5 DAE (cm)	3 DAE (cm)	4 DAE (cm)	5 DAE (cm)	3 DAE (cm)	4 DAE (cm)	5 DAE (cm)
0.0	2.9	4.0b	6.6	2.1	3.1	4.8a	2.5	4.5a	7.2a
0.1	3.1	4.5a	7.2	2.2	3.6	5.0a	1.9	3.8a	5.9b
0.2	4.2	5.6a	6.5	2.0	2.7	3.3b	1.5	2.5b	4.3c
0.3	2.9	3.8b	5.0	2.0	2.5	3.0b	1.3	2.3b	3.8c
0.4	2.3	3.1bc	3.7	1.3	1.9	2.4b	1.2	1.8bc	2.6cd
F test	ns	**	ns	ns	ns	*	ns	**	**
C.V (%)	13.97	8.96	6.59	3.56	5.14	12.93	11.60	14.77	16.94

DAE= Days after emergence

Table 2. Effect of NaCl concentration on shoot development (cm) of mungbean varieties at different dates

NaCl Conc. (%)	BARI Mung 4			BARI Mung 5			BARI Mung 6		
	3 DAE (cm)	4 DAE (cm)	5 DAE (cm)	3 DAE (cm)	4 DAE (cm)	5 DAE (cm)	3 DAE (cm)	4 DAE (cm)	5 DAE (cm)
0.0	4.5	6.3	8.2a	2.9	4.0a	5.2a	2.7	5.9a	8.9a
0.1	6.4	7.0	8.5a	2.6	3.1a	4.2ab	2.6	5.4a	7.2b
0.2	4.0	5.2	7.0b	2.3	2.6b	3.3b	1.5	2.5b	5.5c
0.3	3.9	4.8	6.0b	1.7	1.9bc	2.5bc	1.1	2.0b	3.3d
0.4	3.2	4.0	5.3bc	1.0	1.3c	1.7c	1.0	1.7c	2.6de
F test	ns	ns	**	ns	*	*	ns	*	**
C.V (%)	9.50	4.88	7.66	16.10	17.59	16.74	14.88	22.89	18.84

DAE= Days after emergence

The effect of NaCl concentration on root growth of mungbean (Table 1) varieties at different dates. In case of BARI Mung 6, at 4 days and 5 days after germination root growth showed significance variation. The highest root growth was found at control treatment which was followed by the higher concentration of NaCl treatment. Considering the root growth of three varieties BARI Mung 6 was found better than the other two varieties. Balasubramanian and Sinha (2006) reported that root growth was more sensitive to increase in salt stress both cowpea and mungbean. But in shoot development (Table 2) BARI Mung 4 performed better than other varieties. All the varieties showed significant difference at later stage for shoot development. All the physiological parameters gradually decrease with the increasing of NaCl levels (Table 3). Among the varieties at different NaCl concentration, the highest number of pod/plant, pod length and seed/pod was found in BARI Mung-6 which was fallowed by BARI Mung-5 and BARI Mung-4. Salinity stress results in a clear stunting of plant growth, which results in a considerable decrease in fresh and dry weights of leaves, stems and roots. Increasing salinity is also accompanied by significant reductions in shoot weight, plant height and root length (Parida and Das 2005; Hajier *et al*. 2006).

Table 3. Effect of NaCl concentration on some yield components of mungbean varieties

NaCl Conc. (%)	BARI Mung 4				BARI Mung 5				BARI Mung 6			
	Plant height (cm)	Pods/ plant (no.)	Pod length (cm)	Seeds/ pod (no.)	Plant height (cm)	Pods/ plant (no.)	Pod length (cm)	Seeds/ pod (no.)	Plant height (cm)	Pods/ plant (no.)	Pod length (cm)	Seeds/ pod (no.)
0.0	58a	9.00a	7.20a	8.10a	56	9.50a	7.80	10.0a	57	11.0a	9.50a	10.67a
0.1	52a	7.10b	5.40b	6.33b	53	6.90a	5.30	6.71a	52	8.50a	6.10b	7.00b
0.2	41b	5.00c	4.90b	5.10c	48	5.38b	5.00	5.29b	44	7.34b	5.4bc	5.69b
0.3	38bc	3.45c	3.88c	4.00d	42	3.10c	4.12	4.26b	39	5.0bc	4.08c	4.15c
0.4	35c	2.50d	2.33d	3.15d	40	2.31c	3.00	3.22c	39	3.25c	3.15c	3.46c
F test	*	**	*	**	ns	*	ns	**	ns	**	*	**
C.V (%)	8.47	19.09	11.10	10.58	7.75	21.52	13.31	17.64	12.28	15.99	16.79	22.98

Table 4. Effect of NaCl concentration on nodulation (g/plant) of mungbean varieties

NaCl Conc. (%)	BARI Mung 4			BARI Mung 5			BARI Mung 6		
	Nodules/ plant (no.)	Nodule size (mm)	Nodule fresh mass (g/Plant)	Nodules/ plant (no.)	Nodule size (mm)	Nodule fresh mass (g/Plant)	Nodules/ plant (no.)	Nodule size (mm)	Nodule fresh mass (g/Plant)
0.0	9.70a	3.66	0.52	6.33a	3.04	0.42a	8.16a	2.98	0.47a
0.1	7.47ab	3.02	0.34	5.17a	2.45	0.37a	6.32ab	2.34	0.35b
0.2	5.06c	3.22	0.42	3.03b	2.94	0.36b	4.07c	2.66	0.29bc
0.3	3.13cd	3.40	0.27	2.06bc	2.58	0.26c	2.68d	2.52	0.23c
0.4	1.87d	2.03	0.07	-	-	-	1.24e	1.73	0.16e
F test	**	ns	ns	**	ns	*	**	ns	*
C.V (%)	21.42	8.42	19.27	23.78	7.70	15.03	20.60	11.47	19.61

In plant height, highest were observed in BARI Mung 4, followed by BARI Mung 5 and BARI Mung 6. The results showed that reproductive growth of mungbean was also affected by salinity as the number of pod per plant, pod length and seed per pod substantially decreased with the increasing salinity levels. Vegetative growth and components of seed yield were decreased more by increasing soil salinity. Ram *et al.* (1989) in chickpea and mungbean and Raptan (2001) in mungbean observed that increasing salinity significantly reduced pods per plant. Wests and Francios (2004) reported that vegetative growth reduced 9.0% for each unit increase in electrical conductivity of the soil saturation extract beyond a thresh hold value of 1.6 dS/m in cowpea. Considering the over all performance BARI Mung 6 noticed better growth at higher salinity level than other two varieties. This might be due to the varietals response at plant species to salinity.

Nodulation was adversely affected by salinity treatment (Table-4). The nodule per plant decreased with increasing NaCl levels. The maximum number of nodule per plant was found in BARI Mung 4 at control treatment. The higher level of NaCl concentration (0.4%) completely inhibited nodule formation. In contrast, the nodule size generally increased with increasing of salinity levels. Nodule fresh mass is related with nodule size and nodule size is increased with the increasing of salinity level but nodule per plant decreased with the higher salinity level. The total nodule number, weight and nitrogen content per plant decreased in salt treatment (Balasubramanian and Sinha 2006). Considering the nodulation among the three varieties BARI Mung 4 was found better than the others two varieties. The present results can be compared with some other reports. Elsheikh and Wood (1995) observed that growth and nodulation of soybean was adversely affected by salinity and nodulation was more sensitive than plant growth to salinity. Mirza and Tariq (1992) reported that salinity decreased the number of nodule per plant but increased the size of nodule in *Sesbania sesbane*.

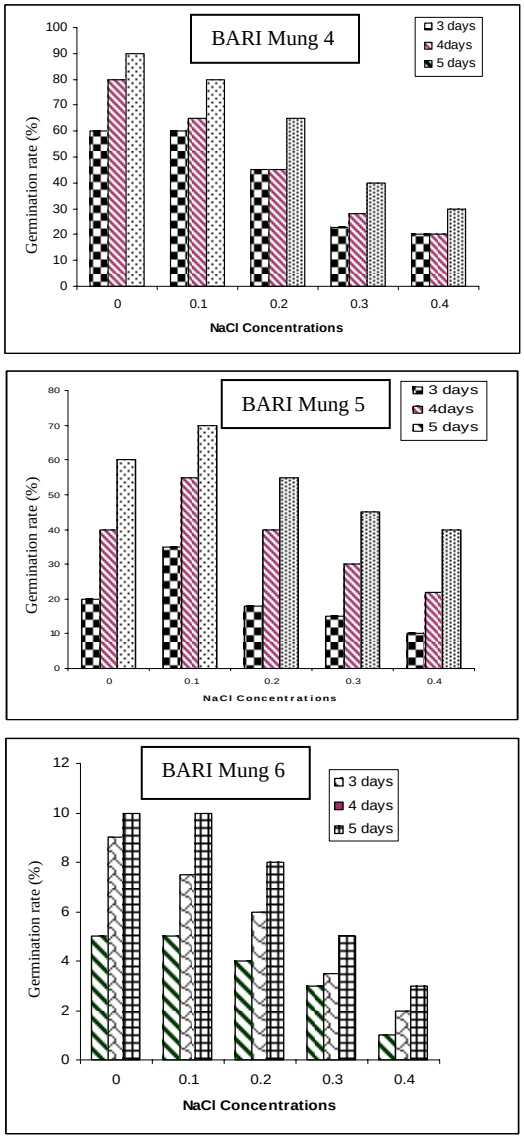

Fig.1. Effect of NaCl concentration on germination rate of BARI Mung 4, BARI Mung 5 and BARI Mung 6

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