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SALICYLIC ACID PREVENTS THE DAMAGING ACTION OF SALT IN MUNG BEAN [(*VIGNA RADIATA* L.) WILCZEK] SEEDLINGS

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Abstract

Growth is greatly affected by salt stress, which can be improved by the pretreatment of Salicylic acid (SA) before salt stress. The present study was conducted to determine the effect of seeds presoaking in 50µM, 100µM and 1000µM Salicylic acid on growth parameters of two mung bean genotypes (NM 19-19 and NM 20-21) under salinity stress (50 mM and 100 mM NaCl). It was found that salt reduced seedling length, fresh and dry weight of both genotypes, which decreased more as salt concentration increased further. Presoaking treatments with SA reduced salinity-induced decline in length, fresh weight and dry weight. However, pretreatment of high concentration of SA (1000 µM) prior to salt treatments was able to cause significant reduction in mean seedling length in both genotypes. It was further noticed that genotype NM 19-19 showed less reduction in the seedling length, fresh weight and dry weight under salt stress therefore seemed to be more salt tolerant than NM 20-21.

Introduction

Plants are usually exposed to number of abiotic stresses like temperature, light, drought, metal and salt stress, which can produce harmful effects on plant growth and development. Among these, salinity is the most serious limiting factor for the productivity of agricultural crops. Salinity affected land, comprises 19% of the 2.8 billion hectares of arable land on earth and increase in this menace is poisoning threat to agriculture globally (Pessarakli & Szabolcs, 1999).

Most abiotic stresses such as salt, extreme temperature and drought eventually cause cellular dehydration (Bartels & Nelson, 1994). Salinity is known to cause several deleterious morphological effects on different stages of plant growth. Both growth as well as metabolism are reported to be affected under saline stress (Katembe *et al*., 1998; Nabil & Coudret, 1995). The salinity at seedling stage of wheat causes reduction in germination percentage, fresh and dry weight of shoot and roots (Afzal *et al*., 2005).

Salicylic acid (SA), a plant phenol is now considered as a hormone-like endogenous regulator, has defense mechanism against biotic and abiotic stresses (Yalpani *et al*., 1994; Szalai *et al*., 2000). It is known to accumulate in plant's tissue under the impact of salinity stress, contributing to the increase of plant resistance to salinization (Ding *et al.,* 2002). Long-term incubation of tomato plant in low concentration of salicylic acid enables plant to tolerate salt-stress caused by 100 mM NaCl via accumulation of Na^+ ion in leaf tissue of treated plant which may functioned as osmolytes (Tari *et al.,* 2002).

Current study is an attempt to study the effect of Sodium chloride on growth of mung bean (*Vigna radiata* L.) seedlings and the pretreatment effect of salicylic acid prior to salt stress on certain morphological parameters.

Materials and Methods

Seeds of mung bean (*Vigna radiata* L.) genotypes, NM 19-19 and NM 20-21 were obtained from National Agricultural Research Center (NARC), Islamabad. Healthy and uniform sized seeds were sterilized with 1% (v/v) sodium hypochlorite solution for 5 minutes, rinsed 3 times with distilled water (d/w). Approximately 20 seeds of each genotypes were imbibed in distilled water and SA solutions (Salicylic acid was dissolved in little volume of dimethylsulfoxide (DMSO) and the final volume was reached by using distilled water) for 13 hr in the dark at 30^{o}C, sown in petri plates of 6 inches diameter, lined with two layers of filter paper moisten with 5 ml of d/w at 30^{o}C for 24 hr. Seedlings were then treated with salt for further 24 hr (Table 1). Eight, 61 hr old etiolated mung bean seedlings were harvested randomly for the measurement of length. Three seedlings were selected randomly from each treatment for fresh weight. Seedlings of same weight were allowed to dry at 70^{o}C for 48 hrs to record their dry weight. Presoaking of seeds before salt treatment was also performed by Mohammed (2007) and Kaydan *et al*., (2007).

Table 1. Salicylic acid and salt treatments given to mung bean genotypes

Treatment codes	Pretreatment (13 hours imbibition)		Incubated with distilled water at 30°C for 24 hours	Salt treatment (24 hours)
	D/w	SA		
T0	+	-		-
T1	+	-		50 mM
T2	+	-		100 mM
T3	-	50 uM		50 mM
T4	-	50 uM		100 mM
T5	-	100 uM		50 mM
T6	-	100 uM		100 mM
T7	-	1000 uM		50 mM
T8	-	1000 uM		100 mM

Statistical analysis: Experiment was performed in factorial design as CRD with n = 2 replicates. The data was subjected to analysis of variance (ANOVA) for length, fresh weight and dry weight, using computer soft ware SPSS version 11. Treatment means were compared by Duncan's Multiple Range Test (DMR) at 0.05 probability level (Steel & Torrie, 1980).

Results

Table 2 showed that mean sum of square of seedling length and fresh weight possessed a highly significant difference for genotypes and treatments with non significant interaction at 0.05 level of significance. A significant difference was present for genotypes with non significant differences for treatments and interaction as far as dry weight was concerned.

Table 2. Mean sum of squares for length, fresh weight and dry weight of mung bean seedlings harvested after treatments.

Sources of variation	MS			
	df	Length(cm)	FW(gm)	DW(gm)
Genotypes (G)	1	183.56 **	0.0085 **	0.0032 **
Treatments (T)	8	44.12**	0.069 **	0.00011 ^{ns}
G x T	8	2.24 ^{ns}	0.0078 ^{ns}	0.000033 ^{ns}
Error	18	1.67	0.0014	0.0000713

** = Significant at $p<0.05$, ns = Non significant

Figures 1 & 2 showed the effect of NaCl and SA on seedling length of both mung bean genotypes. It demonstrates that salt stress (T1 & T2) caused reduction in mean seedling length which was non significant for NM 19-19 and significant for genotypes NM 20-21. It was also noted that the effect of salt was reduced by the imbibition of seeds with 50 and 100µM SA, indicated that pretreatment of SA prior to salt stress caused induction in mean seedling length as compared to salt treatments. However high concentration of SA (1000µM) significantly reduced seedling length when used before the treatments of NaCl for both genotypes.

T0 T1 T2 T3 T4 T5 T6 T7 T8 | T0 T1 T2 T3 T4 T5 T6 T7 T8

NM 19-19 | **NM 20-21**

Fig. 1. Changes in growth charcterstics of two genotypes of mung bean seedlings treated with NaCl and SA {T0(control), T1(50 mM NaCl), T2(100 mM NaCl), T3(50 µM SA+50 mM NaCl),T4(50 µM SA+100 mM NaCl), T5(100 µM SA+50 mM NaCl), T6(100 µM SA+100 mM NaCl), T7(100 µM SA+50 mM NaCl), T8(1000 µM SA+100 mM NaCl)}

Figure 3 showed that fresh weight of genotype NM 19-19 and NM 20-21 reduced significantly after the treatment of NaCl as compared to control, however this reduction was more in NM 20-21. Improvement in mean fresh weight was seen after the pretreatment of 50 and 100µM SA prior to salt treatments. Pretreatment of high concentration of SA (1000 µM) before 50 and 100 mM NaCl treatments caused slight reduction in mean fresh weight for NM 19-19 and more reduction for NM 20-21.

For NM 19-19, there was non significant reduction in dry weight for salt treated samples (T1 and T2) which improved non-significantly for SA treatments T3, T5, T6 and T8. This pattern was almost same for NM 20-21, (Fig. 4).

It was noted that salt reduced seedling length, fresh weight and dry weight where as SA was able to improve seedling length, fresh weight and dry weight, however high concentration of SA caused reduction in seedling length and fresh weight of both genotypes.

Discussions

Present study was performed to monitor the morphological changes occurred by two concentrations of salt and also the effect of presoaking the seeds in various concentrations of SA prior to salt stress. Current results showed that by the increase in salinity there was decrease in length, fresh weight and dry weight of seedlings at both concentrations of salt as compared to control. The effect of salt was found out to be non significant for genotype NM 19-19, may suggestive of its salt tolerant capability than genotype NM 20-21. These results were contestant with many other researchers who studied effect of salt stress on mung bean. Misra *et al*., (1996), reported decrease in germination, shoot and root lengths and fresh mass in mung bean under salt stress. Raptan *et al.,* (2001) found that salinity caused decrease in dry matter, root, stem and leaf weights and plant height of mung bean. Similarly Yupsanis *et al.,* (2001) also reported reduction in plant height and dry weight under salinity stress as compared to control in alfalfa and lentil. Misra & Dwivedi (2004) found that the increasing levels of salinity remarkably decreased seed germination and caused pronounced decrease in seedling vigor in mung bean.

Furthermore, it was noted that the pretreatment of SA prior to salt stress enhanced seedling length, fresh weight and dry weight. These results are in agreement with Khodary, (2004), who reported that SA increases the fresh weight, dry weight of shoot and root of stress maize plants as compared to seedlings received salt alone. Presoaking treatment with SA reduces salinity-induced decline in length, fresh weight and dry weight, which may be a prerequisite for the growth after withdrawing the stressor's effect (Sakhabutdinova *et al*., 2003). Therefore SA treated seeds exhibited an increase in tolerance to salt treatment.

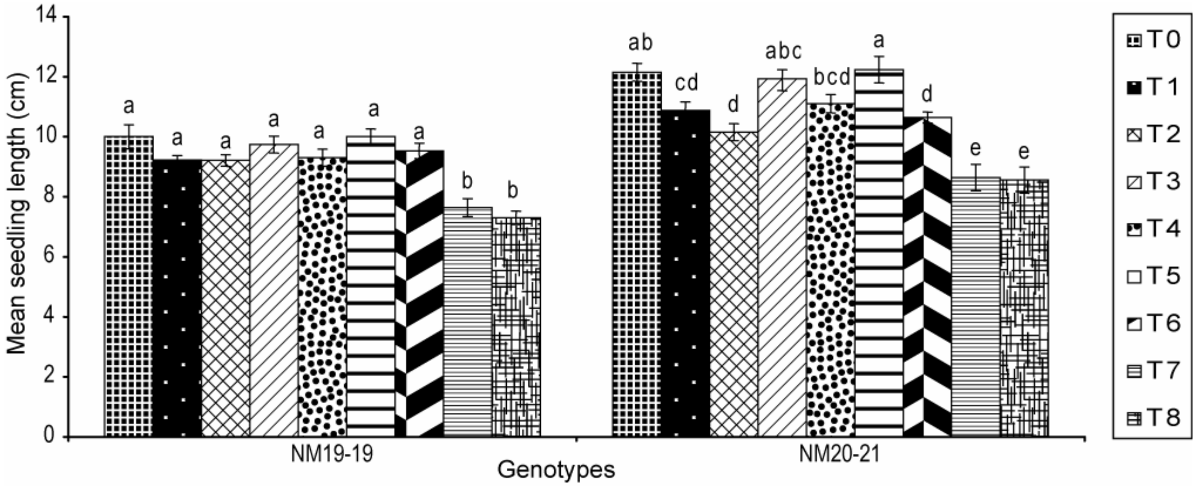

Fig. 2. Effect of NaCl and various concentrations of SA on seedling length of two mung bean genotypes. Homogeneous treatment means are represented by similar alphabets for each genotypes. Values are mean ± SE (n=2), represented by vertical bars.

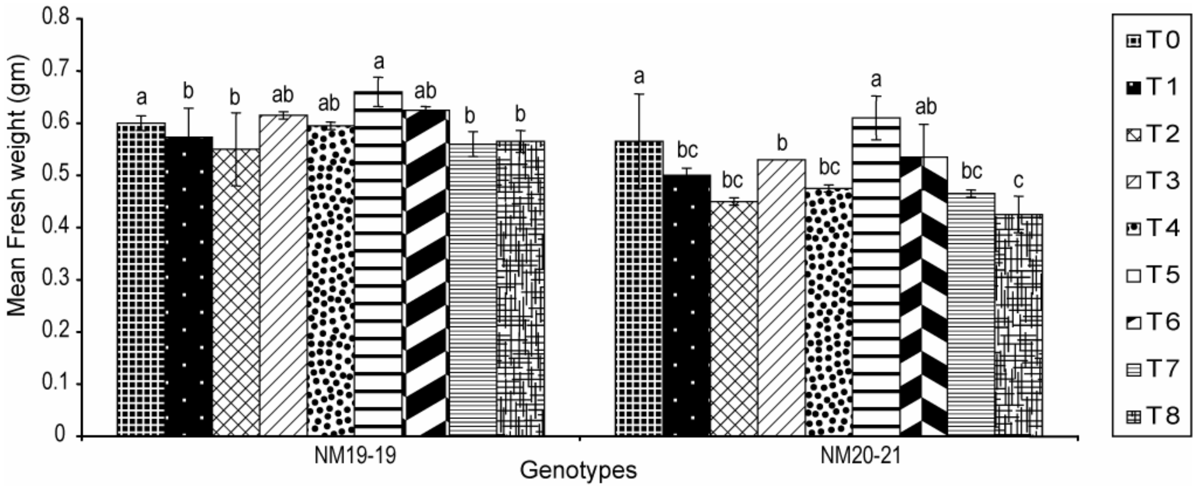

Fig. 3. Effect of NaCl and various concentrations of SA on fresh weight of two mung bean genotypes. Homogeneous treatment means are represented by similar alphabets for each genotypes. Values are mean ± SE (n=2)), represented by vertical bars.

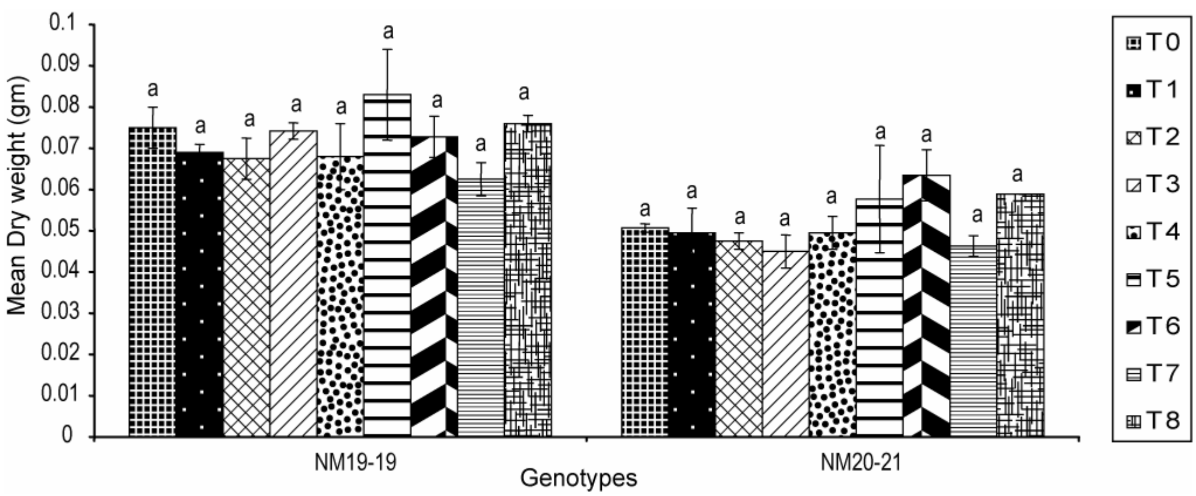

Fig. 4. Effect of NaCl and various concentrations of SA on dry weight of two mung bean genotypes. Homogeneous treatment means are represented by similar alphabets for each genotypes. Values are mean ± SE (n=2)), represented by vertical bars.

It was observed during present work that in both genotypes, 13-hrs pretreatment of 50µM SA prior to 50 and 100 mM NaCl increased length and fresh weight. These results are in agreement with Deef (2007) who reported that pretreatment of *Hordeum vulgare* with 0.05mM Salicylic acid for 6-hr and then subjection at 150 mM salt stress known to increase length upto control seedlings. Similarly pretreatment of 100 µM SA prior to salt stress caused increase in length and fresh weight in both genotypes of mung bean. Kaydan *et al.,* (2007) reported that seeds soaking in Salicylic acid (10^{-2} mol /L, 10^{-4} mol/L, 10^{-6} mol/L) have positive effects on plant growth in salinity and non-salinity conditions. It means that the application of exogenous Salicylic acid enhanced the drought and salt stress of plants (Senaratna *et al*., 2000; Tari *et al*., 2002). However, the high concentration (1000µM) of SA prior to salt stress caused reduction in length and fresh weight for both genotypes. Same results were found in maize by Nemeth *et al*., (2002) who reported that exogenously applied SA through rooting medium caused growth inhibition.

Conclusion

Our results indicated that salinity is responsible for the reduction in various morphological parameters like seedling length, fresh weight and dry weight of seedlings. Salt tolerance was increased by the pretreatment of low molarity of salicylic acid prior to salt stress as indicated by seedling length, fresh weight and dry weight. However, its high molarity (1000 µM) showed antagonistic effect on seedling length and fresh weight. Furthermore it was also observed that genotype NM 19-19 showed better performance and hence considered to be more salt tolerant genotype than NM 20-21

It is suggested that if mung bean seeds are imbibed in low concentration of salicylic acid and then sown in such fields, already affected with salinity, may show salt tolerance and can give better yield.

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