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Research Article

Influence of Vermicompost and Salt Stress on Some Characteristics of Fenugreek (*Trigonellafoenum-graecum* L.)

Melika Barahouee* and Ebrahim Sabbagh

Department of Agriculture, Islamic Azad University, Zahedan Branch, Zahedan, Iran
***Corresponding author:** barsa200014@gmail.com

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ABSTRACT

Fenugreek (*Trigonellafoenum-graecum* L.) is an annual crop belonging to the legume family. This crop is native to an area extending from Iran to northern India, but is now widely cultivated in China, north and east Africa, Ukraine and Greece. In parts of Asia, the young plants are used as potherbs and the seeds as a spice or as herbal medicine. The field experiment was laid out factorial with randomized complete block design with three replications. Treatments included vermicompost (control (A1), 5 weight percent (A2), 10 weight percent (A3), and salt stress (control (B1), 100 mM (B2) and 200 mM (B3).Analysis of variance showed that the effect of vermicompost on all characteristics was significant. The maximum of number of seed per pod, Number of pod, Number of sub branch and Plant height of treatments 10 weight percent, was obtained. The minimum of number of seed per pod, Number of pod, Number of sub branch and Plant height of treatments control, was obtained. Analysis of variance showed that the effect of salt stress on all characteristics was significant. The maximum of number of seed per pod, Number of pod, Number of sub branch and Plant height of treatments control, was obtained. The minimum of number of seed per pod, Number of pod, Number of sub branch and Plant height of treatments 200 mM, was obtained. During the onset and development of salt stress within a plant, all the major processes such as photosynthesis, protein synthesis and energy and lipid metabolisms are affected.

Key words: Plant height, Number of pod, Vermicompost

INTRODUCTION

Fenugreek (*Trigonellafoenum-graecum* L.) is an annual crop belonging to the legume family. This crop is native to an area extending from Iran to northern India, but is now widely cultivated in China, north and east Africa, Ukraine and Greece. In parts of Asia, the young plants are used as potherbs and the seeds as a spice or as herbal medicine (Malik, 2009). Fenugreek plant is susceptible to water stress during the vegetative growth stages, since a soil matric potential lower than –0.3 MPa causes substantial reduction in growth parameters such as height, weight and total leaf area. Fenugreek is a dry land crop but responds well to minimum application of irrigation (kumar, *et al.* 2000). A wide range of environmental stresses (such as high and low temperature, drought, alkalinity, salinity, UV stress and pathogen infection) are potentially harmful to the plants (Sadasivan *et al*., 1998). Salt stress in soil or water is one of the major stresses especially in arid and semi-arid regions and can severely limit plant growth and productivity (Allakhverdiev *et al*., 2000, Koca *et al*., 2007). However, elevated salt content in tissues directly influences photosynthetic enzymes and secondarily influences gas exchange and light reactions. Originally, the results of literature cleared that salinity was inhibiting photosynthesis by stomatal and non-stomatal factors. In a study photosynthesis was inhibited by 65% under saline conditions. Stomatal conductance was also inhibited by a similar amount, while there was no change in chlorophyll concentrations. The reduction in photosynthesis due to non-stomatal factor may be caused by toxic ions. A negative relationship was found between photosynthesis activity and Na+ content in leaves in a number of crop species such as rice (Yeo, 1998), and Cl- content in woody perennials such as citrus. A study with wheat (Leport*et al*., 2006) found that photosynthesis rate was reduced by a further 50% with Na+ concentration in leaves of about 350 mM. Liu *et al* (2004) found that high Cl- concentrations (250-300 mM) in the chloroplast of

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Phaseolus were correlated with the efficiency of Rubisco. Therefore, the tolerance of photosynthetic system to salinity may be associated with the capacity of the plant speciesto effectively compartmentalize the salts in the vacuole. According to the incapacity to grow on high salt medium, plants have been classified as glycophytes or halophytes. Most plants are glycophytes and cannot tolerate salt stress. The deleterious effects of salinity on plant growth are associated with: (1) low osmotic potential of soil solution (water stress), (2) nutritional imbalance, (3) specific ion effect (salt stress) or (4) a combination of these factors (Ashraf and foolad, 2007). During the onset and development of salt stress within a plant, all the major processes such as photosynthesis, protein synthesis and energy and lipid metabolisms are affected. The earliest response is a reduction in the rate of leaf surface expansion followed by cessation of expansion as the stress intensifies but growth resumes when the stress is relieved (Parida*et al*., 2004). Amino acids (alanine, arginine, glycine, serine, leucine, and valine, together with the imino acid, proline, and the non-protein amino acids, citrulline and ornithine) and amides (such as glutamine and asparagines) have also been reported to accumulate in plants subjected to salt stress (Mansour, 2000). Total free amino acids in the leaves have been reported to be higher in salt tolerant than in salt sensitive lines of sunflower (Ashraf and foolad, 2007), safflower Eruca sativa (Ashraf and Hariss, 2004) and Lens culinaris. Proline, which occurs widely in higher plants and accumulates in larger amounts than other amino acids (Abraham *et al*., 2003), regulates the accumulation of useable N. Proline accumulation normally occurs in the cytosol where it contributes substantially to the cytoplasmic osmotic adjustment. It is osmotically very active and contributes to membrane stability and mitigates the effect of NaCl on cell membrane disruption (Mansour, 2000). Even at supra-optimal levels, proline does not suppress enzyme activity. Maggio *et al*. (2002) are of the view that proline may act as a signaling/regulatory molecule able to activate multiple responses that are component of the adaptation process. These results were corroborated by Maqsood *et al*. (2000). However, Aziz *et al*. (1998) and Parida *et al*. (2004) report a negative correlation between proline accumulation and salt tolerance in tomato and Aegicerascorniculatum respectively. Transgenic tobacco plants over-expressing P5CS have shown increased concentration of proline and resistance to both drought and salinity stresses (Postel, 2000). However, whether proline accumulation in these transgenic plants resulted in increased stress tolerance through osmotic adjustment or other mechanisms is unknown (Hinsinger, 2001).

MATERIALS AND METHODS

Location of experiment

The experiment was conducted at the jiroft which is situated between 48° North latitude and 35° East longitude.

Composite soil sampling

Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

Field experiment

The field experiment was laid out factorial with randomized complete block design with three replications.

Treatments

Treatments included vermicompost (control (A1),5 weight percent (A2), 10 weight percent (A3), and salt stress (control (B1), 100 mM (B2) and 200 mM (B3).

Data collect

Data collected were subjected to statistical analysis by using a computer program SAS.

RESULTS AND DISCUSSION

Number of seed per pod

Analysis of variance showed that the effect of vermicompost on number of seed per pod was significant (Table 1). The maximum of number of seed per pod of treatments 10 weight percent was obtained (Table 2). The minimum of number of seed per pod of treatments control was obtained (Table 2). Analysis of variance showed that the effect of salt stress on number of seed per pod was significant was significant (Table 1). The maximum of number of seed per pod of treatments control was obtained (Table 2). The minimum of number of seed per pod of treatments 200 mM was obtained (Table 2).Salt stress in soil or water is one of the major stresses especially in arid and semi-arid regions and can severely limit plant growth and productivity (Allakhverdiev *et al*., 2000, Koca *et al*., 2007). However, elevated salt content in tissues directly influences photosynthetic enzymes and secondarily influences gas exchange and light reactions. Originally, the results of literature cleared that salinity was inhibiting number of seed per pod, photosynthesis by stomatal and non-stomatal factors ((Allakhverdiev *et al*., 2000).

Number of pod

Analysis of variance showed that the effect of vermicompost on number of pod was significant (Table 1). The maximum of number of pod of treatments 10 weight percent was obtained (Table 2). The minimum of number of pod of treatments control was obtained (Table 2). Analysis of variance showed that the effect of salt stress on number of pod was significant was significant (Table 1). The maximum of number of pod of treatments control was obtained (Table 2). The minimum of number of pod of treatments 200 mM was obtained (Table 2). In a study photosynthesis was inhibited by 65% under saline conditions. Stomatal conductance was also inhibited by a similar amount, while there was no change in chlorophyll concentrations. The reduction in photosynthesis due to non-stomatal factor may be caused by toxic ions. A negative relationship was found between number of pod and Na^+ content in leaves in a number of crop species such as rice (Yeo, 1998), and Cl^- content in woody perennials such as citrus. A study with wheat (Leport, 2006) found that photosynthesis rate was reduced by a further 50% with Na+ concentration in leaves of about 350 mM.

Table 1: Anova analysis of the fenugreek affected by salt stress and vermicompost

Sov	df	Number of seed per pod	Number of pod	Number of sub branch	Plant height
Vermicompost (A)	2	29.11**	120.70**	3.86**	104.28**
Salt stress (B)	2	7.24**	40.25**	2.22**	253.11**
A*B	4	1.58**	0.14ns	0.56**	2.77**
Error	18	0.08	1.11	0.07	0.55
CV	-	3.12	5.66	4.08	3.54

*, **, ns: significant at $p<0.05$ and $p<0.01$ and non-significant, respectively.

Table 2: Comparison of different traits affected by salt stress and vermicompost

Vermicompost	Number of seed per pod	Number of pod	Number of sub branch	Plant height
Control	7.13c	15.33c	5.88c	17.51c
5 weight percent	9.86b	17.88b	7.14b	21.28b
10 weight percent	10.52a	22.55a	6.84a	24.30a
Salt stress				
Control	10.16a	20.77a	7.20a	25.81a
100 mM	8.93b	18.44b	6.32b	21.97b
200 mM	8.43c	16.55c	6.35b	15.32c

Any two means not sharing a common letter differ significantly from each other at 5% probability.

Number of sub branch

Analysis of variance showed that the effect of vermicompost on number of sub branch was significant (Table 1). The maximum of number of sub branch of treatments 10 weight percent was obtained (Table 2). The minimum of number of sub branch of treatments control was obtained (Table 2). Analysis of variance showed that the effect of salt stress on number of sub branch was significant was significant (Table 1). The maximum of number of sub branch of treatments control was obtained (Table 2). The minimum of number of sub branch of treatments 200 mM was obtained (Table 2). These results were corroborated by Maqsood *et al*. (2000). However, Aziz *et al*. (1998) and Parida *et al*. (2004) report a negative correlation between number of sub branch and salt tolerance in tomato and Aegicerascorniculatum respectively. Transgenic tobacco plants over-expressing P5CS have shown increased concentration of proline and resistance to both drought and salinity stresses (Postel, 2000). However, whether proline accumulation in these transgenic plants resulted in increased stress tolerance through osmotic adjustment or other mechanisms is unknown (Hinsinger, 2001).

Plant height

Analysis of variance showed that the effect of vermicompost on plant height was significant (Table 1). The maximum of plant height of treatments 10 weight percent was obtained (Table 2). The minimum of plant height of treatments control was obtained (Table 2). Analysis of variance showed that the effect of salt stress on plant height was significant was significant (Table 1). The maximum of plant height of treatments control was obtained (Table 2). The minimum of plant height of treatments 200 mM was obtained (Table 2). The salt stress on plant, decrease plant height (Maggio et al., 2002). It is osmotically very active and contributes to membrane stability and mitigates the effect of NaCl on cell membrane disruption (Mansour, 2000). Even at supra-optimal levels, proline does not suppress enzyme activity. Maggio *et al*. (2002) are of the view that proline may act as a signaling/regulatory molecule able to activate multiple responses that are component of the adaptation process.

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