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Effect of foliar application of salicylic acid and drought stress on quantitative yield of mungbean (*Vigna radiata* L.)

Tahereh Safaei Nezhad[1], Hamid Reza Mobasser[2*], Mehdi Dahmardeh[3] and Mohammadali karimian[4]

1- MSc student, Department of Agronomy, Islamic Azad University, Zahedan Branch, Zahedan, Iran
2- Department of Agronomy, Islamic Azad University, Zahedan Branch, Zahedan, Iran
3- Asistant Professor, Department of Agronomy, University of Zabol, Iran
4- Institute of Agricultural Research, University of Zabol, Zabol, Iran

Corresponding author: Hamid Reza Mobasser

ABSTRACT: Mungbean (*Vigna radiata* L.) is an important legume crop of Asia and a major component of many cropping systems. The crop grown under non-irrigated condition, encounters drought stress at different growth stages. Plants produce proteins in response to abiotic and biotic stress and many of these proteins are induced by phytohormones such as salicylic acid. SA is synthesized by many plants and is accumulated in the plant tissues under the impact of unfavorable abiotic factors, contributing to the increase of plants resistance to drought stress. The field experiment was laid out in randomized complete block design with split plot design with three replications. Drought stress in three levels (I1: Regular watering 5 days, I2: 10 days, I3: 15 days) allocated to main plots and foliar application of salicylic acid in four levels (S1: 0, S2: 0.5, S3:1, S4:1.5 Mmol) was allocated to sub plots. Drought stress and salicylic acid on plant height, Number of Branch , Number of Pod and Biological yield was significant.

Keywords: plant height, Number of Pod, Biological yield.

INTRODUCTION

Mungbean (*Vigna radiata* L.) is an important legume crop of Asia and a major component of many cropping systems. Mungbean seeds are rich in protein and amino acids, thus serve as a valuable protein source for human consumption. Pods and sprouts of mungbean are also eaten as vegetable and are a source of vitamin and minerals. Moreover, this crop fixes atmospheric nitrogen (Ranawake, 2008). It has a short life cycle and therefore widely grown as mixed crop, intercrop or in rotation to improve nitrogen status of soil or to break the diseases or pest cycle. This pulse plays a significant role as supplement of low protein diet of poor people in Bangladesh but its production and acreage is declining day by day with an average yield of 0.69 ton ha-1 (BBS, 2008). Climatic conditions of western Uttar Pradesh is suitable for Mungbean cultivation throughout the year (Ali and Kumar, 2004). The crop grown under non-irrigated condition, encounters drought stress at different growth stages. The crop is potentially useful for improving cropping pattern as it can be grown as a cash crop due to its rapid growth and early maturing characteristics. In a symbiotic relationship with the soil bacteria, Mungbean roots can fix atmospheric nitrogen and thus improve soil fertility (Nabizade, 2011). Mungbean is reported to be more susceptible to water deficits than many other grain legumes (Pandey, 1984). Water stress reduces photosynthesis; the most important physiological processes that regulate development and productivity of plants (Athar and Ashraf, 2005). Reduction in leaf area causes reduction in crop photosynthesis in plants leading to dry matter accumulation (Pandey, 1984). Plants tend to adapt to drought by accumulation of cyto-compatible organic osmolytes (Rhodes and Hanson, 1993) such as polyols, proline and betaines. Seed treatment or foliar application of chemicals like glycinebetaine, kinetin, salicylic acid (Gunes, 2007; Karlidag, 2009) may increase yield of different crops due to reduction in stress induced inhibition of plant growth (Elwana and El-Hamahmyb, 2009), enhanced photosynthetic rates, leaf area and plant dry matter production (Khan, 2003). This crops suffering water stress resulted in decreased pod number, number of seeds pod-1, 1000-seed weight and ultimately seed yield. Supplemental irrigation, particularly at the pod filling stage to improve plant water status gives economic increase in yields in areas of super optimal temperature during the reproductive growth (Ullah, 2002). The late flowering and pod setting stages appear to the most sensitive stages to soil moisture stress. Mungbean yield was depressed when the irrigation treatments were given at flowering, with or without pre flowering irrigation. Maqsood, (2000) observed the highest yield of mungbean with three irrigations. Plants produce proteins in response to abiotic and biotic stress and many of these proteins are induced by phytohormones such as ABA (Jin, 2000) and salicylic acid (Hoyos and Zhang, 2000). SA is synthesized by many plants (Raskin, 1990) and is accumulated in the plant tissues under the impact of unfavorable abiotic factors, contributing to the increase of plants resistance to salinization (Ding, 2002; Kang and Saltveit, 2002). In addition, SA-induced increase in the resistance of wheat seedlings to salinity (Shakirova and Bezrukova 1997). Thus the detrimental effects of high salts on the early growth of wheat seedlings may be alleiveted by treating seeds with the proper concentration of a suitable hormone (Darra, 1973). Salicylic acid, a naturally occurring plant hormone acting as an important signaling molecule adds to tolerance against abiotic stresses. It plays a vital role in plant growth, ion uptake and transport. Salicylic acid is also involved in endogenous signaling to trigger plant defense against pathogens (Khan, 2003). relations (Barkosky and Einhelling, 1993), photosynthesis, growth and stomatal regulation (Khan, 2003; Arfan, 2007) under abiotic stress conditions. L-Tryptophan is known to be a physiological precursor of auxins in higher plants. It is investigated that L-Tryptophan has more positive effect on plant growth and yield as compared to pure auxins (Zahir, 1999).

MATERIALS AND METHODS

The experiment was conducted in 2013 at the institute Agricultural Research Station, University of Zabol (Iran). Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics. The field experiment was laid out in randomized complete block design with split plot design with three replications. Drought stress in three levels (I1: Regular watering 5 days, I2: 10 days, I3: 15 days) allocated to main plots and foliar application of salicylic acid in four levels (S1: 0, S2: 0.5, S3:1, S4:1.5 Mmol) was allocated to sub plots. The distance between sub-plots was 100 cm. The seed row with a length of 4 meters and a distance of 30 cm were planted. Data collected were subjected to statistical analysis by using a computer program MSTATC (Freed and Scott, 1986). Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means (Steel, 1997).

RESULTS AND DISCUSSION

Plant height

Drought stress on height was significant at the 1% level (Table 1). The maximum amount of water in a 5-day high 22.67 cm and the height of the lowest water levels in 15-day and 63.22 cm, respectively. (Table 2). The experimental reported that plant height at vegetative and reproductive growth stages of the plants most sensitive to water stress than is characteristic (Desclaux and Roumel, 1996). Effect of salicylic acid on height was significant at 1% level (Table 1). The highest elevation in the concentration of 1.5 Mmol salicylic rate and the lowest rate of 27.5 cm and a height of 22.66 cm was observed in the control treatment levels. It is possible to enhance the role of salicylic acid is the chemical aspects of physiology (Maity and Bera, 2009). It can also increase the NKP and calcium content, antioxidant enzyme activity and is Glvtanyvn (Khan, 2010).

Table 1. Analysis of variance for some traits in agricultural Drought stress Vmhlvl salicylic acid spray

S.O.V	df	Plant height	Number of Branch	Number of Pod	Biological yield
R	2	1.083^{ns}	0.465^{ns}	0.802^{ns}	0.105^{ns}
Drought stress	2	76.271^{**}	68.882^{**}	8.681^{**}	0.970^{**}
Error a	4	0.635	0.403	0.171	0.009
salicylic acid	3	38.192^{**}	33.155^{**}	0.910^{ns}	0.340^{*}
Drought stress* salicylic acid	6	15.178^{**}	14.030^{**}	1.844^{*}	0.665^{**}
Error b	18	1.544	1.627	0.304	0.068
C.V	-	4.95	9.12	14.47	12.97

ns, * and ** respectively indicate significant and non-significant at the 5% and 1%

Number of Branch

Drought stress on the number of branches was significant at 1% level (Table 1). Maximum number of branches in the water 5 days 16.37 (Table 2). Salicylic effect on the number of branches was significant at the 1% level (Table 1). Foliar application of salicylic acid at 1.5 Mmol, the highest number of branches in the control treatments 6.33 and

11.83 respectively, the lowest number of branches. Foliar application of salicylic acid increased plant weight, number of branches and increased wet and dry bean plant shoots (Bekheta and Talaat , 2009).

Table 2. Comparisons of mean Drought stress effect on some traits

Irrigation intervals (days)	Plant height	Number of Branch	Number of Pod	Biological yield
5	27.6a	16.37a	4.46a	2.32a
10	25.08b	14.00b	4.11a	1.86b
15	22.63c	11c	2.85b	1.32c

Mean that have a common letter are not significantly different at the one percent level with each other

Number of Pod

Drought stress on the Number of Pod was significant at 1% level (Table 1). The highest number of pods per 5-day irrigation water at a rate of 4.46 and a minimum 15-day pods and Pod of 2.85 was observed (Table 2). It also stated that the occurrence of Drought stress in the early reproductive growth, flowering and pod loss increases (Korte, 1983). Announced that the number of pods per plant than other components of yield stress is injured (Pendey, 1984). Interactive effects of drought and salicylic acid 5% level was significant on number of pods (Table 1). Highest pods 5-day irrigation and foliar application of 1.5 Mmol salicylic acid 5.1 and the lowest number of pods per 15-day irrigation and foliar salicylic acid number of 1.73 was obtained.

Table 3. Comparisons of Mean effect of salicylic acid (SA) on some traits

Salicylic Acid (Mmol)	Plant height	Number of Branch	Number of Pod	Biological yield
Control	22.66c	11.83c	3.41a	1.12c
0.5	24.44bc	13.22bc	3.7a	1.35c
1	25.88ab	14.45ab	4.05a	1.88b
1.5	27.50a	16.33a	4.07a	2.45a

Mean that have a common letter are not significantly different at the one percent level with each other

Biological yield

Drought stress on the biological yield was significant at 1% level (Table 1). As Figure comparison to regular watering and biological yield of 2.32 tons per hectare and the performance of watering for 15 days and the lowest rate was 1.32 tons per hectare. Effects of drought stress at flowering stage on total dry weight, grain weight was less than the results (Tesfaye, 2006) are in agreement. Salicylic effect on the number of branches was significant at the 5% level (Table 1). The biological function of the amount of foliar salicylic acid 1.5 Mmol, 2.45 tons per ha and the lowest yield of 1.12 tons per hectare to control levels was observed (table 3). The results with the results (Bekheta and Talaat, 2009) and (Khan, 2010) corresponded to the vetch plant.

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