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Effect of salicylic acid and water stress on percent of protein, harvest index and biological yield in mung bean

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Abstract

Mungbean is a warm season crop requiring 90–120 days of frost free conditions from planting to maturity. Adequate rainfall is required from flowering to late pod filling in order to ensure good yield. Salicylic acid (SA), a plant phenol is now considered as a hormone-like endogenous regulator, has defense mechanism against biotic and abiotic stresses. The experiment was conducted in 2013 at the Research Station tropical fruits and natural resources in bahukalat. The field experiment was laid out in randomized complete block design with split plot design with three replications. Treatments included irrigation as a major factor in three levels included (Full irrigation, Irrigation cut at flowering time, Irrigation cut at pod time) and salicylic acid concentrations in four levels included (0, 900, 1800, 2700 Micromolar) before planting the priming was done. Analysis of variance showed that the effect of water stress and salicylic acid on all characteristic was significant.

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Introduction

Among the pulse crops, Mungbean has a special importance of intensive crop production due to its short growth period (Ahmed *et al*., 1978). Climatic conditions of western Uttar Pradesh is suitable for Mungbean cultivation throughout the year (Ali and Kumar, 2004). The major legumes in Asia are chickpea, (*Cicer arietinum* L), pigeonpea (*Cajanus cajan* L), and Mungbean (*Vigna radiata*). Mungbean is a warm season crop requiring 90–120 days of frost free conditions from planting to maturity. Adequate rainfall is required from flowering to late pod filling in order to ensure good yield. Drought problems for Mung beans are worsening with the rapid expansion of waterstressed areas of the world including 3 billion people by 2030 (Postel, 2000). Crop yield of Mung bean is more dependent on an adequate supply of water than on any other single environmental factor (Kramer and Boyer 1997). Drought is a polygenic stress and is considered as one of the most important factors limiting crop yields around the world. Water is the main factor limiting yield production in the arid and semiarid regions. When water resources are a factor limiting the production, irrigation programming is essential in order to maximize production per m3 irrigation water (Doorenbos and Kassam, 1979). Deficit irrigation is one way of maximizing water use efficiency (Bekele and Tilahun 2007). However, drought and salinity are the most serious threats to agriculture and are far more important globally (Altman, 2003), water stress is major harmful factor in arid and semi-arid regions worldwide (Ranjana *et al*., 2006) that limits the area under cultivation and yield of crops. Drought is observed in irrigated areas due to insufficient supply of water and canal closure (Hafeez *et al*., 2003). Water deficit/drought affects every aspect of plant growth and the yield modifying the anatomy, morphology, physiology, biochemistry and finally the productivity of crop (Jones *et al*., 2003; Hafiz *et al*., 2004). Development of cultivars with high yield is the main goal in water limited environments but success has been modest due to the varying nature of drought and the complexity of genetic control of plant responses (Sadiq, 1994). 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). Several studies have demonstrated that exogenous SA application enhances plant growth and development. Fariduddin *et al*. (2003) showed that mustard plants sprayed with low concentrations of SA produced larger amounts of dry matter and had higher photosynthetic rate in comparison with control plants. SA application to corn and soybean promoted leaf area and dry weight of plants (Khan *et al*. 2003). Motivation and aims of the study were effect of salicylic acid and water stress on percent of protein, harvest index and biological yield in mung bean. purpose of the study were effect of salicylic acid and water stress on percent of protein, harvest index and biological yield in mung bean.

Material and methods

Location of experiment

The experiment was conducted in 2013 at the Research Station tropical fruits and natural resources in bahukalat (In Iran) which is situated between 25° North latitude and 37° East longitude and at an altitude of 85m above mean Sea Level.

Composite soil sampling

The soil of the experimental site belonging loam. 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 in randomized complete block design with split plot design with three replications.

Treatments

Treatments included irrigation as a major factor in three levels included (Full irrigation, Irrigation cut at flowering time, Irrigation cut at pod time) and salicylic acid concentrations in four levels included (0, 900, 1800, 2700 Micromolar) before planting the priming was done.

Data collect

Data collected were subjected to statistical analysis by using a computer program MSTATC. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments` means.

Results and discussion

Thousand grain weight

Analysis of variance showed that the effect of water stress on thousand grain weight was significant (Table 1). The maximum of thousand grain weight (47.81) of treatments Full irrigation was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on thousand grain weight was significant (Table 1). The maximum of thousand grain weight (50.79) of treatments 2700 Mm salicylic acid was obtained (Table 2).

Table 1. Anova analysis of the mungbean affected by water stress and salicylic acid.

S.O.V	df	Thousand grain weight	Economic yield	Biological yield	Harvest index	Percent of protein
R	2	81.80^{**}	327461.5^{**}	138000.7^{**}	307.27^{**}	15.73^{**}
Irrigation cut	2	83.73^{**}	339517.3^{**}	99146^{**}	371.75^{**}	1.95^{**}
Error	4	0.15	2801.18	55778	10.31	0.87
Salicylic acid	3	94.85^{**}	4.19^{**}	4.83^{*}	92.05^{**}	0.54^{*}
Irrigation cut* Salicylic acid	6	16.54^{*}	14416.3^{ns}	50815.4^{ns}	11.25^{ns}	3.56^{ns}
Total error	18	5.67	1477.2	20182.7	12.97	0.17
C.V	-	5.16	12.32	6	9.86	5.03

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

Economic yield

Analysis of variance showed that the effect of water stress on economic yield was significant (Table 1). The maximum of economic yield (106.37) of treatments Full irrigation was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on economic yield was significant (Table 1). The maximum of economic yield (1028.3) of treatments 2700 Mm salicylic acid was obtained (Table 2).

Table 2. Comparison of different traits affected by water stress and salicylic acid.

Treatment	Thousand grain weight	Economic yield	Biological yield	Harvest index	Percent of protein
Water stress					
Full irrigation	47.81a	106.37a	2468.7a	42.94a	20.75a
Irrigation cut at 50% flowering	44.05c	768.63b	2322.6b	33.01b	20.35a
Irrigation cut at 50% pod	46.53b	775.54b	2302c	33.61b	19.38b
Salicylic acid					
0	41.65c	716.5c	1930.6d	37.04a	18d
900	45.56bc	816.02bc	2198c	36.83a	19.66c
1800	46.53b	915.77b	2554.5b	36.80a	22.09a
2700	50.79a	1028.3a	2774.6a	35.86a	20.89b

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

Biological yield

Analysis of variance showed that the effect of water stress on biological yield was significant (Table 1). The maximum of biological yield (2468.7) of treatments Full irrigation was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on biological yield was significant (Table 1). The maximum of biological yield (2774.6) of treatments 2700 Mm salicylic acid was obtained (Table 2).

Harvest index

Analysis of variance showed that the effect of water stress on harvest index was significant (Table 1). The maximum of harvest index (42.94) of treatments Full irrigation was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on harvest index was significant (Table 1). The maximum of harvest index (35.86) of treatments 2700 Mm salicylic acid was obtained (Table 2).

Percent of protein

Analysis of variance showed that the effect of water stress on percent of protein was significant (Table 1). The maximum of percent of protein (20.75) of treatments Full irrigation was obtained (Table 2). Analysis of variance showed that the effect of Salicylic acid on percent of protein was significant (Table 1). The maximum of percent of protein (22.09) of treatments 1800 Mm salicylic acid was obtained (Table 2).

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