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Research Article

Evaluation of Phosphate Fertile 2 and Water Stress on Pod Length, 1000 Grain Weight Number of Seed per Pod of Mungbean

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ABSTRACT

Drought is a widespread climatic event which frequently limits growth of mungbean. Mungbean response to water stress resulting in lower yields. Crop yield of mungbean is more dependent on an adequate supply of water than on any other single environmental factor. In winter cultivation when temperature is low, relative humidity is low and evapotranspiration is greater, then 3-4 times irrigation may need to obtain higher yields of mung bean to overcome drought effect. Treatments included water stress (A1: control, A2: water stress in during vegetative growth, A3: water stress in during reproductive growth) and Phosphate fertile 2 (B1:0, B2:50, B3:100, B4: 150). Analysis of variance showed that the effect of water stress and Phosphate fertile 2 on all characteristics was significant.

Key words: Pod length, 1000 grain weight, number of seed, Number of pod

INTRODUCTION

Drought is a widespread climatic event which frequently limits growth of mungbean. Mungbean response to water stress resulting in lower yields (Miah and Carangal, 2001). The decrease in crop biomass production is frequently observed in response to water deficit. Drought problems for mung beans are worsening with the rapid expansion of water stressed areas of the world including 3 billion people by 2030 (Postel, 2000). Crop yield of mungbean is more dependent on an adequate supply of water than on any other single environmental factor (Kramer and Boyer 1997). In winter cultivation when temperature is low, relative humidity is low and evapotranspiration is greater, then 3-4 times irrigation may need to obtain higher yields of mung bean to overcome drought effect (Lal *et al*., 2000). Moisture deficiency during flowering causes abscission of flower bud and hampers pod development. The response of grain legume to moisture stress is often related to so-called 'moisture sensitive period' –certain developmental phases in which the plant is or appears by its observed response to be more sensitive to moisture conditions than during other phases. Maqsood *et al*. (2000) observed that mung bean suffer due to water stress when grown in an upland rice soil and that irrigation at vegetative and flowering plus pod development stages improve seed yield. Most prominent aspect of growth and development of mung bean is that the plant is sensitive to drought stresses, as a consequence of which growth and developments go significantly below potential. 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 water stressed areas of the world including 3 billion people by 2030 (Postel, 2000). Mungbean is a short-season summer growing grain legume grown as dry land crop in the center and northeast of Asia (Majnon Hoseini, 2009). Mung-bean is one of the most nutritious grain legumes used in different parts of the world. Mungbean is a drought tolerant crop and performs well under conditions of low soil moisture (Kochaki and Benayanol, 1990). Thomas *et al*. (2004) investigate some genotypes of mung bean and stated that water stress accelerate flowering and podding time in many cases. Leaf chlorophyll content is one of the most important indices showing the environmental stress on plants which reduces under stress conditions (Zarco-Tejada, 2000). Wang (2008) stated that

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by increasing water stress, soybean seed protein was decrease. Liu *et al*. (2004) reported that sever water stress, in the first stage of pod development in soybean, decreased pods growth and led to considerable decrease in number of pod. Like other legumes, mung beans are high in protein, having around 25% of the seed dry weight and its amino acid profile is complementary to cereal grains. Mung bean is produced in tropical and sub-tropical rain-fed environments with little or no impounding of water, and it is prone to drought when soil moisture or rainfall is inadequate to meet plant requirements. It is an important pulse crop in developing countries of Asia, Africa and Latin America where it is consumed as a dry seed and fresh green pods (Karuppanapandian *et al*., 2006). To cope with the increasing food requirements and as drought is a major stress which adversely affects plant growth and productivity; it is important to develop stress tolerant crops (Mahajan and Tuteja 2005). Plant can respond and adapt to water stress by altering their cellular metabolism and invoking various defense mechanisms (Bohnert and Jensen, 1996). Environmental stresses (drought, salinity, heat, cold, etc.) represent a major constraint to meeting the world food demand, which effect of drought, affecting 45% loss in crop yield, is of considerable importance. In Iran, low precipitation (around 250 mm) along with its uneven temporal and spatial distribution led agronomists to select the most effective irrigation methods or drought tolerant cultivars (Soltani and Faraji, 2007). Grain legumes are a major source of protein in arid and semiarid region of world and play a key role in economy of these regions (Singh and Patal, 1996). Mungbean is reported to be more susceptible to water deficits than many other grain legumes (Pandey *et al*., 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 *et al*., 1984). Water stress imposed at any growth stage causes reduction in dry matter accumulation depending on the growth stage exposed to stress (Sadasivan *et al*., 1988). According to Sadasivan *et al*. (1988), water stress during vegetative phase reduces grain yield through restricted plant size leaf area and root growth which subsequently the dry matter accumulation, number of pods per plant and low harvest index. Water deficits at the flowering and the post-flowering stages have been found to have a greater adverse impact than that at the vegetative stage (Rafiei Shirvan and Asgharipu, 2009). The reproductive stage is the most sensitive growth phase to drought (Brown *et al*., 1985) resulting to less yield and poor harvest index under drought stress (Uprety and Bhatia, 1989). Water stress reduces plant growth and yield. However, water stress that exists at the reproductive stage severely affects grain yield of mungbean more than its occurrence at other stages (Thomas *et al*., 2004). In addition, the time of flowering and maturity was shortened under stress compared to well-watered conditions. Leport *et al*., (2006) found that pod production of chickpea was more affected by early podding water stress than by late podding water stress. Tolerance to abiotic stresses is very complex at the cellular levels of the whole plant (Foolad *et al*., 2003 a, b; Ashraf and Harris, 2004). This is in part due to the complexity of interactions between stress factors and various molecular, biochemical and physiological phenomena affecting plant growth and development (Zhu, 2001). Phosphorus (P) is among the most needed elements for crop production in most tropical soils, which tend to be P deficient (Adetunji, 1995). The deficiency can be acute in some soils of the Savanna zone of Western Africa to the extent that plant growth ceases as soon as the P stored in the seed is exhausted (Mokwunye *et al*., 1986). P deficiencies primarily result from either inherent low levels of soil P or depletion through cultivation. Phosphorus, although not required in large quantities, is critical to cowpea yield because of its multiple effects on plant nutrition (Muleba & Ezumal, 1985). Phosphorus does not only increase seed yields but also nodulation (Luse *et al*., 1975; Kang & Nangju, 1983) and thus N fixation. Information on the chemical forms of P is fundamental to understand P dynamics and its interactions in calcareous and acidic soils which are necessary for management of P. Jalali and Ranjbar (2010) observed the reactions of P added to the calcareous soils were quite rapid and water-soluble phosphate was converted to relatively less soluble compounds within a very short time due to high sorbing capacities of the soils. P transformations in flooded soils depend on soil characteristics that may affect P availability. P is generally most available to plants when the soil pH is between 6.0 and 6.5. When the soil pH is <6.0, the potential for P deficiency increases for most of crops. Phosphate ions readily precipitate with metal cations, forming a range of P minerals. The type of mineral formed will depend on the soil pH in the first place as it governs the occurrence and abundance of those metal cations that are prone to precipitate with P ions in the soil solution, namely Ca, Fe and Al. Hence, in neutral to alkaline soils, P ions will rather precipitate as Calcium phosphorus (Ca-P): dicalcium or octacalcium phosphates, hydroxyl apatite and eventually least soluble apatites (Hinsinger, 2001).

MATERIALS AND METHODS

Location of experiment

The experiment was conducted at the zabol which is situated between 31° North latitude and 61° 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 in randomized complete block design with factorial design with three replications.

Treatments

Treatments included water stress (A1: control, A2: water stress in during vegetative growth, A3: water stress in during reproductive growth) and Phosphate fertile 2 (B1:0, B2:50, B3:100, B4: 150).

Table 1: Anova analysis of the mung bean affected by water stress and Phosphate fertile 2

S.O.V	df	Pod length	1000 grain weight	Number of seed per pod	Number of pod per plant
R	1	0.634ns	1.561ns	7.820**	22.042ns
water stress (a)	2	7.889ns	50.094**	4.147*	111.028*
Phosphate fertile 2 (b)	3	16.438**	142.040**	13.671**	138.620**
a*b	6	0.0897ns	1.299ns	0.643ns	10.620ns
Error	23	0.561	1.888	0.928	7.650
CV (%)	-	0.471	3.999	12.555	7.749

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

Table 2: Comparison of different traits affected by water stress and Phosphate fertile 2

Treatment	Pod length	1000 grain weight	Number of seed per pod	Number of pod per plant
Water stress				
control	8.77a	36.50a	8.33a	38.75a
vegetative growth	7.80a	34.13b	7.47b	35.67b
reproductive growth	7.68a	32.43c	7.21b	32.67c
Phosphate fertile 2				
0	6.36d	29.41d	6.74c	31.00c
50 (kg/ha)	7.36c	33.29c	6.67c	34.22b
100(kg/ha)	8.47b	35.98b	8.00b	37.56a
150(kg/ha)	9.48a	38.73a	9.28a	40.00a

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

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

Pod length

Analysis of variance showed that the effect of water stress on pod length was not significant (Table 1). The maximum of pod length of treatments control was obtained (Table 2). The minimum of pod length of treatments reproductive growth was obtained (Table 2). Analysis of variance showed that the effect of Phosphate fertile 2 on pod length was significant (Table 1). The maximum of pod length of treatments 150(kg/ha) was obtained (Table 2). The minimum of pod length of treatments no Phosphate fertile 2 was obtained (Table 2).

1000 grain weight

Analysis of variance showed that the effect of water stress on 1000 grain weight was significant (Table 1). The maximum of 1000 grain weight of treatments control was obtained (Table 2). The minimum of 1000 grain weight of treatments reproductive growth was obtained (Table 2). Analysis of variance showed that the effect of Phosphate fertile 2 on 1000 grain weight was significant (Table 1). The maximum of 1000 grain weight of treatments 150(kg/ha) was obtained (Table 2). The minimum of 1000 grain weight of treatments no Phosphate fertile 2 was obtained (Table 2).

Number of seed per pod

Analysis of variance showed that the effect of water stress on number of seed per pod 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 reproductive growth was obtained (Table 2). Analysis of variance showed that the effect of Phosphate fertile 2 on number of seed per pod was significant (Table 1). The maximum of number of seed per pod of treatments 150(kg/ha) was obtained (Table 2). The minimum of number of seed per pod of treatments no Phosphate fertile 2 was obtained (Table 2).

Number of pod per plant

Analysis of variance showed that the effect of water stress on number of pod per plant was significant (Table 1). The maximum of number of pod per plant of treatments control was obtained (Table 2). The minimum of number of pod per plant of treatments reproductive growth was obtained (Table 2). Analysis of variance showed that the effect of Phosphate fertile 2 on number of pod per plant was significant (Table 1). The maximum of number of pod per plant of treatments 150(kg/ha) was obtained (Table 2). The minimum of number of pod per plant of treatments no Phosphate fertile 2 was obtained (Table 2).

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