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Physiological Aspects of Mungbean *(Vigna radiata L.)* in Response to Drought Stress.

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Abstract. In order to investigation of resistance of mungbean and its physiological responses to drought stress, a field experiment carried out as randomized complete block design with three treatments and three replications. This research was done at agriculture faculty, Razi university of Kermanshah, Iran. Water treatments were control (no drought stress) (S1), drought stress during vegetative growth stage (S2) and drought stress during reproductive growth stage (S3). Results showed that there was no significant difference between control and drought stress during reproductive growth stage about yield and yield components, but drought stress during vegetative growth stage decreased significantly yield and yield components. Study of chlorophyll fluorescence showed a significant difference between S2 treatment with S1 and S3 treatments on Performance Index (PI). Also, maximum quantum efficiency of photosystem II (Fv/Fm) in S1 and S3 treatments had regular process, but in S2 treatment was out of regular process. However, these results obtained while that difference between each three treatments about Relative Water Content (RWC) was significant.

Key words: Drought Stress, Mungbean, Chlorophyll Fluorescence, Yield and Yield Components

1. Introduction

In the arid and semi-arid regions, water deficit is the main factor that limits crops performance. Limitation of water source, irregular annual rainfall during growth season and lack of sources management cause severe decreasing in crops yield at these regions (Eack, 1996). Therefore, drought stress during growth season is an important problem that need to attention (khodabandeh, 2005). Using crops with short-term growth is one of the procedures to drought tolerance in dry regions.

Mungbean is belong to fabaceae family that currently is grown in different parts of world and it have large role in nutrition at developing countries (Dhingra *et al.,* 1991). Due to short-term growth, nitrogen fixation capability, soil reinforcement and prevention of soil erosion, mungbean is superior to other plants for second culture. Mungbean is the most common crops in most tropical and sub-tropical regions that cultivated after harvesting of wheat and harvest before planting of autumn crops.

Some experiments show that mungbean contrary to popular belief, cannot tolerate drought stress (Rfiei shirvan and Asgharipur, 2009) but there are little reports about negative effects of drought stress on yield and physiological characteristics of mungbean. Therefore, this experiment was carried out with aim of understanding the effect of drought stress during vegetative and reproductive stages on some physiological traits, yield and yield components of mungbean.

2. Material and Methods

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This research carried out at agriculture faculty, Razi university of Kermanshah, Iran during 2010 summer. The experiment was based on randomized complete block design with three replications. Factors included three levels of control (no drought stress) (S_1), drought stress during vegetative growth stage (S_2) and drought stress during reproductive growth stage (S_3). A plot was contained 15 rows with 5 m length and Plant density was considered 20 plants.m^{-2}.

Relative water content was estimated according to the method of Castillo (1996) and calculated in the leaves for each drought treatments. Samples (0.5 g) were saturated in 100 ml distilled water fo 48 h at 4°C in the dark and their turgid weights were recorded. Then they were oven-dried at 65°C for 48 h and their dry weights were recorded. RWC was calculated as follows:

RWC (%) = [(FW – DW) / (TW – DW)] × 100,

Where FW, DW and TW are fresh weight, dry weight and turgid weight, respectively.

Chlorophyll fluorescence was measured by pocket PEA chlorophyll fluorimeters (Hansatech Instruments, V 1.02).

3. Results and discussion

The results showed that grain yield, performance index of photosynthesis and leaf relative water content were affected by drought stress ($p \leq 0.01$) (table 1).

3.1. Grain yield and yield components

There was no significant difference between control (S_1) and drought stress during reproductive growth stage (S_3) about grain yield so that in S_1, 1560 kg/ha and in S_3 1491 kg/ha grain yield was obtained. Grain yield decreased significantly under drought stress during vegetative growth stage (S_2) and its average grain yield was 939 kg/ha (table 2). Asaduzzaman *et al.,* (2008) also believe that moisture stress reduces grain yield of mungbean and maximum negative effects of drought obtained with once irrigation during growth season. Chaudhary *et al*., (1985), De Costa *et al*., (1999), and Rafiei Shirvan and Asgharipur (2009) also obtained the similar results. According to Ashraf and Foolad (2007) glycine betaine and proline by applying osmotic adjustment, reduce the negative effects of stress in the incidence of drought conditions.

Highest seed weight with 7 grams per plant, was belonged to S_1 treatment but there was no significant difference between S_2 and S_3 treatments. This conditions also was true for the grain weight characteristic so that difference between S_1 treatment with two treatments S_2 and S_3 was significant. However, there was no significant difference between the S_2 and S_3 treatments (table 2).

Table1. Analysis of variance for grain yield, performance index and RWC

SOV	d.f	Mean Squares		
		Yield	Performance Index	RWC
Replication	2	2263.170*	0.856$^{n.s}$	1.549$^{n.s}$
Drought treatments	2	350447.160**	20.073**	1540.458**
Error	4	3808.641	0.624	14.888

*Significant at 5% level, **Significant at 1% level, ^{ns}No significant difference.

3.2. Relative Water Content (RWC)

There was significant difference between three moisture treatments in term of relative water content (table 2). S_1 treatment has the highest RWC and the lowest RWC belongs to S_2 treatment. The results conformed to the Chaudhary *et al.,* (1985) and Efeoglu *et al.,* (2009).

Table 2. Mean comparison of grain yield, yield components and some physiological characteristics

In three drought treatments

Treatments	Grain yield (Kg.ha^{-1})	100 Seed Weight (g)	RWC (%)	Performance Index
S_1	1560 A	7.57 A	86.42 A	5.93 A
S_2	939 B	5.74 B	41.64 C	1.40 B
S_3	1491 A	6.77 B	57.99 B	5.82 A

Means in the same row with different letters are significantly ($P < 0.05$) different.

3.3. Chlorophyll Fluorescence

The maximum quantum efficiency of photosystem II (Fv/Fm) showed a normal trend in S_1 and S_3 treatments while in S_2 treatment it was out of regular process (fig. 1). Also study the chlorophyll fluorescence parameters showed a significant difference at performance index (PI) between S_2 with S_1 and S_3 (table 2). Efeoglu *et al.,* (2009) and Oujarroum *et al.,* (2007) obtained similar results.

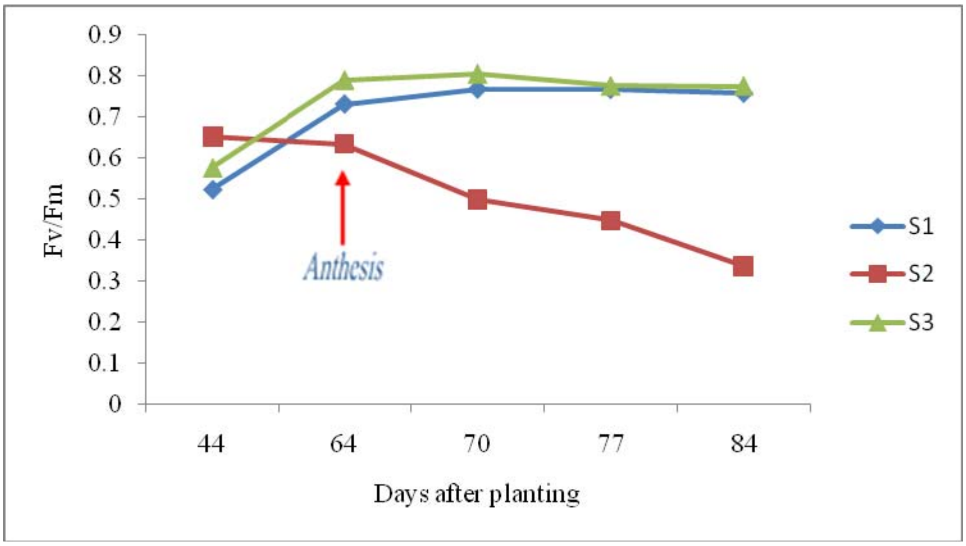

Fig.1. Trend of quantum efficiency of photosystem II (Fv/Fm) in different treatments.

4. Conclusion

According to the results of this experiment, negative effects of drought stress during vegetative is more than during reproductive growth stage. Therefore, removal of irrigation at beginning of pod development can be cost effective.

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