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Effect of Soil Water on Plant Height and Root Depth and Some Agronomic Traits in Common Bean (*Phaseolus vulgaris*) under Biological Fertilizer and Irrigation Management

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Abstract: After irrigation, water penetration the soil is one of key characteristics changing with time. It may prevent surrounding area of root to achieve adequate water.To study the changes of water penetration in the soil on plant height and root depth and influence of water condition on common bean plant under irrigation management and phosphorylated biologic fertilizer, factorial test was performed in complete randomized block design with 3 replications in Astaneh Ashrafiyeh City in the 2011 growing season. In present study, without irrigation conditions and irrigation management with 6, 12 and 18 days interval were selected as first treatment and amounts of phosphorylated fertilized including 0, 1, 2 and 3 g/l per plot was selected as second treatment.Results indicated that plant height and root depth under irrigation was significant in probability level of 1% and biologic fertilizer amount also affected only o plant height. Irrigation management was significant on water rate relative to wet weight in 1% probability level and on water rate relation leaf water was significant in p>0.05.While various amounts of phosphorylated biologic fertilizer didn't affect on water condition in bean plant. Relative leaf water amount in different treatments ranged between 49.4 and 76.6 % soil penetration rate also decreased during development period compared to early season. Average final penetration rate of soil reached to constant rate of 13 mm. According to the results, 6 days irrigation period may be taken as best choice for bean plant in the area.

Key words: Infiltration · Irrigation · Biological fertilizer · Common bean

INTRODUCTION

Bean is one of most important members of cereals and with 12 to 32% protein, it represents about half of land under plantation if cereals in Iran [1]. Bean is an annual plant with one major root and numerous secondary roots.There are irregular brown colored nitrogen fixing tubers on its small roots. Lack of adequate water and its inconsistent distribution during developing season leads to the condition where water requirements of crops is not met adequately and plants are exposed to water stress [2]. Draught is major environmental stress and most important limiting factor in crop production worldwide [3]. Cell growth is most sensitive process influenced by water stress. As cell growth decreased,organ size will be limited.It is why first marked effect of water stress on plants could be determined from smaller sizes of leaf or low heights in plants or decreased wet or dry weight. Plants resistant to water stress, by maintaining cell swelling continue cell metabolism under water stress [4]. Thus leaf relative water may be useful tool for function or its components to select plant under draught stress conditions. Since it indicates water maintenance and survival rates in the plant in stress condition.Biologic fertilizer utilization in agriculture has a long history. However, using these fertilizers has decreased in few recent decades. Today, biologic fertilizers are considered as on alternative for chemical fertilizers with the aim of

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increased fertilization of soil and crop production in sustainable agriculture [5]. Penetration is among important parameters to design irrigation systems based on which irrigation management and planning are performed. Since it determines irrigation continuity to store given amount of water within soil [6]. Using biologic fertilizers in agriculture has a long history. Today, using biologic fertilizers in agriculture is suggested again taken excess usage if chemical fertilizers [7]. Thus, scientific utilization of such resources must be increased so that the potential of soil organism and organic materials being used while considering soil quality and following hygiene and environmental safety [8]. In Guilan province, 3793.5 ha of land is planted by been. Amount of crop yield has been estimated as 6276.8 tones. The changes in water penetration in soil on shrub height and root depth and influence of water condition in common bean plant under irrigation management and phosphorylated biologic fertilizer.

MATERIALS AND METHODS

An experiment was carried out in Astaneh Ashrafiyeh located in 37°16' latitude and 46°56' longitude in the north of Iran at an average altitude of 3 meter (above the sea level). Climatic data of the studied period were obtained from Astaneh Ashrafiyeh meteorological station. From the climatology perspective, this town is considered a temperate and humid region and has a loam soil with 7.4 pH value. The experiment was done as a split-plot in a completely random blocks plan with three replications. Each experimental unit was 4×2.5 m in area and had 4 rows of plantation. Irrigation management was including without irrigation and irrigation cycle with 6, 12 and 18 days intervals and phosphorylated biologic fertilizer rate was including 0, 1, 2 and 3 g/l per plot. Agricultural land was initially ploughed in early may then, on 9 may. Seed plantation (native Dehsari variety) was started manually in rows with 3-4 cm depth. Surface irrigation was as irrigation method in this project. So that, distance between2 hills is 80 cm and distance between plants in the hills is 35 cm. contour was used to Measure amount of water delivered to each experimental unit. Water used during plants growth period was supplied through irrigation water and raining rate. So that in 6,12,18 days irrigation, the number of irrigation times were 8,5 and 3 times, respectively and amount of using water were obtained as 298,255 and 201 mm, respectively. To define water percentage relative to dry weight, firstly leaf fresh weights were measured. Then leave was placed in oven with 70c for 24 hours to dry. Next, using following equation, percentage of water relative to wet and dry weight was obtained [9].

$$\text{Percent of water Ratio The fresh weight} = \frac{\text{Weight of leaves in the field} - \text{Leaf dry weight}}{\text{Weight of leaves in the field}} \times 100$$

$$\text{Percent of water Ratio The dry weight} = \frac{\text{Weight of leaves in the field} - \text{Leaf dry weight}}{\text{Leaf dry weight}}$$

To define leave relative water rate, leave was picked before sunset and was transferred to the lab. Immediately leave weight was measured.Then, sample within beaker was placed in distilled water to absorb water and reach to full swelling. In next stage, this leave sample was placed in pocket and then placed in oven with 70 °Cfor 24 hours to dry. After this period leave dry weight was measured by weighting leave sample. with having weight of leave in the farm, leave dry weight and leave swelling weight, leave relative water rate was evaluated by using following equation [10].

$$\text{RWC (\%)} = \left[\frac{\text{FD-DW}}{\text{TW-DW}}\right] \times 100$$

Where FW is the sample fresh weight, TW is the sample turgid weight and DW is the sample dry weight.

In this study, double cylinder method was used to measured penetration in the farm. Kostiakov equation method was followed to measure penetration equation which was developed as: $D=kt^a$, where D is collective penetration per mm, t is penetration time per minute and is equation coefficients.Two point method was used to calculate equation coefficients. Where 2 points among series of points obtained were selected and equation is solved for these points [11]. In rate agricultural season, characteristics including shrub height and root depth were measured.

RESULTS AND DISCUSSION

Results of this study indicated that after 120 minutes of measurements, penetration intensity rate reached to constant, penetration intensity rate reached to constant figure of 13 mm/day. Mean collective penetration rate D (cm) and mean penetration intensity (mm/h) are given as a function of time t (minute) in Fig. 1. Rasoulzadeh and sepaskhah [12] stated that changes of penetration intensity, will complicate furrow irrigation

Table 1: Characteristics of soil in the study area

	Particle size distribution (%)								
Soil depths (cm)	Sand	Silt	Clay	Total nitrogen	Organic carbon	Soil Texture	Potassium absorbent (ppm)	Phosphorus absorbent (ppm)	Electrical Conductivity (dS/m)
0-30	38	53	9	0.074	0.68	Loamy Silt	641	7.78	0.278

Table 2: Characteristics of soil in the study area

	Particle size distribution (%)								
Soil depths (cm)	Sand	Silt	Clay	Total nitrogen	Organic carbon	Soil Texture	Potassium absorbent (ppm)	Phosphorus absorbent (ppm)	Electrical Conductivity (ds/m)
0-20	38	53	9	10.084	0.68	Silty Loam	239	0.07	0.631
20-40	30	55	1	8.065	0.66	Silty Loam	191	2.17	0.565

Table 3: Variance Analysis for Effect of biological phosphorous fertilizer and irrigation management on of agronomic traits common bean

		Mean squares				
Source of variation	df	Plant root	Plant height	RWC	Percent water ratio to dry weight	Percent water ratio to wet weight
Blokes	2	90.250^{ns}	34.563^{ns}	930.626^{ns}	2311.482*	169.563*
Irrigation	3	79.056**	1008.972**	1935.215*	13601.41*	574.062**
Fertilizer	3	6.833^{ns}	326.972**	83.192^{ns}	6383.166^{ns}	23.395^{ns}
I × F	9	31.667^{ns}	13.269^{ns}	84.127^{ns}	3628.144^{ns}	16.129^{ns}
Error	24	16.028	32.363	141.392	2752.103	10.653
C.V (%)	22.88	15.02	20.54	23.34	5.20	

ns Non significant, *significant at P<0.05 and **significant at P<0.01

management.Because characteristics of water penetration to the soil may change rates of water flow rate. Thus it is difficult to develop a precise equation for penetration.

Irrigation and fertilizer management of biological interaction of biological was meaningless on all parameters (Table 2). Irrigation management was in the 1% level but significant effect on the percentage of water in the wet weight (Table 1). The maximum amount of irrigation water for 6 days with more weight than the 71.5% and 56% in treatments without irrigation, with the least amount won among treatments (Fig. 1). Measurement of water to the fresh weight of leaf weight relative to the time variable is not an optimum way, but this method to compare the percentage of water in different organs or parts of a plant or plant species is useful [9].

Different rates of biologic fertilizer and mutual effect of irrigation management and biologic fertilizer on all parameters was had significant effect on percentage water relative to wet weight with 1% p (Table1). 6 days irrigation had the greatest amount of water relative to dry weight with 227.2 and without irrigation treatment had lowest amount with 196.9 (Table 2).While percentage of water relative to dry weight for leaf and young organs whose dry weight will be added during photosynthesis, was not a good technique.But changes of leave dry weight during 1 hour or even during 24 hours may not be large enough to affect on the results, it is useful for short-term studies and surveying shortage of water in tissues during a during a day and comparing it to the night. Leave relative water in irrigation management was significant with p>0.05 (Table 2) 6 days irrigation management and without irrigation condition with 76.6 and 49.4 respectively had greatest and lowest leave relative water (Table 3).Leave relative content is, in fact, very useful tool to select in draught stress [4]. Blum [13] in a study introduced leave relative water as best Method for measuring water condition in plant.

Irrigation management and biologic fertilizer on shrub height are significant in 1% probability. But their mutual influence is not significant (Table 2).Maximum shrub height with 51.3 cm mean is related to 6 days irrigation (Table 2).In without irrigation condition, plant will experience arrest of growth, plant will experience arrest of growth, smaller leaf, shorter distance between nodes and burning in leaf edges and leaf falling. Yuan *et al* [14] in an examination reported that with increasing utilizes water, shrub height will increase. 1g biologic fertilizer per plot had greatest shrub height with 43.7 cm mean (Fig.3).

Irrigation management was meaningful in 1% probability level on root depth (Table 2). But biologic fertilizer didn't have any effect of root depth (Fig.4).

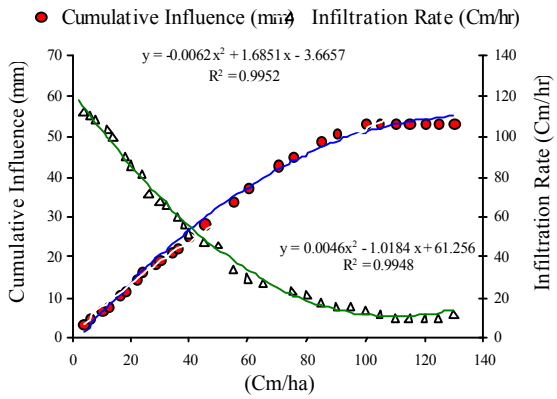

Fig. 1: Mean infiltration rate (cm/hr) and mean cumulative infiltration (cm)

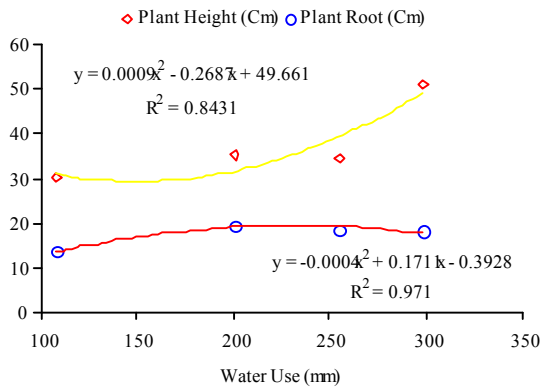

Fig. 2: Relationship between Plant height and Plant Root with Water Use

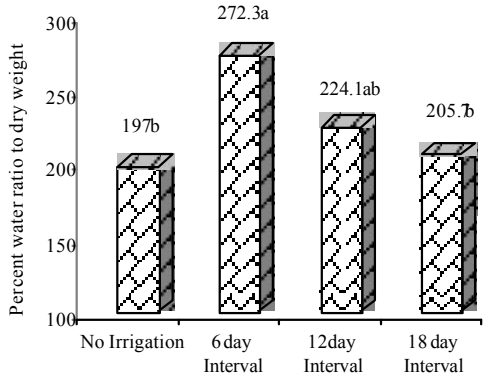

Fig. 3: percent of dry weight in irrigation management

Hoogland *et al* [15] concluded that in wet soils, roots can obtain water from upper layers and moisture of lower layers will be intact.Thus they concluded that surface zones have greater root density. Thus, it could be find that in wet soils, roots it could be fined that in wet soils, roots prefer to absorb the water from upper layers and adsorption rate in profile bottom in root zone end is zero.

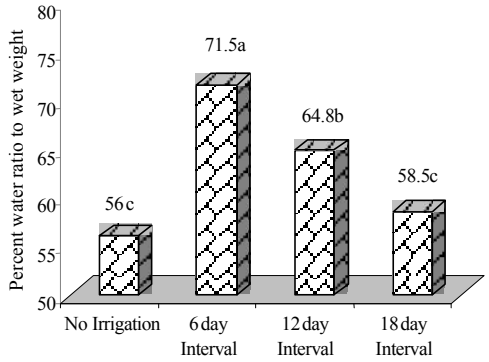

Fig. 4: Percent of More weight in irrigation management

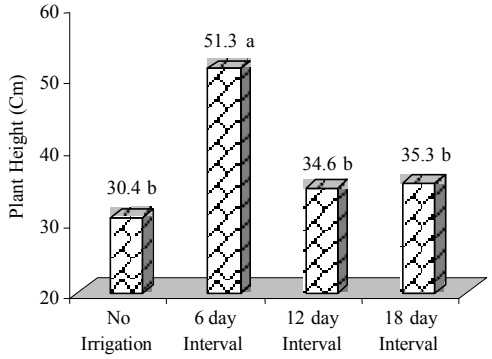

Fig. 5: Height of plant in irrigation management

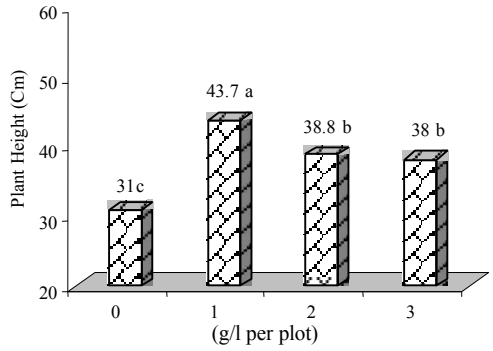

Fig. 6: Fertilizer plant height at different levels of biological

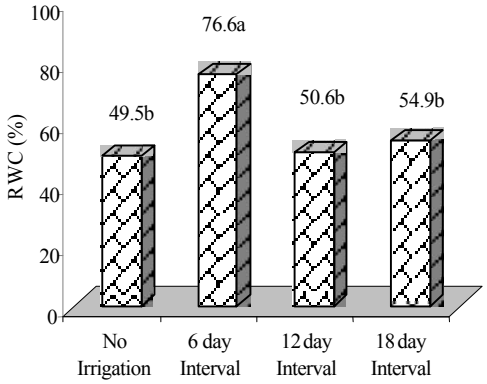

Fig. 7: RWC in irrigation management

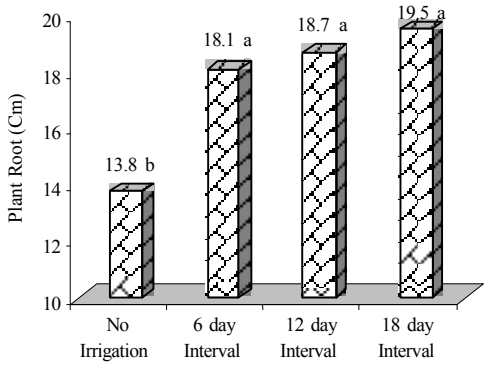

Fig. 8: Height of roots in irrigation management

CONCLUSION

In present study, without irrigation conditions and irrigation management with 6, 12 and 18 days periods were selected as first treatment and amounts of phosphorylated fertilized including 0, 1, 2 and 3 g/l per plot was selected as second treatment.Results indicated that shrub height and root depth under irrigation was significant in probability level of 1% and biologic fertilizer amount also affected only plant height. Irrigation management was significant on water rate relative to wet weight in 1% probability level and on water rate relation leaf water was significant in p>0.05.While various amounts of phosphorylated biologic fertilizer didn't affect on water condition in bean plant. Relative leaf water amount in different treatments ranged between 49.4 and 76.6% soil penetration rate also decreased during development period compared to early season. Average final penetration rate of soil reached to constant rate of 13 mm.

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