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Effect of Irrigation Management and Straw Mulch on Yield of Common Bean (*Phaseolus vulgaris* L.)

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Abstract: To investigate the effect of straw mulch on irrigation management and operation of common bean, split plot experiment in a randomized complete block design with three replications was conducted in the city of Astaneh Ashrafiyeh during the growing year 2012. These studies include no irrigation and irrigation management with three different Intervals (6, 12 and 18 days) and an amount of straw mulch (0, 1, 2 and 3 cm) in each plot was selected. The results showed that a different level of irrigation management and mulch on yield was found to be significant. But its effect on seed yield was was found non-significant. Mean data showed that the highest yield in irrigation management (2431.3 kg ha^{-1}) is obtained for 6 days interval of irrigation. A yield different level of mulch with 1585.6 kg ha^{-1} was higher than without mulch. At the end of the season the numbers of seeds pod^{-1} and plant height and root traits were also measured.

Key words: Irrigation management % Straw mulch % Common bean % yield

INTRODUCTION

Common bean *(Phaseolus vulgaris L.)* A crop is considered one of the most important family members of plant order Leguminoles and because of the high percentage of protein and other desirable agronomic characteristics. About half of the total area under cereal cultivation in Iran has been accounted for it. Common bean crop with a right main root and lateral roots that tubers irregular brown nitrogen stabilizer is located. Water use in agricultural production as one of the most important environmental factors affecting plant growth and development, especially in arid and semi-arid climatic conditions of Iran is of special importance [1]. However, due to rising water costs and reduced water availability in these areas, attention is the use of irrigation water [2]. Drought is the most vital environmental stress limiting the production of crops throughout the world. Of Deming *et al*. [3] in the field of irrigation programs on the importance of optimizing irrigation management strategy for optimum use of water resources in different plants is emphasized. Non-living mulch can be termed as protective coverings for plants and used them against extreme temperature changes and loss of soil, ground water protection. Mulch is one of good management techniques that can preserve the soil and reduce weed infestations [4]. Pirboneh [5] have conducted research and concluded that the high volume of moisture stored in soil structure and reduces evaporation by mulching the cultivated field. Jalota [6] during his research has announced that in arid and semiarid regions of about 40 to 70 percent of water loss by evaporation from the soil surface can be prevented by the material covering the soil and placed at the disposal plant. Burt *et al*. [7] research in the field effect of straw mulching on soil have done, the results showed that this method can be used after water evaporation from the soil surface from 11 to 84 percent for a short period and half of these reduced rate in the long run. Zhang *et al*. [8] studied that in northern China with straw mulch reduced soil evaporation and plant water use efficiency is increased. Scott [9] in summer, dry mulch cover is suitable for any type of plant and mulch the soil surface increases soil moisture and temperature within the purpose of this study on the water status of common bean plants under different levels of irrigation management and the straw mulch.

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Table 1: Information on meteorological data

Month	Max Temp (°C)	Min Temp (°C)	Rain fall (mm)	Wind Speed (m/s)	Max Humidity (%)	Min Humidity (%)
May	21.7	12.3	45.5	1.0	90	56.7
Jun	27.3	17.3	39.5	1.2	92	58.9

Table 2: Characteristics of soil in the study area

	Particle size distribution %							
Soil depths (cm)	Sand	Silt	Clay	Total nitrogen	Organic carbon	Potassium absorbent (ppm)	Phosphor absorbent (ppm)	Electrical Conductivity (dS/m)
0-20	38	53	9	10.08	0.68	239	0.07	0.631
20-40	30	55	1	8.06	0.66	191	2.17	0.565

MATERIALS AND METHODS

This experiment was done in Astaneh Ashrafiyeh in the north of Iran situated at 37°16' and 46°56' with an average altitude of 3m (above the sea level). On the basis of studied split-plot in a randomized complete block design (RCBD) with 3 replications was carried out in growing year 2012. Meteorological data were obtained from the respective stations in Astaneh Ashrafiyeh (Table 1). Prior to tillage, in order to determine physical and chemical properties of the soil, samples were taken from different parts of the field (Table 2). Each experimental unit was 6×2.5m in dimensions consisting of 4 rows. Irrigation management included no irrigation (dry land) and irrigations with 6, 12 and 18-days intervals. At first, the field went under a complete tillage on May 5, 2012 and followed by creating ridges and furrows, cultivation started. Crop management operations included weeding and sides dressing around the root were also made. Irrigation levels were the main-plots consisted of four levels *viz.*, no irrigation, 6, 12 and 18 days interval, respectively. Straw mulch @ zero, 1, 2 and 3 cm per plot was assigned to sub-plots. Consumed water level during the growth period was determined through measuring the amount of irrigation water and the precipitation level. In order to measure the amount of water for irrigation for each experimental unit, a contour was used. For 6, 12 and 18 days irrigation managements, 8, 4 and 3 irrigation frequencies were considered. At the end of the season the numbers of seeds per pod and plant height and root traits were measured. Data obtained were statistically analyzed for analyses of variance (ANOVA) and for comparing the different mean values, Duncan test was carried out using 5% probability level and drawing diagrams of software *MSTATC* was performed using *Excel* software.

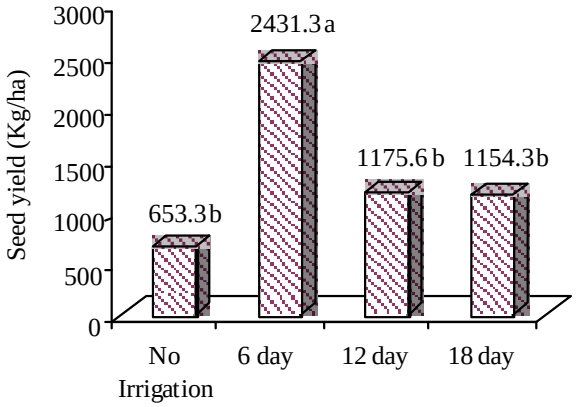

Fig. 1: Seed yield in irrigation management.

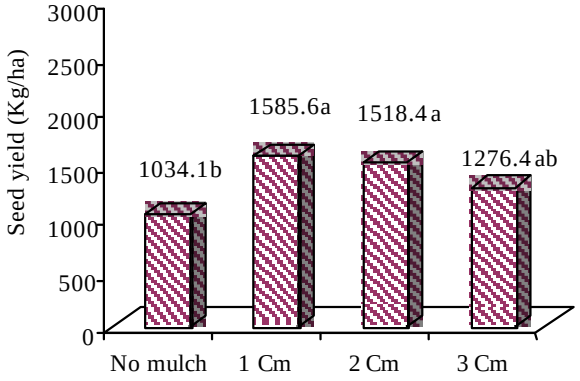

Fig. 2: Seed yield in straw mulch management.

RESULTS AND DISCUSSION

Seed Yield: Different levels of irrigation management and mulch had a significant effect on yield ($P<0.05$). Mean data showed that the highest yield in irrigation management for 6 days were 2431.3 kg ha^{-1} (Fig. 1). A yield at different levels in nearly surface mulch and more mulch is free conditions (Fig. 2). Singh *et al*. [10] in the same study found that use of irrigation and mulch in fruits and vegetables that are high yield product.

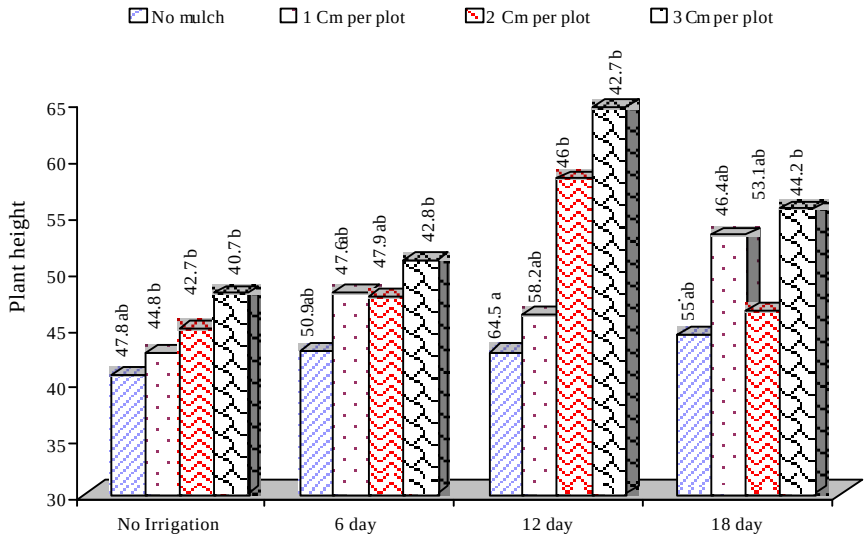

Fig. 3: Plant height regarding reciprocal effect of irrigation management and mulch

Table 3: Analysis of variance of common bean as affected by irrigation and straw mulch treatments

		Mean squares			
Source of variation	df	Seed yield	Plant height	Plant roots	Number of Seed pod^{G1}
Block	2	1666459.396^{ns}	167.271^{ns}	9.155^{ns}	1.318 ^{ns}
Irrigation (A)	3	6893060.981*	168.269^{ns}	87.092^{ns}	4.501*
Error (A)	6	972935.281	73.988	11.547	0.592
Straw mulch (B)	3	75606.754*	297.765**	20.305**	5.735 **
Interaction (A×B)	9	428070.361^{ns}	54.342**	1.288^{ns}	0.485 ^{ns}
Error (B)	24	241212.29	9.636	2.801	0.356
CV (%)		36.28	6.4	11.09	11.54

$^{ns:}$ Non significant; * and $^{**:}$ Significant at 5% and 1% probability level, respectively.

Table 4: Mean analogy by Duncan test

Treatments	Plant height	Plant roots	Number of Seed pod^{G1}
No Irrigation	44 c	14.3b	4.4b
6 day Intervals	47.3 bc	18.9a	5.1ab
12 day Intervals	52.9 a	12.2b	5.9a
18 day Intervals	49.8 ab	15.9b	5.4a
No mulch	42.6 d	13.3b	4.3c
1 Cm per plot	47.4 c	15.9a	5b
2 Cm per plot	49.3 b	15.2a	5.4b
3 Cm per plot	54.7 a	15.9a	6a

Ngouagio *et al*. [11] reported the work before transplanting lettuce, mulch was mixed with soil and the highest yield was obtained on lettuce. Glab and Kulig [12] also concluded that their experiments mulch can reduce yield in reduced tillage systems, due to increased soil porosity, are prevented. Shekour *et al*. [13] reported that mulching treatment was associated with an increase in corn yield.

Plant Height: There was no significant effect of irrigation management on plant height, but the effect of straw mulch on plant height was significant at 1% probability level. Management of irrigation and straw mulch effect on plant height was significant at 1% probability level (Table 2). Maximum plant height, mean i.e., 54.7 cm, is obtained in mulch applied @ 3 cm (Fig. 2). Conditions without mulch, plant growth, smaller leaves, shortening the distance between nodes and marginal burn and shedding leaves it fails. Liasu and Achakzai [14] also reported that mulching with *Tithonia diversifolia* leaves and fertilizer application together promoted the growth (including plant height) and development of potted tomato plants.

Root Length: Management of irrigation and straw mulch was significant at 1% probability level on root length. But the interaction was not significant (Table 3). Hoagland *et al*. [15] concluded that in moist soils, roots can get water from a wet upper layers and lower layers of moisture remains almost intact. So we can conclude that the surface density is of the roots. Hence, we can get at the roots moist soils prefer the water from the upper layers to absorb. In the mulch levels of roots, mulch high were a ffected, so that no

mulch treatment had the lowest (Table 4). Pervez *et al*. [16] noted that soil nutrients are very important for the plants height.

Total Number of Seeds Per Pod G^{1}: Analysis of variance (ANOVA) showed significant ($P<0.05$) influence on the number of seed per pod in relation to irrigation management. Effect of straw mulch on seed number pod G^{1} was significant at 1% probability level. The interaction between irrigation management and straw mulch on seed number per pod G^{1} was not significant (Table 1). Irrigation for 12 days with a mean of 9.5 compared to treatments without irrigation, 6 and 12 days respectively, 34.1, 15.7 and 9.2 percent increase (Table 2). Ramirez and Kelly [17] showed that the number of seed per plant G^{1} would face water stress reduction. Achakzai [18] also recommended mulching for the achievement of better crop growth and yield and also for minimizing the loss of water from the soil surface.

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