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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Effect of Irrigation Levels on Growth and Yield of Mungbean

M.H. Raza[1], G.U. Sadozai[1], M.S. Baloch[1], E.A. Khan[1], I. Din[1] and K. Wasim[2]
[1]Department of Agronomy, [2]Department of Horticulture,
Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan

Abstract: The research was carried out to investigate the effects of different irrigation levels on growth and yield of mungbean at the Agricultural Research Institute, Dera Ismail Khan, Pakistan. The experiment was laid out in a randomized complete block design with 3 replications. The results revealed that application of 5 irrigations i.e. 15, 30, 45, 60 and 75 Days After Sowing (DAS) gave significantly better performance than 3, 4 and 6 applied at different time intervals. However, the number of seeds/pod was not increased by irrigation levels. It was also noted that water stress reduced mungbean yield regardless of whether the stress was imposed when plant were in vegetative or reproductive stage. However, water stress that occurred at the reproductive stages, specially flowering and pod formation, affected seed yield more severely than its occurrence at other stages. Based on the results obtained, it is concluded that 5 irrigations should be applied to mungbean crop to get the maximum grain yield under the agro-ecology of Dera Ismail Khan or similar environmental conditions prevailing in other parts of the country.

Key words: Mungbean, *Vigna radiate*, irrigation levels, growth, yield

INTRODUCTION

Mungbean (*Vigna radiata* L.) is a major caloric (347-Kcal food energy) and protein (22-24%) in Asia, especially for the vegetarian population. It is one of the most important conventional pulses grown in Pakistan for edible seed which is cooked, fermented, roasted, sprouted or milled. It is annually cultivated on an area of 183.3 thousands ha with total production of 118.7 thousands tones in the country (Anonymous, 2010). In Dera Ismail Khan District, it is annually grown on 6.6 thousand ha with production of 4.27 thousand tones.

Mungbean is becoming important crop, as it is the best alternatives to meet the food needs of the large population of developing countries due to its, nutritional superiority and nitrogen fixing character. It is the current practice in cereal producing areas of KPK to grow gram or wheat in rotation with fallow. It may be beneficial to replace that fallow with mungbean as it has ability to provide N needs through biological nitrogen fixation (Haque and Sattar, 2010). The characteristics of mungbean i.e. reducing fertilizer needs and improving soil structure are of particular importance to developing countries where agriculture production is often limited by an economical supply of N fertilizer (Malik, 1990).

The average yield obtain at farmer level is very low due to lack of knowledge of proper production technology, a major cause of not exploiting its potential yield. Similarly, among the crop production tools, irrigation is one of the major factors (Bakhsh *et al.*, 1999). It serves as a medium for nutrient absorption therefore its availability at various crop growth stages affect the yield considerably. An adequate amount of water must be applied at the right time in order to get higher crop yield in irrigated lands. Therefore, it is vital to determine the water consumption of plant and periods that plants are susceptible for water beside the irrigation intervals in order to increase crop yield in a limited area. Water requirements of plants from seed sowing to the harvest vary depending on plant species and plant growth stages.

Most of the important pulses have marked moisture sensitive stage of growth in relation to seed yield. The stage that is less sensitive to moisture deficiency is the period from emergence up to flowering. The greatest sensitivity to indicate water supply is during period when irrigation is reported to give maximum increase in yield. A favorable moisture supply is very important during pod and seed development. The main component of yield which is affected is the number of pods which is increased by irrigation at flowering and 1,000 seed weight which is increased by irrigation during pod growth (Assaduzaman *et al.*, 2008).

Keeping in view, a research trial was undertaken to study the effect of different irrigation levels on yield of mungbean under the agro-climatic conditions of Dera Ismail Khan.

MATERIALS AND METHODS

The study was carried out at the Agricultural Research Institute, Dera Ismail Khan, KPK in 2009. The experiment was laid out in a randomized complete block design with 3 replications. The plot size was 7.2 m^2

Corresponding Author: M.S. Baloch, Department of Agronomy, Faculty of Agriculture, Gomal University, Dera Ismail Khan, Pakistan

having 6 rows with plant to plant and row to row distance of 10 and 30 cm, respectively. The detail of treatments and experimental procedure is given as under;

T_1 = 3 irrigations (30, 60 and 90 DAS)
T_2 = 5 irrigation (15, 30, 45, 60 and 75 DAS)
T_3 = 6 irrigation (20, 40, 60, 80, 100 and 120 DAS)
T_4 = Existing practice 4 irrigations (30, 60, 90 and 120 DAS)
T_5 = Control (no irrigation)

The land was given one-irrigation before its final preparation. It was then given 3-4 ploughing (including operation with disc plough, cultivator and rotavator) in water condition. After proper seed bed preparation, sowing was done by man driven hand drill. Mungbean cultivar NM-98 was sown in mid of May. Fertilizer was applied at 20:50 NP kg/ha. All the nitrogenous and phosphatic fertilizers were applied at the time of sowing. A seed rate of 30 kg/ha was used in this experiment.
The following parameters were recorded during experimentation:

Number of branches/plant): Total number of branches of 10 randomly selected plants was counted in each plot at harvest and their average was calculated.

Number of pods/plant): The number of pods from 10 randomly selected plants in each plot was counted at maturity and their average was recorded.

Number of seeds/pod: The number of seeds of 10 randomly selected pods in each plot was counted at harvest and their average was calculated.

1000-grain weight (g): The sample of 1000-grains was taken from seed lot of each plot and expressed in grams.

Biological yield (kg/ha): Total biomass of central 4 rows in each plot was recorded after harvesting and sun drying separately. The biological yield was recorded in kg/ha by using the formula:

$$\text{Biological yield (kg ha}^{-1}\text{)} = \frac{\text{Plot biomass}}{\text{Plot size (m}^2\text{)}} \times 10000$$

Grain yield (kg/ha): Grain yield of central 4 rows in each plot was recorded after harvesting, sun drying and threshing separately. The yield was recorded in kg/ha by using the formula:

$$\text{Gain yield (kg ha}^{-1}\text{)} = \frac{\text{Plot yield (kg)}}{\text{Plot size (m}^2\text{)}} \times 10000$$

Harvest index (%): Harvest index was calculated by using the formula:

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 10000$$

Biological yield: The data were analyzed statistically using the analysis of variance technique and subsequently least significance difference test (Steel *et al*., 1997) was applied for comparing the treatment means using MSTATC computer software.

RESULTS AND DISCUSSION

Number of branches/plant: Number of branches is considered to be one of the most important characters for higher yield. The data revealed that different irrigation levels had a significant effect on the number of branches per plant. The maximum number of branches (4.97) was recorded by the application of 5 irrigations at different time intervals. The use of 6 irrigation, however, produced statistically similar number of branches (4.67). The lowest number of branches (3.97) was recorded in control treatment where no irrigation was applied (Table 1). The numbers of branches increased significantly by increasing irrigation levels at different growth stages. These results are supported by Soni and Gupta (1999) who reported that 5 irrigations at an interval of 15 days significantly increased all yield attributing parameters. Khan (2001) also found that number of branches per plant was significantly affected by irrigation levels.

Number of pods/plant): The productive capacity of mungbean plant is ultimately determined by the number of pods/plant which is a key yield component. The statistical analysis showed that different irrigation levels had significant effect on number of pods/plant. The data indicated that the maximum number of pods/plant (47.03) was recorded in T_3 which received 6 irrigations. It was, however, statistically at par with T_2, T_1 and T_4 with 43.00, 40.33 and 38.33 number of pods/plant. The lowest number of pods (33.30) was recorded in control treatment (Table 1). Similar results were obtained by Albinet (2000) who reported that an increase in irrigation increased the number of pods/plant. Omid (2008) also studied the response of mungbean varieties to withholding irrigation at various phonological stages. He reported that varying timing of irrigation had significant effect on yield and yield components whereas no irrigation at flowering stage reduced the number of pods/ plant.

Number of seeds/pod: The data collected on number of seeds/pod as affected by different irrigations at various growth stages are shown in Table 1. Statistical analysis of data showed that irrigation levels had non-significant

Table 1: Number of branches/plant, number of pods/plant), number of seeds/pod and 1000-grain weight (g) as affected by irrigation level in mungbean

Treatment	Irrigation interval	Time interval	NOB/plant	NOP/plant	NOS/pod	1000-GW (g)
T_1	3	30, 60 and 90 DAS	4.50bc	40.33ab	5.560^{NS}	45.00b
T_2	5	15, 30, 45, 60 and 75 DAS	4.97a	43.00a	6.617	50.67a
T_3	6	20, 40, 60, 80, 100 and 120 DAS	4.67ab	47.03a	6.133	45.00b
T_4	4	30, 60, 90 and 120 DAS	4.27cd	38.33ab	5.790	44.67b
T_5	Control	No irrigation	3.97d	33.30b	5.483	41.61c
$LSD_{0.05}$			0.376	8.788	---	3.234

Means followed by different letter(s) in a column are significant at 5% level of probability. NS = Non-significant. NOF = Number of Branches/plant; NOP = Number of Pods/plant; NOS = Number of Seeds/pod; 1000-GW = 1000-Grain Weight (g)

Table 2: Biological yield (kg/ha), grain yield (kg/ha) and harvest index (%) as affected by irrigation level in mungbean

Treatment	Irrigation interval	Time interval	BY (kg/ha)	GY (kg/ha)	HI (%)
T_1	3	30, 60 and 90 DAS	17440a	1013.0b	5.82bc
T_2	5	15, 30, 45, 60 and 75 DAS	17470a	1634.0a	9.39a
T_3	6	20, 40, 60, 80, 100 and 120 DAS	16670a	1412.0ab	8.50ab
T_4	4	30, 60, 90 and 120 DAS	15990a	1339.0ab	8.40ab
T_5	Control	No irrigation	11530b	588.0c	5.11c
$LSD_{0.05}$			1932	415.2	2.832

Means followed by different letter(s) in a column are significant at 5% level of probability. BY = Biological Yield (kg/ha); GY = Grain Yield (kg/ha); HI = Harvest Index (%)

effect on number of seeds per pod. However, the maximum number of seeds per pod (6.61) was obtained in T_2 with 5 irrigations. On the other hand, the minimum number of seeds per pod (5.48) was recorded in control.

1000-grain weight (g): Thousand grain weights is very important yield contributing component of every crop including mungbean. The size and vigor of seed is directly correlated with weight of seed. The results obtained are shown in Table 1. As regards the effect of varying irrigation levels, the maximum grain weight (50.67 g) was produced in T_2 (5 irrigations) than the lowest (41.61 g) recorded in T_5. Treatments T_1, T_3 and T_4 produced statistically similar grain weight. The results are in conformity with the findings of Soni and Gupta (1999) who reported that 5 irrigation at an interval of 15 days significantly increased all yield attributing parameters of mungbean. Sangakara (1994) studied the effects of soil moisture on seed yield and quality of mungbean. He reported that the seeds from irrigated plots had a greater weight owing to heavier cotyledons. Khan (2001) also reported that irrigation levels significantly affected 1000-seed weight.

Biological yield (kg/ha): The data regarding the effect of different irrigations on dry matter production are given in Table 2. Statistical analysis of data showed that irrigation had significant effect on biological yield. Among various treatments, higher dry matter was recorded in T_2 (17470 kg/ha). It was, however, statistically at par with T_1, T_3 and T_4 with biological yield of 17440, 16670 and 15990 kg/ha. The lowest biological yield was noted in control (11530 kg/ha). The results are in accordance with Khan (2001) who reported that irrigation significantly increased dry matter production. Similarly, Sangakara (1994) reported that the presence of adequate soil moisture increased growth and yields of mungbean significantly.

Grain yield (kg/ha): The seed yield per unit area is function of the individual yield components which are influenced by crop management and the environment. The grain yield was significantly affected by different irrigation levels applied at different time intervals to mungbean crop. The highest seed yield (1634 kg/ha) was recorded in T_2 with 5 irrigations. It was statistically similar to T_3 and T_4 with 1412 and 1339 kg/ha. The lowest seed yield (588 kg/ha) was obtained in control (Table 2). These present results are supported by Khan (2001) who reported that irrigation levels had significant affect on seed yield. Soni and Gupta (1999) recommended 5 irrigations at an interval of 15 days for increased mungbean yield. Assaduzaman *et al.* (2008) reported that greater dry matter production, as found in T_2 in the present research, eventually partitioned to pods per plant, seeds per pod and 1000-seed weight which resulted in maximum seed yield.

Harvest index (%): Analysis of data revealed that different irrigation levels had significant effect on harvest index. The mean value indicated that T_2 with 5 irrigations produced the maximum harvest index (9.39%) while the control produced (5.11%) minimum harvest index (Table 2). The results are supported by Assaduzaman *et al.* (2008) who found that irrigation during flowering and pod filling stage, increased pod initiation and pod growth rates and thereby increased harvest index.

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