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Effect of Irrigation Scheduling and Phosphorus Levels on Yield and Economics of Green gram (*Vigna radiata* L.)

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ABSTRACT: At the Crop Research Farm, Department of Agronomy, SHUATS, Allahabad (U.P.). A field experiment was undertaken during the *Zaid* season (2021-22). The soil texture of experimental plot was sandy loam, soil pH 7.1, less in organic carbon (0.28 %), available N (225 kg/ha), available P (19.50 kg/ha) and available K (213.7 kg/ha). IR_1 (Irrigation at 25DAS), IR_2 (Irrigation at Vegetative Stage (35DAS)), IR_3 (Irrigation at Vegetative(35DAS) and Pod Formation Stage (55DAS)) were different 3 irrigation scheduling, and (20 kg/ha), (40 kg/ha) and (60 kg/ha) were different 3 levels of Phosphorus. The experiment was conduct in Randomized Block Design with nine treatments and was repeated three times. The result displayed the application of Irrigation at Vegetative (35DAS) and Pod Formation(55DAS) +60Kg P/ha topmost plant height (41.70 cm) recorded in research, Number of nodules/plant (5.90), plant dry weight (11.00 g/plant), pods/plant (40.30 cm), number of seeds per pod (6.80), length of pod (8.40), test weight (36.00 g), grain yield (854.08kg/ha), straw yield (1928.70 kg/ha) and harvest index was non-significant. Highest Gross retunes (59017.7 INR/ha), Net retunes (37832.3INR/ha) and B:C ratio (1.78) also recorded in treatment 9 with apply Irrigation at Vegetative (35DAS) and Pod Formation(55DAS) +60Kg P/ha. Improper Irrigation scheduling and phosphorus application is bigger challenges for Indian farmers to decreases productivity of green gram. Presently the farmer they are given the irrigation as an when they give the water through the canal, there for due to over irrigation in field that they get less yield, but If we give irrigation scheduling in critical growth stages so we can save the number of irrigation and increase the yield of green gram. Application of higher levels of phosphorus was also showed maximum in growth and yield during such as root development, pod maturity, increases the weight of pods, dry weight and seeds per plant so that production can be increased. So that with combination of both irrigation scheduling and phosphorus level we can expect maximum production in green gram.

Keywords: Irrigation, Growth, Yield, phosphorus, Zaid.

INTRODUCTION

Pulses are valuable not only for as human food, also in livestock because of more protein content. Green gram is one of the major pulse crop cultivated in the India. It is favourable in arid and semi-arid region. It is originated in the Indo-Burma region and the area of East Asia. Last two decades World pulse production increased. Dramatic extend in world pulse production was found of 122% increase in crop yields. Green gram changes in maturity periods, that's why useful in different cropping systems. Green gram locally called as moong or mug belongs to the family Leguminosae. When add 20-25kg N/ha they fixes atmospheric nitrogen and upgrade soil fertility. Andhra Pradesh, Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan, Bihar, Gujarat and Orissa are the important states in India. In India it is grown about 43.26million hectares. However, the per capita consumption of pulses was 43.3 g/day and 47.2 g/day in the year (Anonymous, 2017-18) respectively. The sowing time for summer green gram is mid-march to end June. In that time, water loss through evaporation for 50 % of the normal water loss for entire year. The irrigation needed for summer green gram becomes very more because high evapotranspiration rate. But in that period, frequent irrigation produced maximum number of pods /plant, weight of seed/ plant and weight of thousand seed, which ultimately found build up seed yield. But frequent use of irrigations is considered a problem for its cultivation. In such a situations it is necessary to find ways to reduce the number of irrigations (Prasad *et al*., 2014). Phosphorus is also most eventful nutrient after the nitrogen. It is major ingredient of protein and nucleic acids. Phosphorus energy rich bonds play an important role in the formation of phosphates (ADP and ATP). They also play an important role in the growth of new tissue and division of cells. As plants perform complex energy transmissions. The function required phosphorus (P) for pulses production is one of the most essential components. Phosphorus helps in efficient nodulation and efficient functioning of nodulation in

grain development stage, which leads in higher in grain production. Plants take phosphorus from soil solution as phosphate and anion. use of phosphorus solubilizing bacteria as inoculants increase phosphorus uptake. These bacteria also increase prospects of using phosphatic rocks in crop production. Greater efficiency of phosphorus solubilizing bacteria has been shown through co-inoculation with other beneficial bacteria and mycorrhiza (Khan *et al.,* 2009).

MATERIALS AND METHODS

The experiment was done in the *Zaid* season of 2021. The experiment was conducted in Randomized Block Design consisting of nine treatment combinations with three replications and each replication was presented with various treatments assigned at random. The soil of the experimental area was sandy loam in texture, slightly alkaline reaction (pH 7.1) with low level of organic carbon (0.28%), high level of available N (225 Kg/ha), P (19.50 kg/ha), K (92.00 kg/ha). There are combinations of treatments T_1 Irrigation at 25DAS + 20kg P/ha, T_2 Irrigation at 25DAS + 40Kg P/ha, T_3 – Irrigation at 25DAS + 60KgP/ha, T_4 Irrigation at Vegetative Growth (35DAS) + 20Kg P/ha, T_5 - Irrigation at Vegetative Growth (35DAS) + 40Kg P/ha, T_6 - Irrigation at Vegetative Growth (35DAS) + 60Kg P/ha, T_7 - Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 20Kg P/ha, T_8 Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 40Kg P/ha, T_9 - Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60Kg P/ha plant height (cm), number of nodules per plant, plant dry weight, Number of pods per plant, number of seeds per pod, test weight, grain yield and stover yield observation were recorded on different growth parameters at harvest time.

RESULT AND DISCUSSION

A. Yield.

Pods/plant. Treatment with the application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha was recorded maximum pods per plant (40.30) which was significantly superior over all other and treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 40KgP/ha (38.80) which was statistically at par with the treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha. Application of 60 kg P_2O_5 per ha was helped in obtaining the maximum pods per plant. It is well known fact that Phosphorus played a vital role in improving nutritional status of plant through increased photosynthetic activity and N_2 fixation Yadav *et al.* (2017).

Seeds/pod. Treatment with the application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha was recorded maximum seeds per plant (6.80) which was significantly superior over all other and treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 40KgP/ha (6.70) which was statistically at par with the treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha. Application of 40 kgP/ha was helped in obtaining the maximum seeds per pod Yadav *et al.* (2017).

Test weight. Treatment with the application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha was recorded maximum test weight (36.0g) which was significantly superior over all other and treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 40KgP/ha (35.80g) which was statistically at par with the treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha. Application of phosphorus level increases the dry matter accumulation in assimilation organs that in turn brought about increases yield attributes. Application of 45 kg P_2O_5 per ha was helped in obtaining the maximum test weight Patel *et al.* (2017).

Grain yield. Treatment with the application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha was recorded maximum grain yield (854.08 kg) which was significantly superior over all other and treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 40KgP/ha (814.08 kg) which was statistically at par with the treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha. Increases in seed yield due to phosphorus application was attributed to profound branching, better fruiting, increased number of seeds per pod and heavier seeds. However, 40 kg P_2O_5 per ha was helped in obtaining the maximum grain yield Malik *et al.* (2006).

Stover yield. Treatment with the application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha was recorded maximum grain yield (1928.70) which was significantly superior over all other and treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 40KgP/ha (1739.73) which was statistically at par with the treatment with application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha. This was due to higher growth and yield contributing characters under 45 kg P_2O_5/ha. Application of 45 kg P_2O_5 per ha was helped in obtaining the maximum stover yield Akanksha *et al.* (2014).

Harvest yield with the application of Irrigation at 25DAS+20kgP/ha was recorded maximum harvest index (32.45%) and minimum with application of Irrigation at Vegetative Growth (35DAS)+20KgP/ha (30.00%). There is no significant difference between treatments. Application of 60 kg P_2O_5 per ha was helped in obtaining the maximum harvest yield Vikram *et al.* (2019).

B. Economics

Cost of cultivation. Cost of cultivation (21185.40 INR/ha) was found to be highest in Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60KgP/ha. (T9) and the minimum cost of cultivation (20825.40 INR/ha) was found in irrigation at 25 DAS + 20Kg p/ha (T1) as compared to other treatments.

Gross return. Gross return (59017.7 INR) was obtained highest in Irrigation at Vegetative(35DAS) and Pod Formation (55DAS)+ 60Kg P/ha and minimum

gross returns (42625.8 INR) Irrigation at 25DAS + 20kg P/ha as compared to other treatments.

Net return. Net return (37832.3INR) was obtained maximum in Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60Kg P/ha and minimum net return (21800.4INR) was found in Irrigation at 25DAS + 20kg P/ha as compared to other treatments.

Benefits cost ratio. Benefit cost ratio (1.78) was obtained maximum in Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60Kg P/ha and minimum Benefit cost ratio (1.04) with Irrigation at 25DAS + 20kg P/ha as compared to other treatments. The difference in Gross, Net returns and B:C ratio showed that combined use of 60 kg P_2O_5 per ha which led to higher yields and helped in production of maximum economics Sudhakar *et al.* (2021).

Table 1: Effect of irrigation scheduling and phosphorus level on yield of green gram.

Treatments	Pods/plant	Seeds/pod	Testweight(g)	Grain yield (Kg/ha)	Stover yield (Kg/ha)	Harvest index (%)
Irrigation at 25DAS + 20kg P/ha	33.10	5.70	31.87	608.32	1496.10	32.45
Irrigation at 25DAS + 40Kg P/ha	33.60	6.10	32.27	702.53	1616.70	30.15
Irrigation at 25DAS + 60KgP/ha	36.10	6.40	34.03	740.63	1684.26	30.42
Irrigation at Vegetative Stage (35DAS) + 20Kg P/ha	34.20	6.10	32.60	715.30	1663.20	30.00
Irrigation at Vegetative Stage (35DAS) + 40Kg P/ha	36.80	6.40	34.60	747.70	1707.10	30.35
Irrigation at Vegetative Stage (35DAS) + 60Kg P/ha	38.10	6.70	33.33	787.46	1778.16	30.16
Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 20Kg P/ha	35.60	6.30	32.27	724.86	1641.60	30.56
Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 40Kg P/ha	38.80	6.70	35.80	814.08	1739.73	32.08
Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60Kg P/ha	40.30	6.80	36.00	854.08	1928.70	30.60
SEm(±)	0.48	0.15	0.64	12.74	62.77	1.36
CD (p=0.05)	1.45	0.44	1.90	38.21	188.18	—

Table 2: Effect of irrigation scheduling and phosphorus level on economics of green gram.

Treatments	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C Ratio
Irrigation at 25 DAS+ 20kg P/ha	20825.40	42625.8	21800.4	1.04
Irrigation at 25 DAS + 40Kg P/ha	21005.40	48685.3	27679.9	1.31
Irrigation at 25 DAS + 60KgP/ha	21185.40	51219.9	30034.5	1.41
Irrigation at Vegetative Stage (35DAS) + 20Kg P/ha	20825.40	49649.7	28824.3	1.38
Irrigation at Vegetative Stage (35DAS) + 40Kg P/ha	21005.40	51759.1	30753.7	1.46
Irrigation at Vegetative Stage (35DAS) + 60Kg P/ha	21185.40	54408.1	33223.3	1.56
Irrigation at Vegetative(35DAS) and Pod Formation (55DAS) + 20Kg P/ha	20825.40	50100.4	29275	1.40
Irrigation at Vegetative(35DAS) and Pod Formation (55DAS) + 40Kg P/ha	21005.40	55739.9	34734.5	1.65
Irrigation at Vegetative(35DAS) and Pod Formation (55DAS) + 60Kg P/ha	21185.40	59017.7	37832.3	1.78

CONCLUSION

On the basis of one season experimentation it can be concluded that with the application of Irrigation at Vegetative (35DAS) and Pod Formation (55DAS) + 60Kg P/ha was found significantly superior in Pods/plant (40.30), Seeds/pod (6.80), Test weight (36.00 g), Grain yield (854.08 kg/ha), Stover yield (1928.70 kg/ha)and economically viable (1.78) so this treatment is viable for farmers.

FUTURE SCOPE

The conclusions drawn are based on one season data only which requires further confirmation for recommendation.

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Conflict of Interest. None.

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