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Effect of phosphorus level and date of sowing on growth, yield and quality of green gram (*Vigna radiata* L.)

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Abstract
An experiment was conducted at Instructional Farm, Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during *Kharif* season of 2020-2021. The experiment consisted of randomize block design having Factorial arrangement in three replications. In this experiment, 12 treatment combinations including four treatments P0-0 kg P_2O_5 /ha, P1-20 kg P_2O_5 /ha, P2-30 kg P_2O_5 /ha and P3-40 P_2O_5 /ha, while crop sown on three dates were tested are D1-5th July, D2-15th July and D3-25th July. The gross and net plot size was 5.0 m x 3.0 m and 4.40 m x 2.80 m, respectively. significantly affected plant height, number of leaves per plant, number of grains/pod, thousand grain weight, grain and Stover yield of green gram. The significantly higher plant height of green gram was recorded under the application of phosphorus @ 40 kg P_2O_5 /ha (P3) with the respective value of 9.26, 24.41 and 42.30 cm at the growth stage of 30, 45 DAS and at 60 DAS, respectively proved significantly superior to rest of the treatments. Similarly, resulted in significantly maximum number of grain per pod of green gram was recorded under the application of phosphorus @ 40 kg P_2O_5 /ha (P3) with the respective value of 10.38 proved significantly superior to rest of the treatments.

Keywords: Green gram, phosphorus, plant, grains/pod, grain weight, stover yield

Introduction
Green gram (*Vigna radiata* (L) is also known as moong bean. It is an important short duration pulse crop grown in many parts of country. It is mostly cultivated during summer as well as in *kharif* season. The crop is resistant to adverse climatic conditions and improves the soil fertility by fixing atmospheric nitrogen in the soil. It is an efficient cover crop fits well in this system. Green gram is a self-pollinated leguminous crop which is grown during *kharif* (July-October) as well as summer (March-June) seasons in arid and semi-arid regions of India. The nutritive value of green gram lies in its high and easily digestible protein and contain approximately 51% carbohydrate, 25-28% protein, 1.0% oil, 3.5-4.5% fiber, 4.5-5.5% ash and 4% mineral, and 3% vitamins (Mondal *et al.*, 2012) [7]. Besides being a rich source of protein, it maintains soil fertility through biological nitrogen, fixation in soil and thus plays a vital role in sustainable agriculture.

Phosphorus performs important function as a structural component of the membrane system of the cell, the chloroplast and mitochondria. It is an essential ingredient of nucleic acids (RNA and DNA), nucleoproteins, amino acids, proteins, phosphates, phytin, several coenzymes (NADP) viz., thiamine pyrophosphate and pyridoxal phosphate, energy rich adenosine diphosphate (ADP) and adenosine triphosphate (ATP). It is besmeared in energy transfer, metabolic processes and basic reactions of photosynthesis, transformation of sugar and starch, nutrient movement in plants. It is necessary for cell division, meristematic growth, root, seed and fruit development as well as in stimulating flowering, ear emergence and maturation of crops. In pulse crops it hastens and encourages the progress of nitrogen fixing nodule bacteria (ICAR, 2009) [4].

Sowing time, a non-monetary input, is the single most important factor to obtain optimum yield. Hence determination of optimum sowing time for green gram is inevitable. Optimum time of sowing of green gram may vary from genotype to genotype. Therefore, there must be a specific sowing period during the relevant season for different genotypes to obtain maximum yield. Sowing time affects plant physiological and morphological specifications like effect on vegetative and reproductive periods, harvest index, yield and its quality. To achieve good yield, crop must be sown at appropriate time (Ahmed *et al*. 2014) [1].

Materials and Methods

Experiment was carried out at the Instructional Farm, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during *Kharif* season 2020-2021. The experiment was conducted in randomize block design with Factorial concept with three replications. In this experiment, 12 treatment combinations including four treatments P0-0 kg P_2O_5 /ha, P1-20 kg P_2O_5 /ha, P2-30 kg P_2O_5 /ha and P3-40 P_2O_5 /ha, while crop sown on three dates were tested are D1-5th July, D2-15th July and D3-25th July. The gross and net plot size was 5.0 m x 3.0 m and 4.40 m x 2.80 m, respectively. The experimental plots were fertilizers as per treatments.

Results and Discussion

The result shows that plant height, number of leaves per plant, number of grains/pod, thousand grains weight, grain and Stover yield was influenced significantly due to different concentrations of post emergence herbicides and interval of application.

Higher plant height of green gram was recorded under the treatment combination consisting that application of phosphorus @ 40 kg/ha with the sowing of green gram variety on July, 5th with the respective value of 10.48, 26.99 and 44.78 cm at the growth stage of 45 and 60 DAS, respectively proved significantly superior to rest of the treatments. Jaiveer *et al.*, (2017) [5] found significant increase in plant height of green gram due to the application of 40 kg P/ ha.

The significantly maximum number of leaves per plant of green gram was recorded under the treatment combination consisting that application of phosphorus @ 40 kg/ha with the sowing of green gram variety on July, 5th with the respective value of 5.40, 18.67 and 21.00 at the growth stage of 30, 45 DAS and at 60 DAS, respectively proved significantly superior to rest of the treatments.

The significantly maximum number of grains per pod of green gram was recorded under the treatment combination consisting that application of phosphorus @ 40 kg/ha with the sowing of green gram variety on July, 5th with the respective value of 11.47 proved significantly superior to rest of the treatments. Choudhary *et al.*, (2015) [2] was found that number of seeds per pod was significantly increased by phosphorus application.

The significantly highest test weight of green gram was recorded under the treatment combination consisting that application of phosphorus @ 40 kg/ha with the sowing of green gram variety on July, 5th with the respective value of 37.19 g proved significantly superior to rest of the treatments. Kumar *et al.*, (2013) [6] found that the increase in phosphorus levels was significantly increasing the weight of 1000-seed of green gram.

The significantly highest grain yield per hectare of green gram was recorded under the treatment combination consisting that application of phosphorus @ 40 kg/ha with the sowing of green gram variety on July, 5th with the respective value of 14.43 q/ha proved significantly superior to rest of the treatments. Gajera *et al.*, (2014) [3] found that the increase in phosphorus levels was significantly increasing the weight of 1000 seed and seed yield of mung bean.

The significantly highest stover yield per hectare of green gram was recorded under the treatment combination consisting that application of phosphorus @ 40 kg/ha with the sowing of green gram variety on July, 5th with the respective value of 29.19 q/ha proved significantly superior to rest of the treatments. Sunil and Yadav, (2018) [8] was found that straw yield was significantly increased by phosphorus Application.

Table 1: Effect of phosphorus level and date of sowing on growth, yield and quality of green gram (*Vigna Radiata* L.)

Treatment	Plant height (cm)	Number of leaves/ Plant	Number of grains/ Pod	Test weight (g)	Grain Yield (q/ha)	Stover Yield (q/ha)
	Phosphorus levels					
P0	35.79	11.56	5.50	27.60	2.78	10.68
P1	38.58	13.00	7.84	31.08	7.24	20.57
P2	41.49	16.66	9.37	33.36	9.48	24.68
P3	42.30	19.13	10.38	35.30	12.11	27.03
SEm±	1.15	0.99	0.46	0.82	0.92	1.34
CD	3.37	2.91	1.35	2.40	2.69	3.94
	Date of sowing					
D1	40.95	16.48	9.20	33.21	8.98	22.48
D2	40.21	15.62	8.17	31.78	8.22	21.03
D3	37.46	13.17	7.45	30.52	6.51	18.71
SEm±	1.33	1.15	0.53	0.94	1.06	1.55
CD	3.80	3.37	1.56	2.77	3.11	4.55
	Interactive effect of Phosphorus levels and Date of sowing.					
P0D1	37.25	12.60	7.20	29.95	3.22	11.70
P0D2	36.50	11.80	4.97	26.72	2.73	10.42
P0D3	33.62	10.27	4.33	26.15	2.40	9.94
P1D1	38.77	13.60	8.40	31.52	7.53	21.40
P1D2	38.59	12.73	7.67	31.13	7.41	20.65
P1D3	38.39	12.67	7.47	30.60	6.78	19.65
P2D1	43.00	18.73	9.73	33.18	10.76	27.64
P2D2	42.66	17.27	9.58	33.75	9.80	24.69
P2D3	38.81	14.00	8.80	32.17	7.89	21.72
P3D1	44.78	21.00	11.47	37.19	14.43	29.19
P3D2	43.08	20.67	10.47	35.51	12.93	28.37
P3D3	39.04	15.73	9.20	33.18	8.96	23.55
SEm±	0.66	0.57	0.27	0.47	0.53	0.78
CD	1.38	1.19	0.55	0.98	1.10	1.61

Summary and Conclusion

Based upon this experiment it is concluded that application of phosphorus @ 40 kg P_2O_5 /ha with the sowing of green gram variety on July, 5th recorded the maximum and significantly higher grain yield (14.43 q/ha), net returns (₹ 89335.00/ ha) and highest B: C ratio of 5.12: 1. Hence, it can be concluded that application of 40 kg P_2O_5 /ha with crop sown on 5th July with B:C ratio >5.0, can be used as an remunerative strategies.

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