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EFFECTS OF PHOSPHORUS ON YIELD AND GRAIN PROTIEN CONTENT OF TWO IMPORTANT INDIAN PULSES

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ABSTRACT

Foliar application of phosphorus on moong bean and urd bean at the time of flowering at half and full basal fertilizer doses in different concentrations was applied and it was found that the treatment T_5 where 2.5 kg. Phosphorus / ha was applied as foliar spray showed best results. It enhanced almost all the vegetative and yield characteristics of moong bean and urd bean. The best result was observed at T_5 treatment at half basal fertilization dose. In this way a little amount of phosphorus used as foliar spray at the time of flowering when the plant required maximum nutrients can enhanced the productivity and save a large amount of fertilizers.

KEYWORDS : Phosphorus, Hectare, Treatment

Pulses are remarkable Indian diet occupy unique position and form in our country. They supply vegetable protein to predominantly starchy diet. It forms an essential supplement of cereal based diet.

The protein content of the pulses is almost three times more than that of other cereals. Pulse cereal proteins are rich in Lysine and poor in Sulphur containing amino acids where as pulses proteins are rich in sulphur and poor in Lysine containing amino acids. Pulses, the leguminous crop possesses root nodules, which enhance soil fertility by fixing atmospheric nitrogen through symbiotic *Rhizobium*. Amino acid composition of pulse protein is such that a mixed diet of cereal and pulses has a greater biological value rather than that of either component alone. In context of increasing prices of varied food commodities pulses has a unique role to play in Indian economy. Production and consumption of more pulses is one of the best ways to overcome the wide spread protein mal nutrition in our country. The people of our country are mostly vegetarian partially due to their in ability to purchase non-vegetarian diets and partially due to religious considerations. In India the area under pulse crops at present is around 23 million hectare with a production of approximately 50 million tons and a productivity of about 650 Kg/ha. The country needs at least 23 million tons of pulses at present and about 30 million tons by year 2020. There is not much scope for increasing the area under the pulses cultivation. Therefore, it is necessary to increase the productivity by introducing high yielding varieties of pulses with better management of fertilizer utilization of plants so that without increasing the area of pulses cultivation we can increase their yield.

Basal fertilizer dose significantly affected the vegetative and yield characteristics. For optimum growth of the plant, the concentration of nutrients in the soil solution should be maintained at the critical value below which the growth of the plant is decreased (Mengel and Kirby, 1982). Phosphorus play significant role in the growth and development of the plant and occupy an important position in plant nutrition. Some of the nutrients constitute an integral part of several biologically important micro-nutrients including amino acids, nucleosides, co-enzymes, purines, pyrimidines, nucleotides, intermediate metabolites and growth hormones (Develin and Witham, 1986; Salisbury and Ross, 1986) which directly regulate plant metabolism.

The supply of different level of phosphorus in mungbean and urd bean has enhanced the nodule formation. This might be attributed to the fact that phosphorus is an important constituent of energy rich compound for energy transfer during certain metabolic process of plant. The nodule bacteria might have received energy for fixing atmospheric nitrogen in root nodule in the presence of phosphorus. Whyte et al., (1953) held the view that presence of adequate phosphorus is essential to retain the mobility and flagellation of bacterial cells, which helps their migration and thereby favours early infection of legume

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roots. The phosphorus applied to the soil is generally unavailable to the plants because it is redially converted into insoluble phosphates. Therefore, foliar application of phosphorus may be use as an alternative method of phosphorus application to the plants.

Vigna radiata (L.) Wilczek known as mungbean is an important crop of South East Asia and Indian Sub-continent. It has been cultivated mostly during Kharif season in Northern India. Mungbean can grow best in well-drained loam or sandy loam within mean temperature ranged from 20-40^{0}C. The dried beans are prepared for cooking as whole or split (Dal). It is a good source of protein (20-23 %), carbohydrates (60-62 %), water (10 %), fat (1.0 %), fiber (4.0 %) and ash (3.0 %). Mungbean protein is deficient in methionin and cystein but rich in lysine making it an excellent compliment to rice. It is a good source of mineral, pro-vitamin A, B complex and ascorbic acid. Mungbean is thus important from nutritional point of view, hence recently much attention has been paid by Plant Breeders to evolve improved varieties.

The second important legume of this study was *Vigna mungo* (L.) Hepper also known as black gram or Urdbean. It is a good source of protein (20 24 %), carbohydrate (54 56 %), water (10.9 %), fat (1.4 %), fiber (0.9%), ash (3.5%) and minerals (3.3%). It is a very nutritious legume and is cultivated in many tropical and sub-tropical countries in Asia, Africa and Central South America. In our country it is mainly cultivated in U.P., M.P., Punjab and West Bengal. It is cultivated in Kharif season. It is an important pulse crop and occupies unique position in Indian Agriculture. However, the average yield is very low because of non availability of high yielding varieties (Choudhary, et al. 2003).

The aim of the present work is to study the effects of foliar application of different concentration of phosphorus on yield and grain protein content of moong bean and urd bean and to save the basal fertilizer by comparing different basal applications (full and half dose of basal fertilizer) and then applying different foliar applications of phosphorus.

MATERIALS AND METHODS

The seeds of Mungbean (*Vigna radiata* (L.) Wilczek var. K-856) and Urdbean (*Vigna mungo*(L.) Hepper var. T-9) were obtained from agriculture office at Azamgarh. The healthy seeds of uniform size were tested for their per cent viability. Mercuric chloride solution (0.01%) was used for surface sterilization of seeds.

The field experiment was conducted at the research field of Shibli National P.G. College, Azamgarh to study the effect of different concentration of phosphorus as foliar spray at the time of flowering on yield and grain protein content of mungbean (*Vigna radiata* (L.) Wilczek var. K-851) and Urd bean (*Vigna mungo (*L.) Hepper var. T-9). The experiment was carried out according to the split plot design with two main plot i.e. half basal fertilizer dose and full basal fertilizer dose applied in the soil at the time of sowing and 5 split plot for phosphorus. Different concentration of phosphorus used in foliar spray at the time of flowering were T_1 (0.5 kg P/ha), T_2 (1 kg P/ha), T_3 (1.5 kg P/ha), T_4 (2 kg P/ha) and T_5 (2.5 kg P/ha). The healthy and disease free seeds of uniform size were selected for experiment. After proper surface sterilization, the seeds were sown in the experimental plots. Five replicates of each concentration were made. The usual “behind the plough” method of sowing was adopted. The seeds were sown at the rate of 25 Kg/ha. The distances between the seeds were 1 X 1 feet. The field irrigated five times between sowing and harvesting at 7, 21, 40, 55, 70 days. After sowing, weeding was done twice at interval of 30 days. Five replicates were made for each concentration of phosphorus to study grain yield (q/ha) and grain protein content. The growth parameters were taken at 45-60 days and all the yield parameters were taken at the time of harvesting. The following parameters were studied:

- Grain yield.
- Grain protein content.

OBSERVATION

Effect of different spray of phosphorus at the time of flowering (split lot) as well as two basal fertilizer dose (main plot) on mungbean regarding the grain yield kg/ha was studied. The data obtained are presented in Table, 1.

Table 1 : Effect of different concentrations of Phosphorus as foliar spray at the time of flowering on the grain yield Q/ha in Mungbean and Urdbean.

MAIN PLOT						
S PLIT P LOT Treatments	**Basal Fertilizer Dose**			**Basal Fertilizer Dose**		
	Half	**Full**	**Mean**	**Half**	**Full**	**Mean**
	Mungbean	*(Vigna radiata* (L.) Wilczek) var. K - 851		Urdbean	*(Vigna mungo* (L.) Hepper) var. T - 9	
T_0	5.00	5.80	5.40	4.90	5.20	5.05
T_1	5.20	5.90	5.55	5.00	5.45	5.22
T_2	5.30	6.00	5.65	5.40	5.80	5.60
T_3	5.35	6.30	5.82	5.80	5.90	5.65
T_4	5.45	6.60	6.02	5.90	6.00	5.95
T_5	5.58	6.80	6.19	6.00	6.40	6.20
MEAN	5.31	6.23		5.50	5.79	

NB :T_0 = Control
T_1 = 0.5 Kg P/ha as foliar spray at the time of flowering.
T_2 = 1.0 Kg P/ha as foliar spray at the time of flowering.
T_3 = 1.5 Kg P/ha as foliar spray at the time of flowering.
T_4 = 2.0 Kg P/ha as foliar spray at the time of flowering.
T_5 = 2.5 Kg N/ha as foliar spray at the time of flowering.

The comparison of mean values of main plot at full and half basal fertilizer dose was made. An increase of 17.31 per cent was recorded in full basal fertilizer dose mean over half basal fertilizer dose, although it was statistically non-significant. The full basal fertilizer dose mean showed an increase of 24.66 per cent over control set of half basal fertilizer dose. The increase was due to combined effect of fertilizer and foliar application of phosphorus. The full basal fertilizer dose mean showed an increase of 7.47 per cent over the control set of full basal fertilizer dose and this increase was due to the foliar application of phosphorus at the time of flowering (Table, 1).

A comparison between the control set and treatments at split plot design was also made. All the treatments showed increase in the grain yield of mungbean while the maximum increase was recorded in T_5 treatment where plant received 2.5 kg P/ha as foliar spray at the time of flowering and this increase was 14.62 per cent over control (T_0). Two basal fertilizer dose mean at same level of treatment was also studied and all the treatments showed increase in grain yield at full basal fertilizer dose.

	Mungbean	Urdbean
C.D. for split plot treatment at 5%	0.6334	0.8134
C.D. for main plot treatment at 5%	0.9561	0.6810
C.D. for two basal fertilizer dose mean at same level of treatment	0.8739	0.7670

Maximum increase in T_5 treatment was recorded where plant received 2.5 kg P/ha. It was 21.86 per cent over control (Table, 1).

Effect of various spray of phosphorus at the time of flowering (split lot) as well as two basal fertilizer dose (main plot) on urdbean regarding the grain yield kg/ha was studied and data are presented in Table, 1. Comparison of mean values of main plot at full and half basal fertilizer dose was made. The full basal fertilizer dose mean was found to increase the grain yield by 5.30 per cent over the half basal fertilizer dose mean. This increase was found to be non-significant at 5 per cent level of significance. The full basal fertilizer dose mean showed an increase of grain yield by 18.19 per cent over the control set of half basal fertilizer dose. This significant increase in the grain yield of urdbean was due to combined effect of fertilizer and foliar spray of phosphorus. The full basal fertilizer dose mean showed an increase of 11.37 per cent in grain yield over the control set of full basal fertilizer dose and this increase was due to the foliar application of phosphorus at the time of

Table 2: Effect of different concentrations of Phosphorus as foliar spray at the time of flowering on the grain protein percentage in Mungbean and Urdbean

	MAIN PLOT					
SPLIT PLOT	Basal Fertilizer Dose			Basal Fertilizer Dose		
Treatments	Half	Full	**Mean**	Half	Full	**Mean**
	Mungbean	*(Vigna radiata* (L.) Wilczek) var. K - 851		Urdbean	*(Vigna mungo* (L.) Hepper) var. T - 9	
T_0	21.30	22.00	21.65	23.40	23.80	23.60
T_1	21.40	22.12	21.76	23.40	23.90	23.65
T_2	21.45	22.15	21.80	23.60	24.12	23.86
T_3	21 .80	22.80	22.30	23.84	24.45	24.15
T_4	22.00	23.00	22.50	24.12	24.90	24.51
T_5	22.50	23.12	22.81	24.50	25.12	24.81
MEAN	21.74	22.53		23.81	24.38	

NB :
T_0 = Control
T_1 = 0.5 Kg P/ha as foliar spray at the time of flowering.
T_2 = 1.0 Kg P/ha as foliar spray at the time of flowering.
T_3 = 1.5 Kg P/ha as foliar spray at the time of flowering.
T_4 = 2.0 Kg P/ha as foliar spray at the time of flowering.
T_5 = 2.5 Kg N/ha as foliar spray at the time of flowering.

	Mungbean	Urdbean
C.D. for split plot treatment at 5%	0.3942	0.2391
C.D. for main plot treatment at 5%	0.9105	0.7168
C.D. for two basal fertilizer dose mean at same level of treatment	0.7169	0.5430

flowering.

A comparison between the control set and treatments at split plot design was made due to treatment showed increase in the grain yield of urdbean. The maximum increase was recorded in T_5 treatment where plant received 2.5 kg P/ha as foliar spray at the time of flowering and it was 22.77 per cent over control (T_0). Two basal fertilizer dose mean at same level of treatment showed increase in grain yield at full basal fertilizer dose and maximum increase was recorded in T1 treatment where plant received 0.5 kg P/ha. as foliar spray. This increase was 9.0 per cent over control (Table,1).

Effect of various spray of phosphorus at the time of flowering (split lot) as well as two basal fertilizer dose (main plot) on mungbean regarding the grain protein percentage was studied. The data obtained are presented in Table, 2. The comparison of mean values of main plot at full and half basal fertilizer dose was made. An increase of 3.63 per cent was recorded in full basal fertilizer dose mean over half basal fertilizer dose. This increase was found to be non-significant. The full basal fertilizer dose mean showed an increase of 5.78 per cent over control set of half basal fertilizer dose. The increase was due to combined effect of fertilizer and foliar application of phosphorus. The full basal fertilizer dose mean showed an increase of 2.42 per cent over the control set of full basal fertilizer dose and this increase was only due to the foliar application of phosphorus at the time of flowering (Table, 2).

Comparison between the control set and treatments at split plot design was also made. All the treatments showed increase in the grain protein percentage of mungbean while the maximum increase was recorded in T_5 treatment where plant received 2.5 kg P/ha as foliar spray at the time of flowering and this increase was 5.35 per cent over control (T_0). Two basal fertilizer dose means at same level of treatment was also studied and all the treatments showed increase in grain protein percentage at full basal fertilizer dose. Maximum increase was recorded in T_3

treatment where plant received 1.5 kg P/ha as foliar spray. It was 4.58 per cent (Table, 2).

Effect of various spray of phosphorus at the time of flowering (split lot) as well as two basal fertilizer dose (main plot) on urdbean regarding the grain protein percentage was studied and data are presented in Table, 2. A comparison of mean values of main plot at full and half basal fertilizer dose was made. The full basal fertilizer dose mean was found to increase the grain protein percentage by 2.40 per cent over the half basal fertilizer dose mean. The full basal fertilizer dose mean showed an increase of grain protein percentage by 4.19 per cent over the control set of half basal fertilizer dose. This increase in the grain protein percentage of urdbean was due to the combined effect of fertilizer and different foliar spray of phosphorus. The full basal fertilizer dose mean showed an increase of 4.19 per cent in grain protein percentage over the control set of full basal fertilizer dose and this increase was due to the foliar application of phosphorus at the time of flowering.

A comparison between the control set and treatments at split plot design was made. All the treatments showed increase in the grain protein percentage of urdbean. The maximum increase was recorded in T_5 treatment where plant received 2.5 kg P/ha as foliar spray at the time of flowering and it was 5.12 per cent over control (T_0). Two basal fertilizer dose mean at same level of treatment was also studies and all the treatments showed increase in grain protein percentage at full basal fertilizer dose and maximum increase was recorded in T_4 treatment where plant receive 2.0 kg P/ha as foliar spray. This increase was 3.23 per cent (Table, 2).

RESULTS AND DISCUSSION

Phosphorus plays an important role in the living system specially in energy transfer. Phosphorus, as ATP and other phosphorelated compound is involved in almost all the biosynthetic reaction in the cell. The hydrolysis of pyrophosphate bond in phosphorelated nucleotides yields energy which is sufficient for driving almost every biochemical reactions. It is also a component of cytoplasmic protein as phosphoserine. Phosphates are one of the important buffers. In mature plants the maximum proportion of it is stored in fruits and seeds while in growing plants, most of the phosphorus present in meristematic tissues that is why the additional supply of phosphorus favours the vegetative growth and development of fruits in Mungbean and Urdbean. Phosphorus influences total yield by promoting the number of root nodules, average length of pod etc. It also increases disease resistance, probably due to normal cell development and resultant vigorous growth (Tamhane et. al., 1970).

A large amount of phosphorus applied in the soil as basal fertilizer dose, fixed in soil and is beyond the reach of crop plants. The foliar spray of phosphorus has been tried successfully at A.M.U. Aligarh for NP-13 barley. Afridi and Samiullah (1973) suggested that much waste could be avoided by reducing the initial quantity of phosphorus fertilizer and supplementing it by its foliar sprays. They also worked out the doses of phosphorus spray and stages of growth at which optimum yield could be achieved.

Effect of various spray of phosphorus as foliar spray (split plot) as well as two basal fertilizer dose (main plot) regarding grain yield was made and the data are presented in Table-1. The full basal fertilizer dose mean increased over half basal fertilizer dose mean by 17.31 per cent and 5.30 per cent in Moong bean and Urd bean respectively but this increase was found to be non-significant. The split plot treatment revealed the increase in grain yield in almost all the treatment over control. The maximum yield was recorded in T_5 treatment in both the crop. The comparison between two basal fertilizer dose mean at the same level of treatments showed maximum increase in T_5 treatment in both the crop (Table,1). This observation confirm the earlier finding of Qaseem (1975) while working on wheat and barley he recommended that 2.0 Kg P_2O_5/ha as sodium arthophosphate sprayed as 2.0 per cent aqueous solution as foliar spray on the plants receiving half basal fertilizer dose. Similar findings were also reported by several workers like Mukherji and Saxena, (1966); Singh et al., (2001); Chaudhari et al., (2003) on a number of other plat species.

Effect of various concentration of phosphorus at two basal fertilizer dose regarding grain protein percentage

in Mungbean and Urdbean was made and data are presented in Table, 2. The full basal fertilizer dose mean increased by 3.63 per cent over half basal fertilizer dose mean in Mungbean and it was 2.40 per cent in Urdbean. Both the increase were found to be non-significant. At split plot treatment all the concentration showed the increase grain protein percentage in all the treatment over control and maximum increase was recorded in T_5 treatment in Mungbean and Urdbean. The two basal fertilizer dose mean at same level of treatment showed maximum increase at T_3 treatment in Mungbean and at T_5 treatment in Urdbean (Table, 2). The result indicated that the foliar application of phosphorus increases the grain protein percentage significantly in plant which were supplied half basal fertilizer dose as compare to the control set (T_0) supplied the full basal fertilizers and several other treatment receiving full basal fertilizers. Therefore, the overall effect of the treatments in main plot showed non-significant effects on the pulse protein percentage. This finding confirm the earlier findings of Qaseem, (1975) in wheat and barley, Rai et al, (2007) on *Adhatoda Vassica*, Beg and Ahmad, 2007 and, 2012.

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