Phosphorus and Weeding on Growth and Yield of Mungbean (*Vigna radiata* L.)

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Abstract

An experiment was conducted to study the influence of phosphorus and weed management on growth and yield performance of mungbean (*Vigna radiata* L.). Experiment consisted of four levels of phosphorus (P_20_5), viz. P_0 (0 kg P_20_5), P_1 (30 kg P_20_5), P_2 (60 kg P_20_5), and P_3 (90 kg P_20_5) ha^{-1}; and three levels of weeding (W), viz. W_0 (no weeding), W_1 (one weeding), and W_2 (two weeding) with 12 treatment combinations (P_0W_0, P_0W_1, P_0W_2, P_1W_0, P_1W_1, P_1W_2, P_2W_0, P_2W_1, P_0W_2, P_3W_0, P_3W_1 and P_3W_2) and three replications. 60 kg P_20_5 showed significantly highest values on all parameters studied. Response of different weeding levels was significant for all the parameters except test weight and total dry matter at early growth stage. Weeding twice performed best for all the parameters. Application of 60 kg P_20_5 in combination with two weeding recorded the highest values in all parameters except number of seeds pod^{-1} which was highest in $P_20_{5\ at}$ 60 kg ha^{-1}. The study recommends that 60 kg P_2O_5 ha^{-1}along with two weeding produce best mungbean during summer season.

1. Introduction

Mungbean (*Vigna radiata* L. Wilczek) is an important pulse crop in Bangladesh. It is principally cultivated for human consumption for its edible seeds which are high in protein. The crop is important for both human nutrition and enrichment of soil fertility (Norman et al., 1984). Its straw is also used as livestock feed. The country produces pulses to the tune of about 34,000 metric tones annually in area of 53000 hectare (FAO, 2008). The crop is potentially useful in improving cropping pattern as it can be grown as a catch crop due to its rapid growth and early maturing characteristics. It can fix atmospheric nitrogen and may play an important role to supplement through symbiotic relationship between host mungbean roots and soil bacteria, thus improves soil fertility. It can also play an important role to supplement protein in cereal-based low-protein diet of the people of Bangladesh, but the acreage and production of mungbean is steadily declining (BBS, 2005). There are many reasons of low yield of mungbean, among which management of fertilizer and weeding are the important ones which greatly affect the growth, development and yield of this crop.

Mungbean is a short duration crop, and for that easily soluble fertilizer like phosphorus should be applied in the field. The phosphorus requirements vary depending upon the nutrient content of the soil (Bose and Som, 1986). Phosphorus shortage restricts the plant growth and remains immature. Secondary mechanism of interference was the adsorption of phosphorus from the soil through luxury consumption, increasing the tissue content without enhancing smooth biomass accumulation (Santos et al., 1993)

Weed is one of the most important factors responsible for low yield of crops (Islam et al., 1989). Mungbean is not very competitive against weed, and therefore, weed control is essential for its cultivation (Moody, 1978). Yield loss due to uncontrolled weed growth in mungbean ranges between 27-100 % (Khan et al., 2008). However, such relationship may be changed for a crop which is in competition with weed for solar radiation. Development of leaf area of mungbean may be modified by competition with weeds. Hence, the present study was undertaken to maximize the seed yield of mungbean with optimum phosphorus level and proper weed management.

2. Materials and Methods

2.1. Study site

Experiment was conducted at the farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from March to May, 2010. The climate of experimental site was under sub tropical and which was situated between 23^0 74ì N latitude and 90^0 35 ììE longitude. The experimental field was located under the AEZ (Agro-ecological Zone of Bangladesh) no. 28. The soil of selected experimental plots was red brown terrace soil. The characteristics of the soil of experimental filed are given in Table 1.

2.2. Treatments and plant material

The experiment consisted four levels of phosphorus (P_2O_5), viz. P_0 (0 kg), P_1 (30 kg), P_2 (60 kg), and P_3 (90 kg) ha^{-1}; and three levels of weeding (W), viz. W_0 (no weeding), W_1 (one weeding), and W_2 (two weeding). Thus, there were 12 treatment combinations expressed as P_0W_0, P_0W_1, P_0W_2, P_1W_0, P_1W_1, P_1W_2, P_2W_0, P_2W_1, P_0W_2, P_3W_0, P_3W_1 and P_3W_2. The experiment was laid out with randomized complete block design with three replications and there were thirty six experimental plots. BARI *mung-6* (a variety of mungbean) was used as the test crop with maximum recommended seed yield 1.1-1.4 t ha^{-1}. The land was first opened with the tractor drawn disc plough. Ploughed soil was then brought into desirable fine tilth by 4 operations of ploughing and harrowing with country plough and ladder. The plots were spaded one day before planting and the basal dose of fertilizers were incorporated thoroughly before planting. Seeds of mungbean were sown on March 1, 2010. Seeds were treated with a fungicide named Bavistin 50 WP @ 0.20 kg for kg^{-1} seed before sowing to control seed borne disease.

2.3. Intercultural operation

Seeds were sown in solid rows in the furrows at a depth of 2-3 cm with 30 cm row to row distance. Fertilizers at 30: 33 kg ha^{-1} of N: K_2O were applied from the source of Urea and Muriate of Potash as per BARI (Bangladesh Agricultural Research Institute, Joydepur, Gazipur in Bangladesh) recommendation rate. Thinning was done twice—first at 8 days and second at 15 days after sowing-to maintain proper plant population (333333 plants ha^{-1} by maintaining spacing 30 cm x 10 cm) in each 36 plots. Phosphorus was applied, and irrigation and weeding was done, as per treatment. All the agronomic operations were kept normal and uniform for all the treatments.

2.4. Data collection and statistical analysis

Ten plants from each plot were harvested to collect data on growth and yield parameters. Harvesting was done when 90% of the pods became brown to black in color. Data on yield components, viz. number of flowers and pods $plant^{-1}$, number of seeds pod^{-1}, and test weight were recorded from ten harvested plants. Seed yield was recorded from pre-demarcated three linear lines of each plot which were sun dried properly. Data colleted on various parameters under study were statistically analyzed using MSTAT-computer package program. Means were compared following least significance difference (LSD) test at p=0.05 level of significance.

3. Results and Discussion

3.1. Effect on total dry matter

Due to application of different levels of phosphorus and weed management, total dry matter (TDM) of mungbean varied significantly at 15, 25, 35, 45 and 55 days after sowing (DAS). Phosphorus level P_1 and P_2 showed better performance through out the study period than P_3 and P_0. P_2 treatment accumulated the highest quantity of dry matter (Figure 1) as 4.84, 6.06, 7.12, 8.27 and 9.13 g at 15, 25, 35, 45 and 55 DAS, respectively which was followed by the corresponding values recorded for treatment P_1. Similar result was obtained by Edwin et al., (2005). One the contrary, maximum TDM was recorded in W_2 at each observation stage (Figure 2) which is supported by Sultana et al. (2009). In contrast, lowest amount of dry matter was observed at P_0W_0. Phosphorus and weeding treatment simultaneously increased the dry matter accumulation at each subsequent recording day from 15 to 55 DAS (Table 2). Among the twelve combinations, P_2W_2 accumulated significant amount of dry matter as 4.96, 6.46, 7.54, 8.55 and 9.95 g at 15, 25, 35, 45 and 55 DAS respectively. Similar trend of distribution of dry matter in mungbean was reported by Sultana et al. (2009). P_0W_0 produced lowest amount of dry matter at each growth stage. So, it can be said that as a pulse crop mungbean showed lag phase for slow dry matter production in early growth stage, and in addition shortage of nutrient and weed stress restricted the optimum growth of mungbean. Asaduzzaman et al., (2008) reported similar findings of dry matter in mungbean.

3.2. Effect on yield parameters

Both phosphorus and weeding solely influenced the number of flowers and pods $plant^{-1}$, seeds pod^{-1}, and test weight significantly. Table 3 shows that P_2 and W_2 gave significantly higher number in all yield contributing parameters except in number of flowers $plant^{-1}$ while W_1 gave maximum number of flowers $plant^{-1}$ (31.04). Similar trend was also reported by Edwin et al. (2005) for number of pods $plant^{-1}$. P_2W_2 gave significantly the highest number of flowers (35.99) $plant^{-1}$, pods (22.36) $plant^{-1}$, and maximum test weight (23.51 g) followed by P_2W_1(22.52 g). In contrast, highest number of seeds pod^{-1} (8.22) was recorded from P_2W_1. Result was in conformity with the findings of Moody (1978). All yield contributing characters were found lowest in control treatment (P_0W_0) which might be due to phosphorus deficiency and weed stress restricting plant growth adversely affecting yield contributing characters of mungbean.

3.3. Effect on yield

Table 3 shows sole effect of phosphorus and weeding treatment on yield. Both P_2 and W_2 separately produced maximum seed yield (1.31 and 1.11 tha^{-1}, respectively) followed by P_1 and P_3, and W_1 and W_2. Bhat et al. (2005) reported that 90 kg P_2O_5 ha^{-1} (P_3) produced maximum seed yield and was at par with 60 kg P_2O_5 ha^{-1} (P_2), and both were significantly superior to 30 kg P_2O_5 ha^{-1} (P_1). Sultana et al. (2009) reported two weeding as more economical than one and thrice.

Table 4 shows interaction effect of phosphorus and weeding of mungbean. Interaction effect of P_2W_2 combination was significant in respect of seed yield (t ha^{-1}). Among the interactions, P_2W_2 performed better and produced the maximum seed yield (1.35 t ha^{-1}) (Table 4) followed by other levels of weeding with same phosphorus level and it might be due to maximum production of crop characters influencing the plant to produce good quantity dry matter consequently raising the partitioning the reproductive units. Two weeding also help plants more intercept the solar radiation for increasing the rate of photosynthesis. Similar findings are reported by Nadeem et al.,(2004) and Sultana et al., (2009) who also stated that the maximum seed yield(1.98 t ha^{-1}) was obtained when 60 kg P_2O_5 ha^{-1} and two weeding was applied in mungbean filed.

4. Conclusion

From the present study, it may be concluded that both phosphorus and weeding were beneficial for yield and yield contributing characters of mungbean. Solely 60 kg P_2O_5 ha^{-1} and separately two weeding provided the best results, and individual effect of phosphorus (60 kg P_2O_5 ha^{-1}) and two weeding was reflected by their interaction effect too. However, from statistical point of view among twelve treatment combinations, 60 kg P_2O_5 ha^{-1} along with two weeding) was the best to produce better mungbean during summer season. Results need to be verified by further experiment in different agro-ecological conditions of Bangladesh.

5. References

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Table 1: Some physical and chemical properties of soil at experimental plot

Soil characteristics	Value	Soil characteristics	Value
pH	5.6	Organic matter (%)	0.78
Total N (%)	0.03	Available P	20 ppm
Exchangeable K (me 100 g^{-1})	0.10	Available S	45 ppm

N:Nitrogen; K: Potassium; P:Phosphorus; S:Sulpher

Table 2: Interaction effect of phosphorus and weeding on TDM of mungbean at different DAS

Phosphorus-weeding interaction	TDM(g) at different DAS				
	15	25	35	45	55
P_0W_0	3.79	4.65	5.44	6.41	6.78
P_0W_1	3.76	5.25	6.38	7.53	8.59
P_0W_2	3.95	5.55	6.32	7.47	8.00
P_1W_0	4.75*	5.97 *	6.94*	8.13*	8.70
P_1W_1	4.63 *	6.03*	6.98 *	8.17*	8.74
P_1W_2	4.82 *	6.18 *	7.12 *	8.32*	9.00
P_2W_0	4.80*	5.81*	6.87 *	8.08*	8.67
P_2W_1	4.74 *	5.92*	6.96*	8.18*	8.76
P_2W_2	4.96 **	6.46**	7.54 **	8.55**	9.95*
P_3W_0	4.12	5.48	6.52	7.65	8.19
P_3W_1	4.08	5.61*	6.63	7.78*	8.20
P_3W_2	4.32	5.79 *	6.78 *	7.95*	8.48
CV (%)	6.50	7.86	6.31	5.96	5.51

*($p\leq0.05$); **$p\leq0.01$

Table 3: Sole effect of phosphorus and weed management on yield contributing characters of *mungbean*

Level of P	Number of flowers $plant^{-1}$	Number of pods $plant^{-1}$	Number of seeds pod^{-1}	Test weight (g)	Yield (t ha^{-1})
P_0	19.97	16.97	6.88	19.06	0.86
P_1	31.90	20.05	7.70*	21.90*	1.13
P_2	34.05*	21.42*	7.83*	22.53*	1.31*
P_3	28.59	18.72	7.59*	20.88*	1.01
Level of weeding					
W_0	26.02	17.16	7.05	20.51	1.03
W_1	31.04*	19.47*	7.70*	21.20	1.08*
W_2	28.82	20.50*	7.75*	21.56	1.11*
CV (%)	4.91	7.13	6.09	8.23	4.34

*($p\leq0.05$)

Table 4: Interaction effect of phosphorus and weed management on yield contributing characters and yield of mungbean

Phosphorus-weeding interaction	Number of flowers $plant^{-1}$	Number of pods $plant^{-1}$	Number of seeds pod^{-1}	Test weight (g)	Seed yield (t ha^{-1})
P_0W_0	15.35	14.37	6.33	17.86	0.83
P_0W_1	22.30	17.89	7.03	20.02	0.84
P_0W_2	22.27	18.65	7.29	19.29	0.89
P_1W_0	31.50	18.34	7.16	21.63*	1.08
P_1W_1	35.46*	18.91	7.99*	22.05*	1.13
P_1W_2	28.20	20.89*	7.95*	22.01*	1.16
P_2W_0	31.53	18.28	7.57*	21.56*	1.28*
P_2W_1	35.15*	21.54*	8.22*	22.52*	1.31*
P_2W_2	35.99*	22.36*	7.70*	23.51*	1.35**
P_3W_0	25.71	17.63	7.15	21.01*	0.95
P_3W_1	30.72	18.41	7.55*	20.22*	1.04
P_3W_2	29.33	20.12*	8.07*	21.41*	1.05
CV (%)	4.91	7.41	6.09	8.23	4.25

*($p\leq0.05$); **$p\leq0.01$

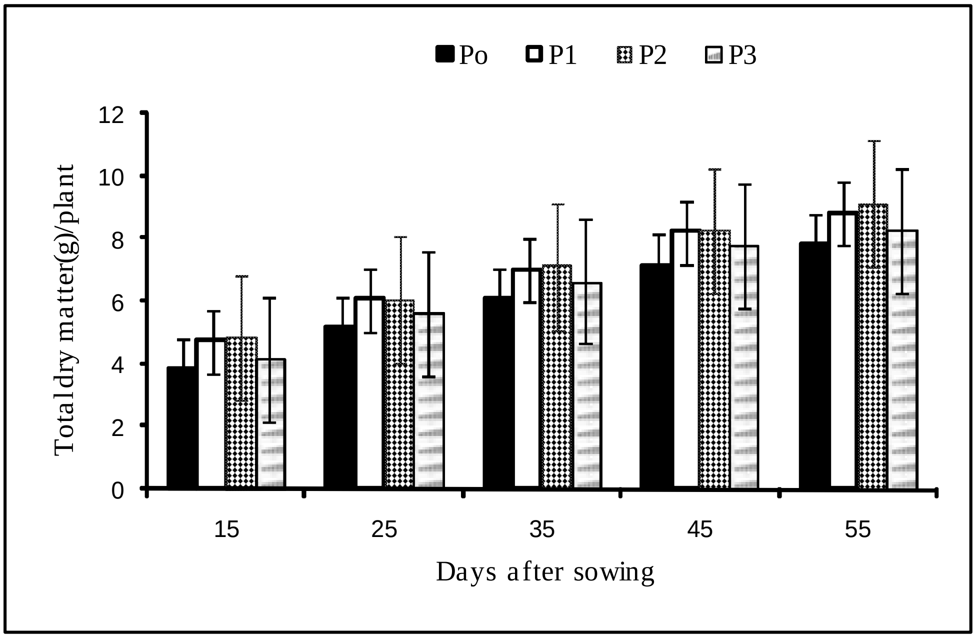

Figure 1: Sole effect of phosphorus on TDM production of mungbean ($p \leq 0.05$)

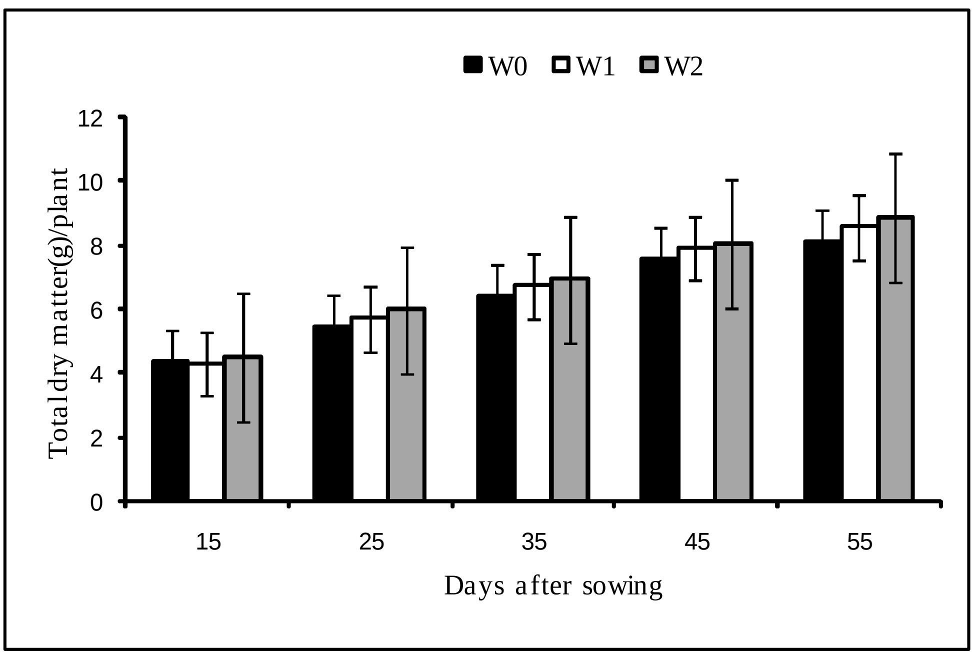

Figure 2: Sole effect of weeding on TDM production of mungbean (($p \leq 0.05$)