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Influence of Different Levels Phosphorous and Zinc on Yield and Yield Attributes of Mung Bean [*Vigna radiata* L.]

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Abstract

To study the influence of different levels of phosphorous and zinc on yield and yield attributes of mung bean (BARI Mug 6) an experiment was conducted at Agronomy Research Farm, Peshawar, during kharif season of 2017. Four phosphorus (P) levels (0, 15, 20 and 25kg P ha^{-1}) and three zinc (Zn) levels (0, 1.5 and 4kg Zn ha^{-1}) were used in the study. The results of the study shown that stover and seed yield of mung bean improved with increasing phosphorus and zinc levels up to positive level. For instance of Phosphorous the significant maximum stover yield (2.59t ha^{-1}) and seed yield (1.53t ha^{-1}) were obtained with the treatment P3 (25kg P ha^{-1}) and the significant minimum stover yield (2.08t ha-1) and minimum seed yield (1.43t ha^{-1}) were obtained with the treatment P0 (0kg P ha^{-1}). In case of Zn the significant maximum stover yield (2.77t ha^{-1}) and maximum seed yield (1.77t ha^{-1}) were obtained with the treatment Zn2 (4kg Zn ha^{-1}) and the significant minimum stover yield (2.19t ha^{-1}) and minimum seed yield (1.38t ha^{-1}) were achieved with the treatment Zn0 (0kg Zn ha^{-1}). The significant maximum number of branch $plant^{-1}$ (3.32), taller plant (53.45cm), seed yield (1.94t ha^{-1}), yield supporting factors as number of pods $plant^{-1}$ (20.89), 1000 seeds weight (45.66g) and number of seeds pod-1 (12.98) were achieved with the treatment combination P2Zn2 (20kg P ha^{-1} + 4kg Zn ha^{-1}).

Keywords: Phosphorous; Zinc; Mung bean; Micro-symbionts; Rhizobium; Seed germination

Introduction

Mung bean (*Vigna radiata* L.) is an excellent source of easily digestible protein and is one of the chief pulse crop [1]. It belongs to the family Leguminosae. BARI mug 6 is a yield potential, innovated by Bangladesh Agricultural Research Institute (BARI) and contribute well in crop rotation between two different cereal crops [2]. In Bangladesh, daily consumption of pulses is only 14.30g capita-l day^{-1}, while 45g $capita^{-l}$ day^{-1} for a balanced diet suggested by World Health Organization (WHO). Mung bean is rich source of vegetable protein [3]. It is considered as poor man's meat containing almost triple amount of protein as compared to rice. It contains 50.4% carbohydrates, 3.5-4.5% fibers, 1-3% fat and 4.5-5.5% ash, while phosphorus and calcium are 367 and 132mg per 100 grams of seed, respectively [4]. Hence, on the nutritional point of view, mung bean is perhaps the best of all other pulses [5]. Due to short duration of mung bean it can fit as a cash crop between major cropping seasons. Mung bean cultivation can advance the physical, biological and chemical properties of soil as well as enhance fertility of soil through nitrogen fixation by symbiotic process with the help of micro-symbionts (Rhizobium) Phosphorus is a key constituent of ATP and it plays a significant role in the energy transformation in plants [6] and also essential for energy storage and release in living cells. The Zn essentially is being employed in functional and structural component of several enzymes, such as carbonic anhydrase, alcohol dehydrase, alkaline phosphatase, phospholipase, carboxypeptidase and RNA polymerase [7]. Further, plants emerging from seeds with lower Zn could be highly sensitive to biotic and abiotic stresses [8]. Zn enriched seeds performs better with respect to seed germination, seedling growth and yield of crops [9]. The farmers of Bangladesh generally grow mung bean with almost no fertilizers. Considering the above facts, the present study is aimed at following objectives to determine the effects of phosphorus and Zinc on the growth and yield of mung bean and to study the combine effect of phosphorus and zinc on growth and yield of mung bean [10].

Material and Method

The experiment was carried out in the Agronomy Research Farm, University of Agriculture Peshawar, Pakistan, during the passé from April to July, 2017. BARI mug 6, a great yielding variety of mung bean was taken by National Agricultural Research Institute (NARC). It is photo unaffected, semi synchronous maturity, short lifecycle (60 to 65 days) and bold seeded crop. Its yield potentiality is about 2t ha^{-1}. BARI mug 6 variety is much resistant to various viruses' diseases like yellow mosaic virus diseases, insects and pest attack. The plot taken for the experiment was driven by rotavator on the 6th April 2017, after the practice of rotavator the land was ploughed and cross-ploughed numerous times. The experiment comprised of two factors: Factor A: Phosphorus (P), P0= No P ha^{-1}, P1=15kg P ha^{-1}, P2= 20kg P ha^{-1} and P3= 30kg P ha^{-1}; Factor B: Zinc (Zn), Zn0= No Zn ha^{-1}, Zn1=1.5kg Zn ha^{-1} and Zn2=4kg Zn ha^{-1} [11] treatment combinations were arrange from these levels. The experiment was placed in a Randomized Complete Block Design (RCBD) with four replications. The total number of plots was 48, each sub plot was 2.5m x 2m. Blanket recommended doses of K, N and Sulphur (30kg K from MoP, 20kg N from urea and 15kg S ha^{-1} from Gypsum, respectively) were applied. The basal dose of whole amounts of MoP, Gypsum and half of total Urea fertilizer were applied during land preparation. The rest of the fertilizer urea was given after 28 days of seed sowing. The required amounts of P (from TSP) and Zn (from Zinc oxide) were applied at a time as per treatment combination after field layout of the experiment and were mixed properly through hand spading. Mung bean seeds were sown on 18th April 2014 in rows following the recommended row to row distance of 30cm and plant to plant distance of 10cm. Various intercultural operations such as thinning of plants, weeding and spraying of insecticides were accomplished whenever required to keep the plants healthy and the field weed free. The crop was harvested at maturity on 29th June 2014. The harvested crop of each plot was bundled separately. Ten (10) plants from each plot were selected as random and were tagged for the data collection. Data were collected at harvesting stage. The collected data were analyzed with the help of MSTAT-C program and mean values of all the parameters were adjusted by Least Significant Difference (LSD) at 5% level of probability [12].

Results and Discussions

Influence of phosphorus on growth and yield of Mung bean

Table 1: Influence of phosphorous on parameters of growth.

Levels of P (Kg ha^{-1})	Plant Height (cm)	No. of Branches $plant^{-1}$	No. of Pods plan t^{-1}	No. of Seeds pod^{-1}	Pod Length (cm)	1000 Seeds Weight (g)	Seed Yield (t ha^{-1})	Stover yield (t ha^{-1})
P0	43.11^{d}	1.78^{d}	15.03^{c}	10.40^{c}	7.43^{d}	42.23^{c}	1.43^{c}	2.08^{c}
P1	47.83^{c}	2.44^{c}	17.23^{b}	11.43^{b}	8.32^{c}	43.87^{b}	1.48^{b}	2.31^{b}
P2	50.02^{a}	2.85^{a}	20.75^{a}	13.31^{a}	9.44^{a}	45.33^{a}	1.54^{a}	2.58^{a}
P3	48.93^{b}	2.66^{b}	18.97^{b}	10.69^{b}	8.34^{b}	42.17^{ab}	1.53^{a}	2.59^{a}
LSD (0.05)	1.22	0.071	0.76	0.48	0.44	1.18	0.069	0.082

Mung bean plants revealed significant variation in respect of plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, Pod length, 1000 seeds weight, seed yield (t ha^{-1}) and stover yield (t ha^{-1}) when phosphorus application in different dosages were applied (Table 1). Plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}: Plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, Pod length and thousand seeds weight were increased with P levels from 0-20kg ha^{-1}. The taller plant (50.02cm), number of branches $plant^{-1}$ (2.85), number of pods $plant^{-1}$ (20.75) and number of seeds pod^{-1} (13.31) were achieved with the application of 20kg P ha^{-1}. On the other hand, the shorter plant (43.11cm), number of branches $plant^{-1}$ (1.78), number of pods $plant^{-1}$ (15.03) and number of seeds pod^{-1} (10.40) were observed where no application of phosphorous. The result is approved with the findings of Kumar et al. [13]. Pod length and weight of 1000-seeds as affected by different doses of phosphorus showed significant variation statistically. Among the different doses of Phosphorous the highest pod length (9.44cm) and thousand seeds weight (45.33g) was observed in P2 (20kg P ha^{-1}). The lowest pod length (7.43cm) and thousand seeds weight (42.23g) were observed where no phosphorous fertilizers were applied i.e. P0. The result is similar with the outcomes of Kumar et al. [13] who detected significant increase in pod length, number of grains pod^{-1}, 1000 seeds weight, seed yield, and stover yield of mung bean due to the application of increasing level of Phosphorous fertilizer. Seed yield and stover yield was also found significant by different doses of Phosphorous been applied (Table 1). The highest seed yield (1.54t ha^{-1}) was recorded in P2 (20kg P ha^{-1}) but the highest stover yield (2.59t ha^{-1}) was recorded in P3 (30kg P ha^{-1}) treatment. The lowest seed yield (1.43t ha^{-1}) and stover yield (2.08t ha^{-1}) of mung bean was recorded where no phosphorous application was applied i.e. P0. There was no significant difference between P2 and P3 treatments. The result is fixed with the findings of Oad et al. [14] who recorded significant increase in grain yield, and straw yield of mung bean by the application of 100kg P fertilizer.

Effect of zinc on growth and yield of mung bean

Mung bean crop revealed significant variation for plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$, number of seeds pod^{-1}, pod length, 1000 seeds weight, seed yield and stover yield different dosages of zinc were applied. Plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$ and number of seeds pod^{-1}. Among zinc fertilizer dosages, Zn2 (4kg Zn ht^{-1}) showed the taller plant (50.55cm), number of branches plant-1 (2.54), number of pods $plant^{-1}$ (19.11) and number of seeds pod^{-1} (11.70). On the divergent, the shorter plant (46.80cm), number of branches $plant^{-1}$ (2.01), number of pods $plant^{-1}$ (15.34) and number of seeds pod^{-1} (10.14) was noted in the treatment where no application of zinc was practiced. Islam et al. [15] noticed significant increase in plant height, number of branches $plant^{-1}$, number of pods $plant^{-1}$ and number of seeds pod^{-1} of mung bean due to the application of 0.3% - 0.6% ZnO solution. Among the different Zn doses, Zn2 (4kg

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Zn ha-1) showed the highest pod length (9.43cm) and 1000 seeds weight (42.86g). On contrary, the lowest pod length (8.04cm) and 1000 seeds weight (38.22g) was noted where no application of zinc practiced i.e. Zn0. Islam et al. [15] recorded significant increase in length of pod of mung bean due to the application of 0.3% - 0.6% ZnO solution. Among the zinc fertilizer dosages, Zn2 (4kg Zn ha-1) gave the highest seed yield (1.77t ha-1) and stover yield (2.77t ha-1) of mung bean. On the other hand, the lowest seed yield (l.38t ha-1) and stover yield (2.19t ha-1) of mung bean were found in Zn0 where no Zn fertilizer was applied. Zn 1 and Zn 2 were statistically similar in case of stover yield (Table 2).

Table 2: Influence of zinc on parameters of growth.

Levels of Z (Kg ha-1)	Plant Height (cm)	No. of Branches plant-1	No. of Pods plant-1	No. of Seeds pod-1	Pod Length (cm)	1000 Seeds weight (g)	Seed Yield (t ha-1)	Stover Yield (t ha-1)
Zn0	46.80b	2.01c	15.34b	10.14b	8.04c	38.22b	1.38c	2.19b
Zn1	48.32ab	2.43c	16.43b	10.92a	8.78b	40.48ab	1.65b	2.30b
Zn2	50.55a	2.54a	19.11a	11.70a	9.43a	42.86a	1.77a	2.77a
LSD (0.05)	1.22	0.09	0.82	0.53	0.76	1.96	0.06	0.06

Interactive effect of phosphorous and zinc on yield and yield attributes of mung bean

Mutual application of dosages of phosphorus and zinc revealed significant effect on the plant height, number of branches plant-1, number of pods plant-1, number of seeds pod-1, pod length, thousand seeds weight, seed yield and stover yield of mung bean. The shorter plant (41.55cm), number of branches plant-1 (1.58), number of pods plant-1 (14.06) and number of seeds pod-1 (8.74) were observed where no phosphorous and zinc application applied i.e. P0Zn0. On the contrary the taller plant (53.45cm), number of branches plant-1 (3.32), number of pods plant-1 (20.89) and number of seeds pod-1 (12.98) were noted in P2Zn2 (20kg P ha-1 + 4kg Zn ha-1) treatment combination. Ahmed et al. [16] recorded significant increase in plant height, number of branches plant-1, number of pods plant-1 and number of seeds pod-1 of mung bean due to the increasing application level of P and Zn. The highest pod length (10.57cm) and thousand seeds weight (45.66g) were noticed in P2Zn2 (20kg P ha-1+ 4kg Zn ha-1) treatment combination. On the divergent, the lowest pod length (6.43cm) and 1000 seeds weight (38.98g) were noted in P0Zn0. Singh et al. [17] recorded significant increase in pod length and thousand seeds weight of mung bean due to the increasing application levels of P fertilizer. The highest seed yield (1.94t ha-1) and stover yield (2.69t ha-1) of mung bean were verified with the treatment combination of P2Zn2 (20kg P ha-1 + 4kg Zn ha-1). On the other hand the lowest seed yield (1.09t ha-1) and stover yield (2.06t ha-1) of mung bean were recorded in P0Zn0 and P0Zn1 (No P and 1.5kg Zn) treatment combinations, respectively. Singh and Bajpai 18 found that P and Zn enhance significantly the grain as well as stover yields of chickpea [18] (Table 3).

Table 3: Interactive effect of phosphorous and zinc on yield and yield attributes of mung bean.

Interaction of P and Zn	Plant Hight (cm)	No. of Branches plant-1	No. of Pods Plant-1	No. of Seeds plant-1	Plant Length (cm)	1000 Seeds Weight (cm)	Seed Yeild (t ha-1)	Strover Yeild (t ha-1)
P0Zn0	41.55h	1.58i	14.06g	8.74f	6.43g	38.98g	1.09g	2.06gh
P0Zn1	42.17h	2.09i	14.65fg	9.42ef	6.87fg	39.67fg	1.15g	2.04b
P0Zn2	43.44g	1.98h	15.43f	10.30cd	7.12f	41.57de	1.18fg	2.15fg
P1Zn0	45.66f	2.54g	15.59f	9.97de	7.27f	40.80ef	1.20f	2.16fg
P1Zn1	46.33e	2.76f	16.64e	10.94bd	7.28f	42.00ce	1.30e	2.17f
P1Zn2	49.32d	2.90de	18.54bc	11.34bc	8.27e	43.32bc	1.43d	2.42de
P2Zn0	49.09c	2.79ef	17.86cd	10.59bd	7.95e	42.08cd	1.42d	2.38e
P2Zn1	52.21ab	3.12b	19.37b	12.95a	9.94b	43.25bc	1.48cd	2.54cd
P2Zn2	53.45a	3.32a	20.89a	12.98a	10.57a	45.66a	1.94a	2.69cd
P2Zn0	49.98c	2.79ef	17.04de	10.58bd	8.44de	42.07cd	1.42d	2.53cd
P3Zn1	50.39bc	2.87d	17.48ce	11.03b	8.96cd	43.70b	1.53bc	2.59bc
P3Zn2	49.07c	2.60c	18.46bc	10.91bc	9.27c	43.33bc	1.64b	2.68b
LSD (0.05)	1.23	0.09	0.98	0.52	0.63	1.17	0.073	0.072

Conclusion

On the Basis of the results of the present findings, the following recommendation may be considered - Application of Phosphorus and Zinc fertilizers @ 20kg P ha-1 and 4kg Zn ha-1 may be the finest combination for higher yield of mung bean and also to conserve soil fertility and productivity than their individual application.

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