

Response of Mung bean (*Vigna Radiate L.*) to Phosphorus Fertilizer Levels in Northeast Agro-Ecology of Afghanistan

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ABSTRACT

During the 2023 cropping season, an In the northeastern agro-ecology of Afghanistan, a study was conducted at Kunduz University's Research Farm to determine the response of the mung bean (*Vigna radiata*) to the quantity of phosphorus fertilizer. Four treatments were used in the trial, which included a Randomized Complete Block Design and three replications: The highest plant height (63.50 cm), branches/plant (12.40), leaf area index (2.10), minimum days to maturity (76.50), pod length (6.73 cm), seeds/pod (9.27), pods/plant (18.33), 1000 seed weight (39.32 gr), and grain yield (1.35 t/ha) were noted for 0 kg p₂o₅/ha, 20 kg p₂o₅/ha, 40 kg p₂o₅/ha, and 60 kg p₂o₅/ha. A straw yield of 2.17 t/ha and a 3.52 t/ha were obtained with a 60 kg p₂o₅/ha phosphorus treatment. biological yield. These findings suggest that, in similar agro-ecological zones, phosphorus fertilizer use should be improved to boost mung bean profitability and productivity

INTRODUCTION

One of the most significant legume crops is The Fabaceae family includes the mung bean (*Vigna radiata* L.). Around the world, it thrives in tropical and subtropical climates (Kumari, 2012). Widely grown for human consumption, mung beans may also be utilized as animal feed and green manure. Mung bean seeds typically include calcium, phosphorus, vitamins, minerals, 62.5% carbs, 1.4% fiber, and 26% protein. In tropical parts of the world, they take the role of the limited amount of animal protein in the human diet since they are simple to digest (Ali, 2012). This crop's short life cycle and capacity for biological nitrogen fixation, which meets the crop's nitrogen needs, are its most prevalent traits (Anjum., 2006; Khaleeq et al., 2023a). This crop's early maturity and quick development make it suitable for Because it may be planted as an intercrop and catch crop, it can enhance planting patterns. It may primarily be planted with cereals in crop rotation (Yagoob, 2014).

LITERATURE REVIEW

Additionally, it is a rich source of protein and contributes significantly to sustainable agriculture by utilizing biological nitrogen fixation to preserve soil fertility (Muhammad et al., 2004). It needs less water than summer crops since it is a crop with a shorter growing season. Its resilience to drought and harsh weather conditions might be advantageous for rain-fed regions (Anjum et al., 2006; Khaleeq et al., 2023b; Ahmadi et al., 2024). Phosphorus is known to have an impact on root development and establishment (Hossain et al., 2007; Khaleeq et al., 2024a). One of the three essential macronutrients that plants need from the soil is phosphorus.

It is a crucial part of substances that aid in ripening, blooming, root development, and growth (Khaleeq et al., 2023a). Applying N and P fertilizer speeds up the development of the roots, improving the flow of water and other nutrients to the plant's growth sections. This increases the photosynthetic surface, which leads to the accumulation of additional dry matter (Raboy et al., 2003 and Nazir et al., 2022). For small landholder farmers in poor nations, where considerable grain-legume production cannot be applied, inadequate soil nutrient status is a specific problem (Khaleeq et al., 2023e; Peter et al., 2003). Increasing cropping intensity and introducing high-yielding cultivars require heavy N and P fertilizer inputs. As demonstrated by Lack of phosphorus fertilizer is one of the main reasons lowering soil productivity, since it has been shown that applying the deficient macronutrient to the soil increases the production of a range of crops (Khan et al., 2004; Hemmat et al., 2023). However,, the application method affects how well soil phosphorus is fixed. Phosphorus broadcasting increases the ratio of fertilizer to soil contact. whereas the contact ratio between soil and phosphorus is decreased by band application Farkhari et al., Shah et al., 2006; Khaleeq et al., 2024b; 2023). Phosphorus is the second most crucial nutrient for plant growth and development, after nitrogen.

The remainder of the phosphorus in soil is inorganic and accessible to plants, but 95–99% of it is found in organic form. The early development of roots and shoots, stem elongation, cell division, and meristematic activity are the main functions of phosphorus in plants. Phosphorous fertilizer's primary disadvantage is that it quickly fixes in clays, which can result in significant deficiencies in plants and soils. Composting, a lower pH, and increased bacterial activity in the soil are some of the variables that might increase the amount of phosphorus available to plants (Anderson and Magdoff, 2005 and Sadiq et al., 2023). This study's objective is to improve mung bean output in Afghanistan's northeast climate by offering suggestions for sustainable phosphorus fertilization techniques.

METHODOLOGY

In order to assess the During the 2023 cropping season, In order to investigate how mung beans (*Vigna radiata*) respond to phosphorus fertilizer levels in the An agronomic research farm at Kunduz University conducted a field experiment on the northeast agro-ecology of Afghanistan. With three replications and four treatments – 100% Control, 20 kg p₂o₅/ha, 40 kg p₂o₅/ha, and 60 kg p₂o₅/ha, respectively – the experiment was set up using a Randomized Complete Block Design. The Watani genotype of mung beans was obtained from the agronomy department at Kunduz University. The trial location had low amounts of phosphate and nitrogen, and the net plot size was 12 m³. Before planting, all phosphorus fertilizer was administered at the base application level because the soil had a medium potash content and little organic matter. 20 and 40 days after planting, then 40 kg N/ha. The pH of the soil was 7.2, and the seeds were sown 3 cm deep, 30 cm apart in rows, and 10 cm away from one another. Five plants provided all growth data parameters, and the net plot area provided the yield components and yield date. After being sown, the plants were watered right away, twenty days later, and forty days later. Analysis of variance (ANOVA) was used to statistically analyze the yield metrics and growth stage data. The least significant difference was used to compare treatment averages at the 5% level of significance. method significance.

RESULTS AND DISCUSSION

According to According to the scientific investigation, growth metrics were significantly impacted by the quantities of phosphorus fertilizer, as table (1) illustrates. The plants with the maximum 60 Plants that had the maximum height (63.50 cm), branches/plant (12.40), leaf area index (2.10), and shortest days to maturity (76.50) were treated with kg P₂O₅ ha⁻¹. 40 kg P₂O₅ ha⁻¹ was used when administered, the Absolute Control treatment produced the lowest values for all growth indices, including plant height, branches/plant, and leaf area index... Dikr and Garkebo (2022) found that the maximum plant height and branches/plant were achieved by applying phosphorus at a rate of 60 kgp₂o₅/ha. According to Khaleeq et al. (2023b), the application of 60 p₂o₅ had the maximum pant height, branches/plant, and leaf area index when compared to other treatments. Seerat et al. (2023) found that the Black-eyed bean's growth

characteristics were most enhanced by an application of the maximum amount of phosphorus, 60 kg p₂o₅/ha.

Table 1. Effects the Impact of Phosphorus Levels on Mung Bean Plant Height, Branch Count, Leaf Area Index, and Number of Days Till Maturity

Treatments	Plant height (cm)	Branches /plant	Leave Area Index	Days to Maturity
Absolute Control	51.16c	8.20c	1.09c	82.83a
20 kg P ₂ O ₅ ha ⁻¹	52.83bc	9.00c	1.27bc	81.00b
40 kg P ₂ O ₅ ha ⁻¹	56.04b	10.60b	1.56b	79.66b
60 kg P ₂ O ₅ ha ⁻¹	63.50a	12.40a	2.10a	76.50c
SE m±	3.201	0.210	0.034	0.701
CD (P=0.05)	3.575	0.916	0.369	1.673

Phosphorus fertilizer levels had a notable effect on the mung bean yield components seen in figure (1). The plots with perfect control had the lowest The yield components are pod length (4.95 cm), seeds/pod (5.44), pods/plant (13.75), and 1000 seed weight (33.88 gr). The highest yield components in the 60 kg p₂o₅/ha phosphorus treatment were pod length (6.73 cm), seeds/pod (9.27), pods/plant (18.33), and 1000 seed weight (39.32 gr). Following these were phosphorus treatments of 40 kg p₂o₅/ha and 20 kg p₂o₅/ha, respectively. Using phosphorus fertilizer at the right dosage resulted in this improved yield component. Samim et al. (2023) observed that phosphorus administered at a rate of 60 kg p₂o₅/ha produced the highest numbers of seeds/pod, pod length, pods/plant, and 1000 seed weight of mung beans. Our results are in line with their findings. The highest mung bean yield component, pod length, and number of pods per pant were 60 kg p₂o₅/ha. Khaleeq et al. (2023d) state that 60 kg of p₂o₅ per hectare is the optimal amount to improve cotton crop growth and yield metrics.

The highest grain yield (1.35 t/ha), straw yield (2.17 t/ha), and biological yield (3.52 t/ha) were obtained with a phosphorus treatment of 60 kg p₂o₅/ha. This was followed by applications of 40 kg p₂o₅/ha and 20 kg p₂o₅/ha, respectively. Absolute control plots produced the lowest yields of grain (0.9 t/ha), straw (1.47 t/ha), and biological (2.37 t/ha) when compared to phosphorus-fertilized techniques. Phosphorus levels were shown to significantly affect biological, grain, and straw yields. Our findings were supported by Hanan et al.'s (2022) data, which showed the mung bean's grain output, straw yield, and biological yield after administering phosphorus at a rate of 60 p₂o₅/ha. These findings are in line with those of Khaleeq et al. (2023b), who said in 2024f that an application of 60 p₂o₅/ha produced the maximum grain and straw yields. When the proper quantity of phosphorus was applied, the common bean produced more grain, straw, and biological output; according to Khaleeq et al. (2023a), the highest amount of grain and straw produced was 60 kg p₂o₅/ha. The maximum pod length, 1000 seed weight, and pods/plant of phosphorus fertilizer applied at a rate of 60 kgp₂o₅/ha were determined by Khaleeq et al. (2023c).

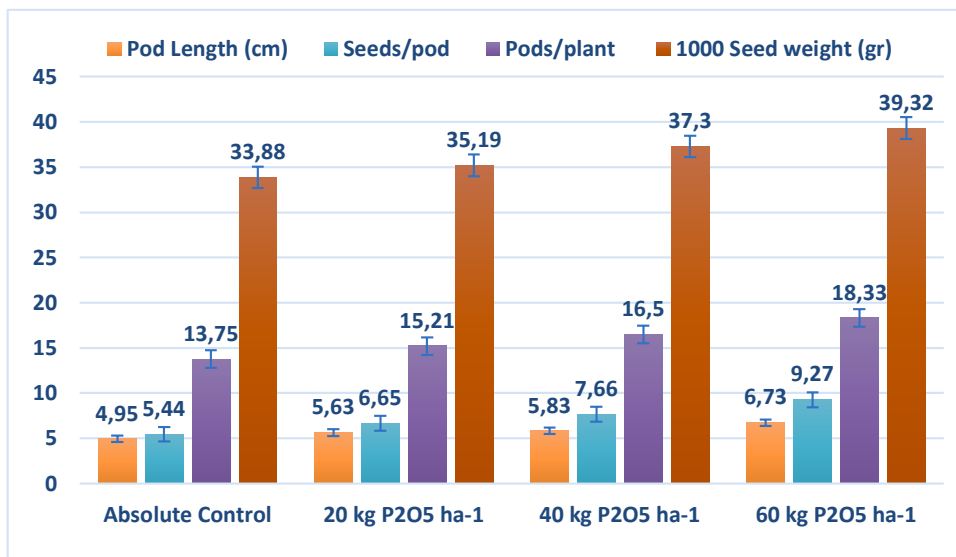


Figure 1. Phosphorus's Impact on 1000 Seed Weight, Pod Length, Seeds/Pod, and Pods/Plant

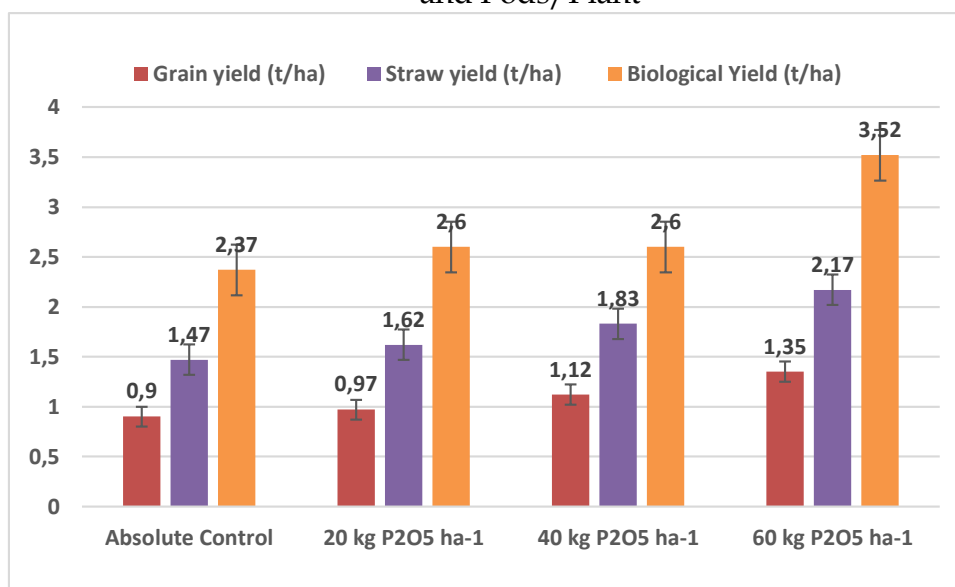


Figure 2. Impact of Phosphorus on Biological, Grain, and Straw Yields

CONCLUSIONS AND RECOMMENDATIONS

The study's findings show that mung bean production and growth in northeastern Afghanistan were greatly increased by using 60 kg of phosphorus fertilizer (p2o5) per hectare. When 60 kg p2o5/ha was applied, the growth metrics that displayed the greatest values were plant height, branches per plant, leaf area index, pod length, and yield-related characteristics such seeds per pod and pods. per plant, 1000 seed weight, grain yield, straw yield, and biological yield. According to these results, boosting the use of phosphorus fertilizer might be a workable plan to raise mung bean yields in this area. To confirm these findings and improve phosphorus management techniques for mung bean production in comparable agro-ecological zones, more investigation and field testing could be necessary.

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