

Effect of Organic and Inorganic Fertilizers on Yield and Yield Components of Common Bean (*Phaseolus vulgaris* L.) in Badakhshan, Afghanistan

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www.jrasb.com || Vol. 2 No. 2 (2023): April Issue

Received: 16-04-2023

Revised: 07-05-2023

Accepted: 17-05-2023

ABSTRACT

For a high and usable yield of common bean, key challenges include the high expense of inorganic fertilizers and their excessive usage. Concurrently, integrated crop management methods are worldwide needs for agriculture and the environment. Because of this, the present study was carried out at the Research Farm of the Agriculture faculty at Badakhshan University in Afghanistan in order to evaluate the effect of single and combination applications of NPK, chicken manure, and the combine of NPK and chicken manure (NPK + Ch. M) with different concentrations on the growth, yield, and yield components of common bean during the summer season (June to September) of the year 2022. A randomized complete block design (R.C.B.D) was used for the experiment, and there were three replicates of each factor. It was discovered that NPK (15:15:15) at 150 kg per ha produced the highest plant in terms of height (54 cm), number of leaves per plant (63), and branch count per plant (7). These findings were based on the data that were obtained. Also, it was discovered that the optimum performance of common bean with regard to 25gr pod number/plant (PNP) ha⁻¹ and 253g pod weight/plant was achieved with the combination of NPK (15:15:15) at a rate of 150 kg/ha and chicken manure at a rate of 20t/ha above control. This was shown to be superior to the performance of the control. A substantial (p 0.01) influence on grain production was found to be caused by the application of NPK + Ch. M. On the other hand, the NPK fertilizer and a combination of NPK and Ch. M fertilizer had a substantial impact on the grain production. The integrated of NPK + Ch. M fertilizer ha⁻¹ treatment produced the highest grain yield (4.97t/ha⁻¹), followed by Ch. M produced (4.22t/ha⁻¹) seed yield. The control treatment, in which no organic or inorganic fertilizer was applied, produced the lowest grain yield (2.83t/ha⁻¹), making this significantly higher than the control treatment. According to the findings of this study, an integrated application of NPK plus Ch. M is an effective way to get Phosphorus as well as other key elements that are necessary for the development and production of common bean.

Keywords- common bean, chicken manure, NPK fertilizer, yield, yield components.

I. INTRODUCTION

In Afghanistan, particularly in the provinces of Nangarhar, Badakhshan, and Bamyán, legumes play an important role as secondary crops. These include the common bean, grass pea, mung bean, chick pea, and garden pea. [8] Forage legumes are also grown in Afghanistan. Common bean, dry bean, French bean, and

green bean are all names that are often used to refer to *Phaseolus vulgaris* L. [15]. In 2002, the country of Afghanistan had a total planted area of 110,043 acres for its major crops and pulses. The common bean is the most important of the pulse crops that are cultivated in the lowlands and mid-altitudes in the central, southern, eastern, and western regions of Ethiopia. In addition to its usage by farmers as an easily accessible source of protein,

it is also a significant cash crop and export commodity that generates foreign money for the nation [19]. The majority of its cultivation and use takes place in underdeveloped nations in Asia, Africa, and Latin America.

Its output in sub-Saharan Africa is around 3.5 metric tons' ha⁻¹, with 62% of that production coming from East African nations such as Burundi, the Democratic Republic of the Congo, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda [9]. Apparently, [12] states that. The crop provides necessary nutrients as a meal including proteins, vitamins, and minerals, and the stems are also used as fodder for cattle, especially during the dry period that follows the main cropping season [6] [10] [18]. The crop provides essential nutrients as a diet including proteins, vitamins, and minerals.

According to the source [16]. Organic fertilizers are types of fertilizers that are derived from animal waste, vegetable matter (such as compost or manure), human feces or urine, or a combination of these three. Organic fertilizers are manufactured using natural immature material; this often refers to our biodegradable wet suit. Organic fertilizers may be used directly on plants. Compost is typically produced by the decomposition of various biodegradable wastes. These are the wastes, which consist of things like leaves, paper, leftover fruit layers, and even fruit liquids. The addition of organic fertilizers results in a beneficial excess for the soil. According to Assefa and Tadesse (2019), it renders the soil more amenable to planting and makes it easier to do so. The use of organic fertilizer is beneficial for a number of reasons: it may lessen the amount of pollution released into the environment, improve the condition of land in a way that is environmentally friendly, and boost agricultural production. The use of organic fertilizer has been shown to, over the course of several years, boost soil productivity and slow the rate of land deterioration [25]. Inorganic fertilizers are sometimes referred to in their shortened form as mineral fertilizers because of their heavy reliance on synthetic-organic or inorganic substances. Despite the fact that they are currently used in significant quantities by farmers, we often fail to do in-depth research on the three major nutrients, which are nitrogen (N), phosphorus (P), and potassium (K) [11].

The cultivation of bean on about 1,240 tons of land and 700 hectares of land in the province of Badakhshan this year led to an increase in output of common bean in the year 2020. The districts of Baharak, Kishm, Shohada, Warduj, Jurm, and Faizabad in Badakhshan province have the most amount of land dedicated to the production of beans. Farmers in this province are interested in cultivating beans for a number of reasons, the primary one being the high price of beans as well as the healthy local market. In the local market of Faizabad city, the price of 7 kilograms of beans is 800 Afghani. As a result of the price being mentioned, the farmer revenue was one million Afghanis. Because of the very high demand for common bean among the local

population, there is a significant quantity of bean that is imported from nearby provinces like as Takhar, Kunduz, Baghlan, Samangan, and Balkh [14]. This is because Badakhshan does not have a bean producing industry.

II. MATERIALS AND METHOD

This study was carried out during the summer months (June–September) of the year 2022 at the Research Farm of Agriculture faculty at Badakhshan University in Afghanistan. A randomized complete block design (R.C.B.D) was used for the experiment, and there were three replicates of each factor. The treatments consisted of applying chemical fertilizer NPK (15:15:15) at a rate of 150 kg per ha, applying chicken manure at a rate of 20t/ha, or serving as a control and without applying any fertilizer. The total land area was four square meters (two square meters each). The plots were kept at a distance of one meter from one another, and the holes were kept at a spacing of 0.6 meters apart. The seed bed had been well prepared by plowing and disking prior to the planting of the seeds. A chemical fertilizer known as NPK was administered in three doses, each separated by 15 days, and the first dosage was included in the sowing process. Chicken manure was spread on the land 15 days before planting. The sandy loam to loamy soil in the field has a pH of 8.5, and its type ranges from loamy to sandy. The climate of the experimental site had average temperatures from May until August during the spring, high temperatures from June until September during the summer, average temperatures from November until January, and the wettest month was March. Before beginning the harvesting process, ten guarded plants in each plot were tagged, and data on the plots' growth metrics were collected. Analysis of variance (ANOVA) and Fisher's least significant difference tests were used to analyze the differences between the treatments. Total yield was calculated by area, and then that number was converted into tons per hectare. Pods weight per plant was determined by harvesting pods from tagged plants and then using a digital balance. Pods and leaves number was determined by visual counting. Utilizing the DSAASTAT program allowed for the completion of the statistical analysis.

III. RESULT AND DISCUSSION

The growth responses of common bean were significant for Plant height (PH), Number of leaves plant (NLP), and Number of branch per plant (NBP) when organic and inorganic fertilizers were administered to the soil. All of the treatments had a significant impact on the plant's height, with a p value of less than 0.01 compared to the control. The greatest value was recorded by NPK, which was 54 cm, followed by the combination of NPK and chicken manure, which was 43 cm, and chicken dung, which was 34 cm, while the value recorded by the control was 26 cm. It was determined that there was a statistically significant difference between the two levels of NPK and chicken manure (Table 1, fig. 1). The slow release of

critical nutrients required by beans from NPK fertilizer and the availability of P and N elements from NPK manure over the growth phase may be able to be ascribed to the increased height of the plant. Both of these factors are important.

Our finding was confirmed by Baghdadi et al. [6], who found that using a combination of NPK and Ch.M. ha-1 resulted in the same plant height as when using 100% NPK. Saleem et al. [22] and Mitchell et al. [18] also found that using a combination of 50% poultry manure and 50% inorganic fertilizer resulted in the tallest corn plants in a corn-legume cropping system against the

control. In a similar manner, the administration of NPK in T1, which reacted well to NLP and NBP (63.00a and 7.00a respectively), was then followed by alone and unamended (control) treatments, which produced the lowest means (Table 1, Fig 1). It is congruent with the findings of Saha et al. [21], who discovered that the combined use of chicken manure and NPK produced better growth in maize crop compared to alone and incorporated use of NPK and other FYM. It is also congruent with the findings of Lima et al. [14], who reported that the utilization of organic improved the yield of crop, and soil properties were amended.

Table 1: Analysis of Variance (ANOVA) for the bean observed parameters: Plant height (PH), number of leaves plant⁻¹ (NLP), number of branch plant⁻¹ (NBP), number of seed plant⁻¹, pod weight (PW), Seed per pod (SPP), Hundred Seed Weight (HSW) and Grain Yield (GY)

Source of Variation	df	Mean Square							
		PH	NLP	NBP	NSP	PW	SPP	HSW	GY
Replication	2	65.44	150.75	1.45	748.22	2724.27	0.56	78.44	1.11
Treatments	3	425**	730.08**	5.75**	1258.8**8	2785.4**1	1.87**	146.2**	2.50**
Error	6	9.53	18.75	0.86	123.33	219.016	0.68	28.53	0.17
CV %		7.81	9.36	17.28	11.33	17.63	19.45	15.86	10.61

**Significant difference at 1%, *significant difference at 5%, CV: coefficient of variation, df: degrees of freedom

Table 2: Effect of organic and inorganic fertilizers on yield and yield components of Common Bean

Treatments	PH	NLP	NBP	NSP	PW	SPP	HSW	GY
NPK	54.00a	63a	7.00a	84.00b	253.00a	4.33ab	53.00ab	1675.67ab
Ch.M.	34.33c	43b	4.15b	102.67ab	157.67b	4.50ab	46.67bc	1426.33bc
NPK+ Ch. M	43.33b	52b	6.10ab	125.00a	230.67a	5.00a	60.33a	2359.67a
Control	26.33d	26c	4.33b	80.33c	133.67b	3.13b	45.67bc	1080.67c
LSD	9.31**	8.64**	2.11**	33.61**	44.81**	2.44 **	16.17**	1.22**

**Significant difference at 1%, *significant difference at 5%, LSD: least Significant Difference, Plant height (PH), number of leaves plant⁻¹ (NLP), number of branch plant⁻¹ (NBP), number of seed plant⁻¹, pod weight (PW), Seed per pod (SPP), Hundred Seed Weight (HSW) and Grain Yield (GY)

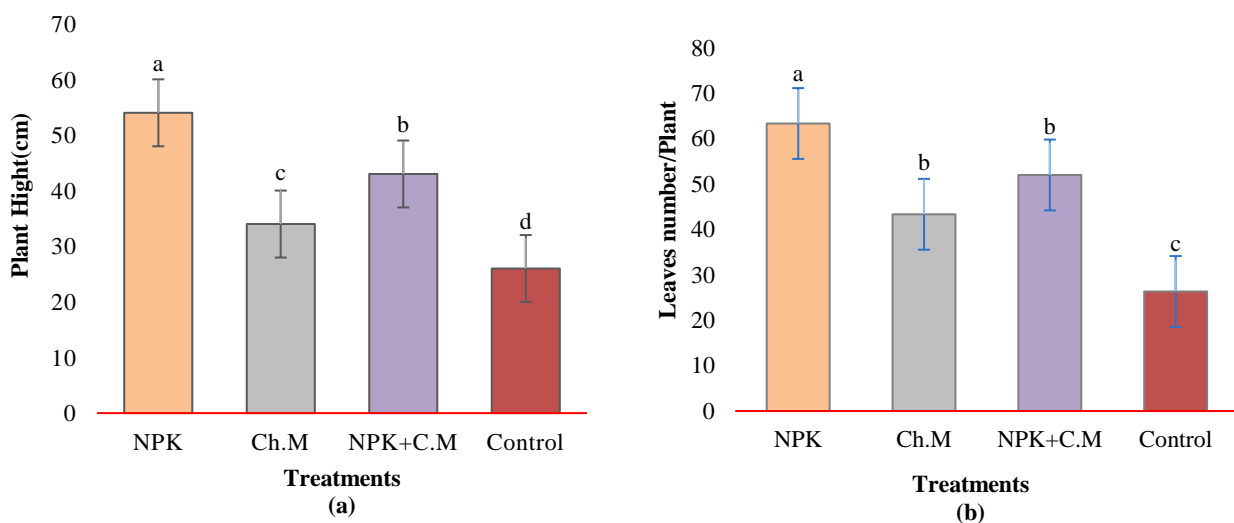
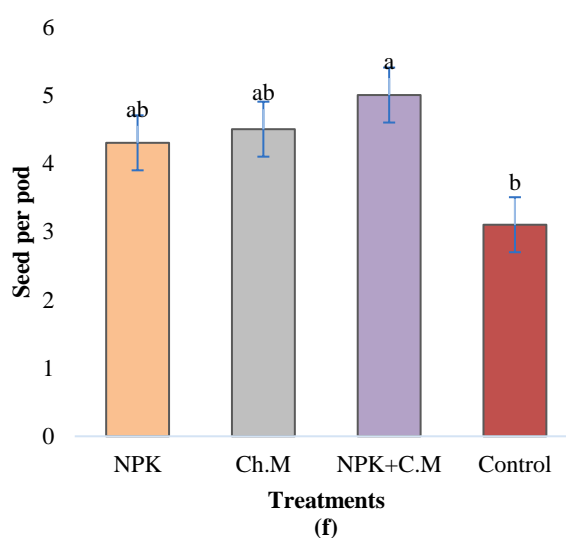
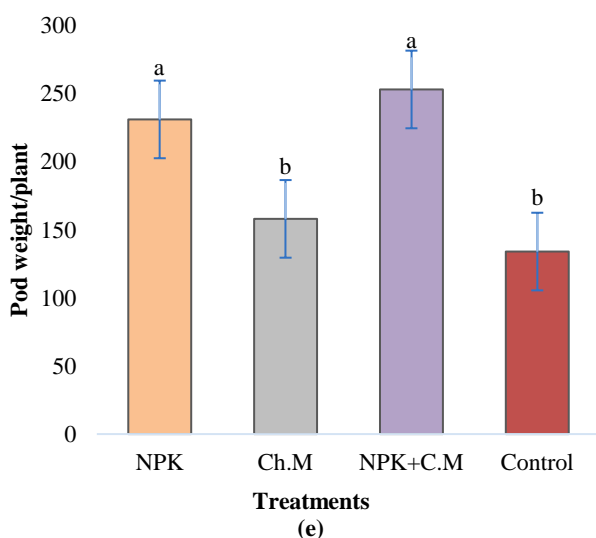
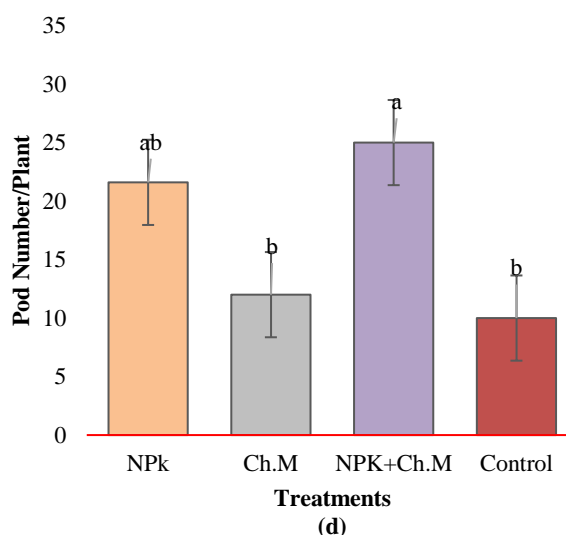
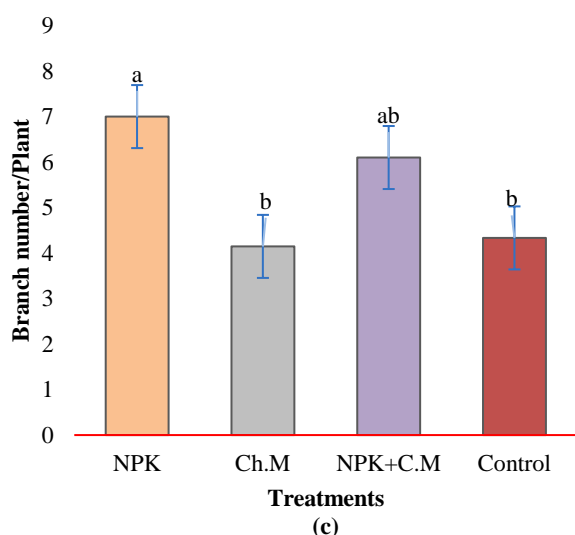


Figure 1: Effect of organic and inorganic fertilizer on (a) Plant height and (b) leaves per plant

IV. COMMON BEAN YIELD AND YIELD COMPONENTS

NSP, PWP, SPP, and HSW and GY are the yield components of common bean that play key roles in the yield crop. Other yield components include GY. In this study, the values for these characteristics were considerably higher on T3 (125.00a, 230.67a, 5.00, 60.33a, and 4.97a respectively), but the values for these characteristics were significantly lower on T4 (control) (80.33bc, 133.67b, 3.13b, 45.67bc, and 2.63c respectively), as shown in Table 2 and Figure 2 (c), (d), (e), (f), (g), (h). The data on GY of common bean also indicated significantly significant changes in outcomes brought about by combining the application of NPK and Ch. M with all other types of derived applications. The treatments that only contained one application each exhibited a change that was not significant when compared to the combined therapy, but both treatments

demonstrated significance when compared to the control (Table 1). On T2 and T3, respectively at 4.22ab and 4.97a, the Maximum GY was seen and recorded. While the control group had the lowest recorded value of GY (2.83c), as seen in Figure 2(h). The results of this study agree with the findings of Zafar et al. [29], Maman et al. [15], and Baghdadi et al. [6], who indicated that the composition application of inorganic and organic fertilizer provided superior yield and yield components compared to individual usage. The conclusions of this study have been acknowledged by those researchers. Timsina [26] has made the observation that a rise in the yield components may be associated with the release of critical macro and micro soil nutrients by the Ch. M. Similar reports were also created by Dorahy et al. [9], who reported significant increases in the maize yield biomass and other yield components with the application of Ch. M + NPK. On the other hand, Rahman et al. [20] reported that the foliar application of NPK resulted in a yield that was superior to NPK and Ch. M. in terms of yield.



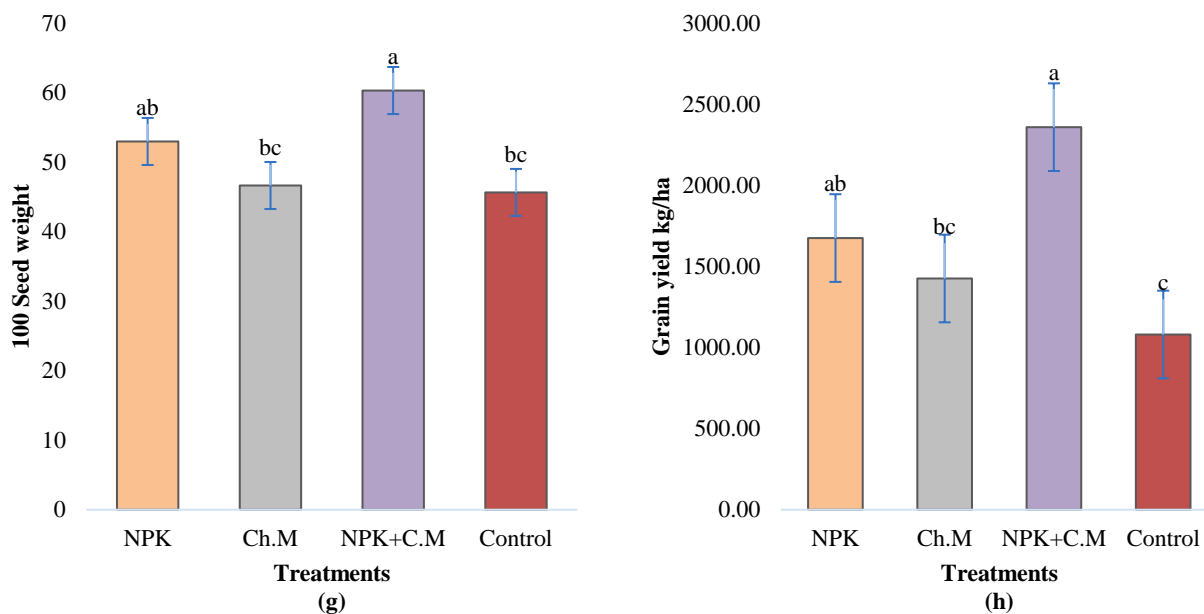


Figure 2: Effect of organic and inorganic fertilizer on (c) branch per plant, (d) pod number per plant, (e) pod weight per plant, (f) seed per pod, (g) 100 seed weight and (h) Grain yield kg/ha

The use of NPK fertilizer led to an increase in growth characteristics of common bean, and this result is consistent with earlier findings concerning the same crop [1]. When compared with the control, the findings of other studies indicated that organic fertilizer boosted growth characteristics in cluster bean first, followed by chemical fertilizer. The findings also demonstrated that the crop exhibited considerably enhanced growth characteristics as a consequence of the addition of chicken manure. Another research found that using chicken manure in conjunction with NPK resulted in an increase in the number of pods produced by each plant of common bean [19].

According to the findings of another research [25], compared to bio-fertilizers and control treatments, chemical fertilizers resulted in a greater number of common bean beans produced per pod and better overall yields per hectare. The use of an organic fertilizer (chicken manure) led to an increase in the common bean's total yield, pod weight, and pod dry weight [17]. A possible explanation for the positive reaction of common bean to the application of chicken manure is that the manure lowers the pH of the soil, which in turn makes nutrients like phosphorus more readily accessible to the plants. The increase in yield and yield component of the maize plant was attributed to the use of chicken manure in combination with NPK [2]. Another research found that the combination of cow dung and chemical fertilizer enhanced the yield of sweet maize as well as the yield component of the crop. All of the aforementioned results matched with our findings, which suggested that the productivity of common bean was raised by all of the treatments compared to the control.

V. CONCLUSION

It is possible to draw the following conclusion from the data of this research: the compound application of NPK and chicken manure demonstrated substantial impacts on the growth as well as the yield and the yield components of common bean. While the use of NPK and Ch. M alone had modest impacts on growth, yield, and yield characteristics, an integrated application of NPK and Ch. M generated a higher GY (2359.67kg/ha and 1675.67kg/ha, respectively) on T3 and T1, but the use of NPK and Ch. M alone had no effect. Therefore, nitrogen, phosphorus, and potassium fertilizers (NPK) may be administered with chicken dung to boost bean production. The study also provides further research on investigating the available sources of organic materials and their combined usage with inorganic fertilizer for the purpose of preserving the soil and sustaining the crop's production. This aspect of the research is included in the study.

ACKNOWLEDGEMENTS

We thank Engineer Najibullah Sharif, research farm manager and his staff of Agriculture Faculty, Badakhshan University, for supporting this research in the field.

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