Pak. J. Bot., 42(3): 1535-1541, 2010.

ASSESSMENT OF WHEAT YIELD POTENTIAL AFTER CROPPING MUNGBEAN (*VIGNA RADIATA* (L.) WILCZEK)

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Abstract

The present work was aimed to investigate the impact of legume on the oncoming wheat crop. Mungbean (NM92) was planted during Kharif 2007. The wheat variety Inqalab-91 was sown before and after the mungbean plantation during Rabi 2006-07 and 2007-08. Twelve different treatments were applied having different doses of N and P but Farm Yard Manure (FYM) remained constant. Six parameters were selected to investigate the potential effects of the legume viz., soil physico-chemical properties, plant height, spike length, number of grains/spike, 1000 grains weight and yield/plot. The results showed significant increase in plant height, spike length, number of grains/spike, 1000 grains weight and yield/plot after cropping mungbean. The yield was obtained at an increase of 26.90% after mungbean application. Based on results, cereal legume crop rotation is highly recommended.

Introduction

Wheat covers more of the earth's surface than any other cereal crop. It is a major food for the people of Pakistan sharing 13.7% to the value added in agriculture and 3% to GDP. The country is the 10th largest wheat producing country, contributing about 2% of global wheat supply. It was cultivated over an area of 8303 thousand hectares (Anon., 2005).

Crop rotation has been utilized as a helpful management practice for centuries. Mungbean is grown mostly in rotation with cereals such as wheat and rice and is principally cultivated for human consumption for its edible seeds having high protein content. Although mungbean can be grown in a variety of cropping systems but wheat-mungbean-wheat was the dominant cropping rotation in Pakistan (Ali *et al*., 1997). Besides its application in increase of soil fertility, its straw is used as livestock feed (Agboola & Fayemi, 1972). However, mungbean requires low inputs but it restores soil fertility through symbiotic nitrogen fixation (Firth *et al*., 1973). Imai (1991) calculated the pH in soybean-mungbean based rotation systems for 10 years. They observed that rotation induced pH changes up to one unit. Similar results were obtained by Powell & Ikpe (1992). They also reported that a neutral soil dissolved the maximum phosphorus from iron and aluminium complexes. Alvey *et al*., (2001) stated that enhanced cereal yields following legumes have been attributed to chemical and biological aspects such as higher levels of mineral nitrogen and *Arbuscular mycorrhizae*. Many crop rotation studies have focused on rotation-induced differences in the availability of N (Pierce & Rice, 1988).

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Sharma *et al*., (1996) reported that without N application the grain yield of wheat following mungbean and uridbean (without residue incorporation) was 0.45 and 0.48 t ha^{-1} more than the yield of wheat following sorghum fodder. They further stated that yields were equivalent to that predicted when 36 and 38 kg urea-N ha^{-1}, respectively, was directly applied to wheat. Keeping in view, the present study has been carried out to evaluate the growth on cereal-legume rotations and to quantify increase of soil productivity and fertility.

Materials and Methods

Experiments were conducted at the Research Farm Kurti, Kotli AJK, to investigate the residual effect of cereal legume crop rotation on the following wheat crop and its yield under wheat-mungbean-wheat rotational experiments. Fine seed beds were prepared before sowing and plant-plant distance was kept at 10cm and row-row distance was 30cm. Mungbean was planted during the season Kharif 2007 at the farm and the total number of the plots used were 39 at the size of 140x60 feet. The seeds of wheat (Inqilab-91) and mungbean (NM92) were procured from NARC, Islamabad. Wheat seed were sown @ 150 kg/hec before and after the mungbean plantation during Rabi 2006-07 and 2007-08. Soil physico-chemical properties viz., saturation %age, pH, Organic matter, nitrogen %age and phosphorous (ppm) were checked for soil fertility and the nutrient status of soil before and after mungbean crop. Yield parameters like plant height (cm), spike length (cm), number of grains/spike, 1000 grains weight (mg) and yield/plot (kg) were selected to investigate the potential effects of the legume on yields. The parameters were examined at Soil and Water Testing Laboratory, Kurti Kotli. Twelve different treatments were applied with three replications which kept constant in both before and after mungbean cropping. Application of Nitrogen (N) and Phosphorus (P) fertilizers were given at different doses in all plots but FYM remained constant throughout the study. In the three plots of control, no FYM was given (all treatments were triplicated). Different N and P ratios are shown in Table 1. The plots were arranged according to randomized complete block design with three replications. The wheat crop was harvested at maturity and data regarding yield parameters were recorded. All the six parameters analyzed statistically in MSTATC program. The data was checked at 5% degree of freedom.

Results

There were significant differences before and after mungbean cropping in physico-chemical properties and wheat yield parameters. There was an increase of 8.723%, 31.877%, 21.895%, 3.825% and 21.240% in plant height (cm), spike length (cm), number of grains/spike, 1000 grains weight (mg) and yield/plot (kg) respectively.

Soil physico-chemical properties: It was found that organic matter, nitrogen %age and phosphorous (ppm) increased significantly with the application of mungbean, while saturation %age, pH and potassium (ppm) were decreased. The interaction between the treatments and soil properties is highly significant with the *P* value 0.0073 with 23.36% coefficient of variation (Table 2).

Plant height (cm): Lowest plant height was seen in T0 (69.6) and highest in T6 (74.40) before cropping mungbean while lowest (74.66) was seen in T1 and highest (82.0) was exhibited by T10 after cropping mungbean. Statistically very highly significant difference was seen before and after cropping mungbean in plant height (*P* value 0.00). On the other hand, no significant interaction was found in treatments of before and after cropping mungbean with the 0.3489 *P* value and 4.73% coefficient of variation. The coefficient of variation was 4.73% (Fig. 1).

Table 1. Treatment showing various levels of fertilizers/plot.

Treat. #.	Treatments	Treat. #.	Treatments
T_0	Control	T7	N 80 kg/hec+P 40 kg/hec
T1	N 40 kg/hec+P 40 kg/hec	T8	N 80 kg/hec+P 50 kg/hec
T2	N 40 kg/hec+P 50 kg/hec	T9	N 80 kg/hec+P 60 kg/hec
T3	N 40 kg/hec+P 60 kg/hec	T10	N 100 kg/hec+P 40 kg/hec
T4	N 60 kg/hec+P 40 kg/hec	T11	N 100 kg/hec+P 50 kg/hec
T5	N 50 kg/hec+P 40 kg/hec	T12	N 100 kg/hec+P 60 kg/hec
T6	N 60 kg/hec+P 60 kg/hec		

Table 2. Nutrients status of soil before and after mungbean crop.

Nutrients	Before mungbean	After mungbean
Saturation %	42.66	36
pH	6.95	6.31
Organic matter %	0.657	0.773
Nitrogen %	0.575	0.713
Phosphorus (ppm)	6.9	7.667
Potassium (ppm)	92	70

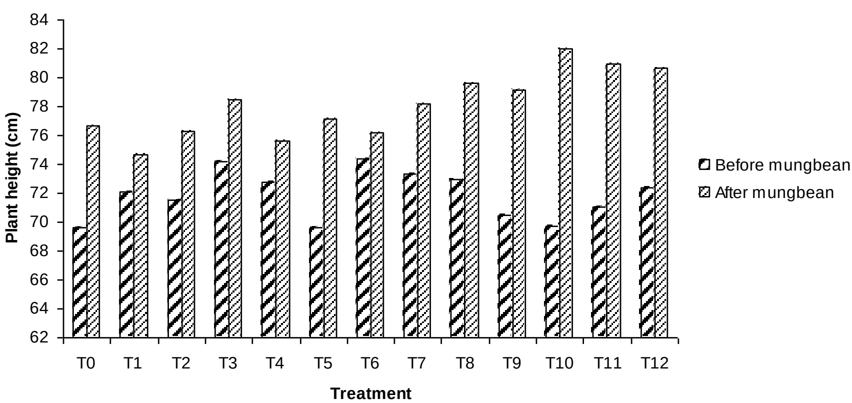

Fig. 1. Comparison of plant height (cm) of wheat planted before and after mungbean crop with different fertilizer treatment.

Spike length (cm): The lowest spike length was observed in T1 (6.40) and highest in T8 (7.73) before cropping mungbean, while lowest (7.83) in T2 and highest (10.83) in T12 was observed after cropping mungbean. Highly significant results were obtained before and after mungbean cropping with a *P* value of 0.00, while replications were found significant (*P* value 0.0189). The coefficient of variation was 15.15% (Fig. 2).

Number of grains/spike: The least number of grains were recorded at T_0 (27.667) and highest number of grains were obtained at T9 (46.333) before mungbean cropping while least number of grains per spike (38.00) in T6 and highest (48.667) in T9 was seen after cropping mungbean. Before and after cropping mungbean showed highly significant results with the *P* value 0.00, while replications showed significant results. On the other hands, treatments showed non-significant results with a *P* value of 0.428. The coefficient of variation was 19.63% (Fig. 3).

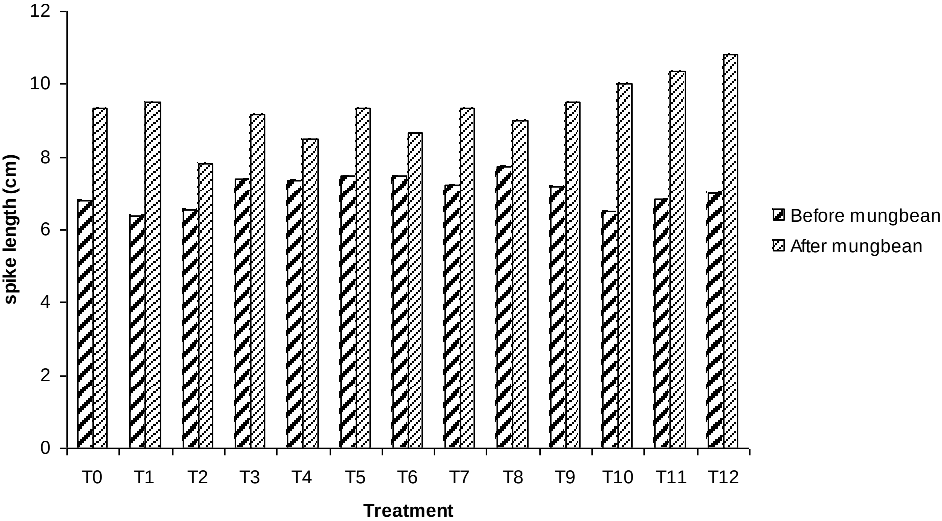

Fig. 2. Comparison of spike length (cm) of wheat planted before and after mungbean crop with different fertilizer treatments.

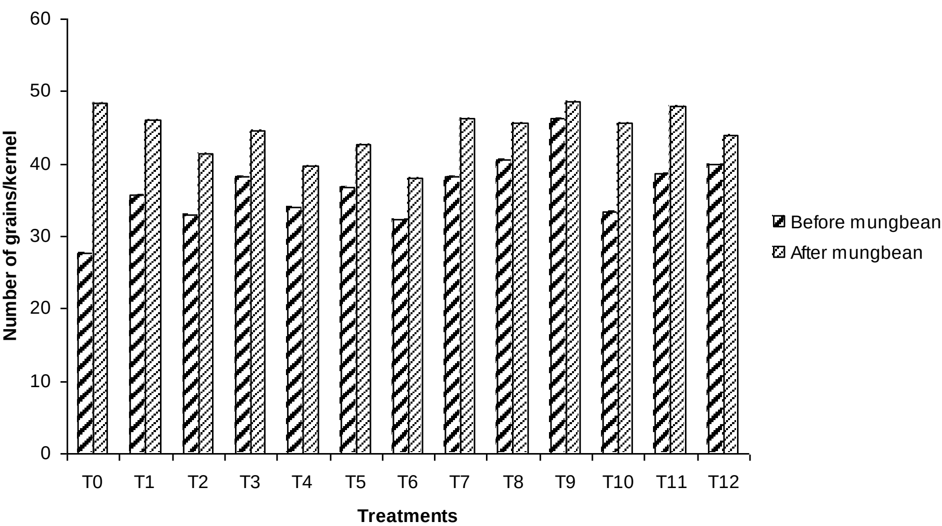

Fig. 3. Comparison of number of grains per spike of wheat planted before and after mungbean crop with different fertilizer treatments.

1000 grains weight (gm): The least 1000 grain weight was observed in T0 (63.367) and highest in T9 (70.333) before cropping mungbean, while least 1000 grain weight was noted in T3 (67.00) and highest in T11 (71.767). Results were highly significant before and after cropping mungbean with *P* value 0.0006, while treatments and replications showed non-significant results. The coefficient of variation was 4.53% (Fig. 4).

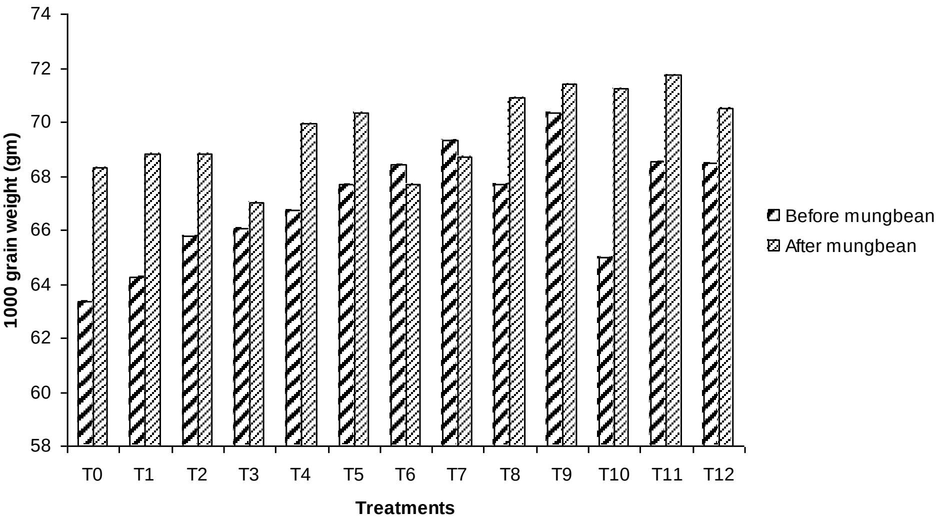

Fig. 4. Comparison of 1000 grain weight (gm) of wheat planted before and after mungbean crop with different fertilizer treatments.

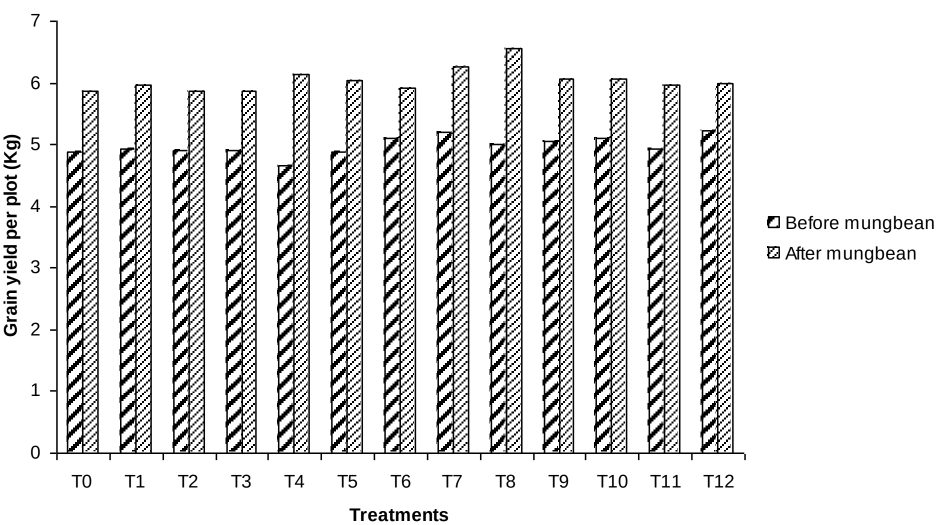

Fig. 5. Comparison of grain yield per plot (Kg) of wheat planted before and after mungbean crop with different fertilizer treatments.

Yield per plot (Kg): There was least yield obtained from T4 (4.667) and highest from T12 (5.223) before mungbean cropping, whereas least yield was acquired from T2 (5.863) and highest from T8 (6.550) after mungbean cropping. Highly significant results were seen before and after cropping mungbean with the 0.000 *P* value, but treatment showed non-significant results with a *P* value 0.272. The coefficient of variation was 5.12% (Fig. 5).

Discussion

In our experiment, a significant increase was seen in organic matter, nitrogen % age and phosphorous (ppm), while saturation % age, pH and potassium (ppm) were decreased. In a study conducted by Ali *et al*., (1997), 40% less nitrogen (N) was applied to wheat after mungbean and compared the application in the other two rotations. They stated that an application of farmyard manure to wheat following mungbean resulted in high yields compared with the no application of mungbean. This is with the agreement of the findings of Nawab *et al*., (2006).

Likewise, Alvey *et al*., (2001) conducted a study to examine the relative contribution of increased nitrogen (N) and phosphorus (P) availability to cereal/legume rotation effects. They noted that P uptake in cereals rotation was on average of 62.5-fold higher than in continuous cereals. This study provides strong evidence that cereal/legume rotations can enhance P nutrition of cereals through improved soil chemical P availability and microbiologically increased P uptake. The same rotational trials was done by Hayat & Ali (2004) to investigate the residual effect of summer legumes in wheat based cropping system showed that both legume rotation and fertilizer N improved the biomass and grain yield of following wheat crop. Khaliq *et al*., (2007) reported that mungbean-wheat-mungbean-wheat cropping system resulted in 113% of wheat grain yield following mungbean-wheat cropping system. It can be concluded that mungbean rotation increase the yield parameters and should be familiarized through Agriculture Extension Department amongst farmers.

Acknowledgement

The authors are thankful to the Department of Agriculture, Directorate of Research AJK for providing financial support for the piece of work. Thanks are due to NARC for providing seed samples.

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(Received for publication 21 December 2008)