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Agronomic Traits of Mungbean and Subsequent Rice Crop as Affected by Seed Inoculation and Different Fertilizer Level

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Abstract: Effect of seed inoculation and different fertilizer levels on the yield and yield components of mungbean and subsequent rice crop was studied. Results showed that seed inoculation and different fertilizer levels significantly affected yield and yield components of mungbean and rice crops. Treatment (T_6) exhibited superior performance for exploiting maximum potential of mungbean crop (954.8 kg ha^{-1} grains), which was 50% more than that of control. Whereas T_7 gave maximum residual effect (4075 kg ha^{-1} paddy yield), however statistically it was at par with T_3, T_4, T_5 and T_6. In conclusion, T_6 proved better for getting maximum mungbean yield while T_7 produced highest paddy yield.

Key words: Inoculation, NPK fertilizer, mungbean, rice, residual effect, yield, yield components

Introduction

Mungbean (*Vigna radiata* L.) and rice (*Oryza sativa* L.) are important crops of Pakistan. Former is popular for its nutritive value and digestibility. It is short duration, drought tolerant and fits well in our crop rotation program. In Pakistan annually 202.7 thousand hectares are put under its cultivation and 94.8 thousand tons of yields are achieved with an average of 468 kg ha^{-1}. Latter is the second largest staple food crop in Pakistan and is also a major export item. Rice is grown on 2515 thousand hectare with an estimated production of 5156 thousand tons, with an average of 2050 kg ha^{-1} (Anonymous, 2001). The average yield of both the crops is too low. A tangible approach to solve this problem may be the use of fertilizers along with beneficial microbes in agriculture.

Singh *et al.* (1993) reported that grain yield of mungbean was increased by the application of 20 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1}, whereas K_2O application has no significant effect. Bahlu *et al.* (1995) concluded that seed yield of *Vigna mungo was* increased by seed inoculation, seed yield was also increased when N was applied @ 20 kg ha^{-1}. Patra and Bhattacharyya (1997) observed that highest nodule numbers and seeds yield were obtained by treating the mungbean seeds with rhizobium and applied urea @ 25 kg ha^{-1}. Ali *et al.* (1998) reported that rice biomass was maximum for azolla (30 kg N + azolla, 7.2%) followed by bacterial treatment (30 kg N + bacteria, 7.0%) and minimum was with 60 kg N ha^{-1} (-2.3%). Provorov *et al.* (1998) observed in field trials that inoculation of mungbean seeds with brady rhizobium increased the herbage mass by 6%, seed mass by 3.6 %, mass of 1000-seeds by 0.8%, nitrogen content in seeds by 8.9%, starch content in seeds by 5.5% and number of nodules by 2.54%.

Ahmad (2000) found that PGPR increased paddy yield of two rice cultivars over control. Numbers of tiller hill^{-1} were significantly affected by all the PGPR inoculants. Straw yield was increased by all bacterial cultures in both cultivars. Kashem *et al.* (2000) observed that brady rhizobium inoculation and NPK fertilization increased the grain and straw yields of mungbean significantly and obtained the highest grains yield by the treatment 0-30-20 NPK kg ha^{-1} + inoculum. Shivesh *et al.* (2000) observed that seed inoculation + 20 kg P_2O_5 ha^{-1} to mungbean gave high growth, seed yield and dry matter accumulation. Van *et al.* (2000) reported that the inoculation had a significant effect on shoot weight (33 %), root weight (57 %) number of tiller hill^{-1} (13 %) and grain yield (22 %) over uninoculated control. Ashraf (2001) found that in mungbean number of pod plant^{-1}, no. of seeds pod^{-1} and 1000 grain weight were affected significantly by the application of 50 kg P_2O_5 with varying level of N from 20 to 50 kg ha^{-1} in addition to seed inoculation.

It was therefore, felt that there was an urgent need to determine the effect of seed inoculation and appropriate level of NPK for getting higher seed production of mungbean and subsequent rice crop under Farooqabad (Sheikhupura) conditions.

Materials and Methods

The present studies were carried out at the Agronomic Research Station Farooqabad, District Sheikhupura for two consecutive years (1999, 2000). Experiments were laid out in randomized complete block design with three

replications. After harvest of wheat, mungbean variety NM-92 was sown during the 1st fortnight of May and harvested during 2nd week of July. The mungbean seeds were inoculated with *Rhizobium phaseoli* just before drilling. The whole quantity of fertilizers was side dressed just after sowing. All other agronomic practices for mungbean crop were kept uniform for all the treatments. Subsequently after the harvest of mungbean crop, a fine rice variety Basmati-385 was transplanted during the 2nd week of July in the same plots and harvested during 2nd week of November keeping all other management practices uniform. The following treatments were used:

T_1 = No seed inoculation + No fertilizer (control)
T_2 = Seed inoculation alone + No fertilizer
T_3 = Seed inoculation+20-50-0 NPK kg ha^{-1}
T_4 = Seed inoculation+30-50-0 NPK kg ha^{-1}
T_5 = Seed inoculation+40-50-0 NPK kg ha^{-1}
T_6 = Seed inoculation+50-50-0 NPK kg ha^{-1}
T_7 = Seed inoculation+50-50-25 NPK kg ha^{-1}.

Observations regarding various agronomic characteristics of both the crops were recorded by using standard procedure. Data collected and analyzed statistically by using the analysis of variance technique and Duncan's new multiple range tests at 5% probability was applied to compare the treatment means (Steel and Torrie, 1984).

Results and Discussion

Mungbean

Number of pod $plant^{-1}$: Number of pod $plant^{-1}$ was significantly ($P<0.05$) affected by seed inoculation and fertilizer application. T_7 (seed inoculation + 50-50-25 kg NPK ha^{-1}) gave maximum number of pods $plant^{-1}$ (26.07) but was statistically at par with T_6 (25.03). While T_1 (no seed inoculation + no fertilizer) produced minimum number of pods $plant^{-1}$ (13.92) (Table 1). Results are in line with those obtained by Ashraf (2001).

Number of grain pod^{-1}: Seed inoculation and fertilizer application exhibited a positive effect towards number of grain pod^{-1} (Table 1). Maximum number of grain pod^{-1} was noted in plot treated with T_6, which was statistically at par with T_5 and T_7. Whereas minimum number of grains pod^{-1} were received in case of T_1. Ashraf (2001) also reported similar results.

1000-grains weight (g): Seed inoculation and NPK application significantly affected 1000-grains weight. Maximum 1000-grains weight was recorded in plots having T_6 (42.22 g) with minimum in case of plot applied T_1 (37.06). The heavier seed could be because of favorable soil environment and better fertilizer supply, which finally improve the grain weight. Provorov *et al.* (1998) also reported almost similar results.

Biological yield (kg ha^{-1}): Seed inoculation +50-50-0 kg NPK ha^{-1} (T_6) produced highest biomass (4668 kg ha^{-1}), which was (36%) higher than that of control. Provorov *et al.* (1998) and Kashem *et al.* (2000) are in agreement with these results.

Grain yield (kg ha^{-1}): Final grain yield is a function of cumulative effect of various yield parameters. Data reflects that seed inoculation and fertilizer application has a significant effect on grain yield $hectare^{-1}$. Maximum grain yield (954.8 kg ha^{-1}) was noted in plots applied with T_6, while the T_1 produced only 635.5 kg ha^{-1} grains. This increase in yield is due to the better N supply and growth promoting effect of inoculation. These results are in conformity with those of reported by Bahlu *et al.* (1995), Patra and Bhattacharyya (1997), Kasheem *et al.* (2000) and Ashraf (2001).

Rice

Number of tiller $hill^{-1}$: Seed inoculation and fertilizer application affected number of tiller $hill^{-1}$ significantly (Table 2). T_6 produced maximum number of tiller $hill^{-1}$, nevertheless it was statistically at par with T_3, T_4, T_5 and T_7. Whereas T_1 and T_2 produced minimum number of tiller $hill^{-1}$. The results are similar with those obtained by Ahmed (2000), who found that numbers of tiller $hill^{-1}$ were significantly affected by all the PGPR inoculants and Van *et al.* (2000), who stated that 13 % increase in number of tillers per hill than uninoculated control.

Number of grain $panicle^{-1}$: The data (Table 2) revealed that different treatments significantly affected number of grain $panicle^{-1}$. T_4 produced maximum number of grain $panicle^{-1}$ (75.17), while T_2 produced minimum number of grain $panicle^{-1}$ (65.67). Van *et al.* (2000) reported 13-22% increase in grains per panicle in rice by inoculation.

Biological yield (kg ha^{-1}): Data (Table 2) indicated that seed inoculation and fertilizer had a concrete effect towards biological yield. T_4 produced maximum biomass (17460 kg ha^{-1}), however statistically it was at par with T_3, T_5, T_6 and T_7. The results are in conformity with the results got by Ali *et al.* (1998).

Straw yield (kg ha^{-1}): Maximum straw yield was obtained from plot treated with T_4 (13390 kg ha^{-1}), however

Table 1: Various agronomic characteristics of mungbean as affected by seed inoculation and different fertilizer levels

Treatments	Number of pod plant^{-1}	Number of grain pod^{-1}	1000-grains weight (g)	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})
T_1	13.92d	7.907d	37.06f	3441e	635.5e
T_2	15.41cd	7.873d	38.84e	3877d	787.0d
T_3	17.10c	9.057c	39.92d	3961d	798.7cd
T_4	21.69b	9.903b	40.66c	4163c	844.0bc
T_5	22.69b	10.92a	40.09d	4220c	798.7cd
T_6	25.03a	11.33a	42.22a	4668a	954.8a
T_7	26.07a	11.02a	41.28b	4391b	871.7b
LSD (0.05)	1.963	0.5626	0.5569	151.7	51.54

Table 2: Various agronomic characteristics of rice as affected by seed inoculation and different fertilizer levels

Treatments	Number of tiller hill^{-1}	Number of grain panicle^{-1}	Biological yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Paddy yield (kg ha^{-1})
T_1	9.583b	68.17b	14640b	11120b	3516b
T_2	9.567b	65.67b	14340b	10970b	3368b
T_3	12.53a	74.67a	17110a	13110a	4000a
T_4	12.70a	75.17a	17460a	13390a	4047a
T_5	12.60a	69.17b	15560ab	11910b	3645ab
T_6	12.83a	66.33b	15570ab	11850b	3718ab
T_7	11.82a	64.83b	17360a	13280a	4075a
LSD (0.05)	1.323	4.236	2266	1115	424.7

Means followed by different letters differ significantly at 5% level of probability.

statistically it was at par with T_3 and T_7. T_2 produced the minimum straw yield (10970 kg ha^{-1}) (Table 2). Results are in line with those maintained by Ahmed (2000) who reported that straw yield of rice was increased by all bacterial cultures.

Paddy yield (kg ha^{-1}): T_7 (Seed inoculation+50-50-25 NPK kg ha^{-1}) produced maximum paddy yield kg ha^{-1} (4075); nevertheless, statistically it was at par with T_3, T_4, T_5 and T_6. This yield of T_7 was about 16% higher than that of control. This increase in yield is due to the residual effect of P_2O_5 and K and growth promoting effect of inoculation. Results rare in agreement with those obtained by Ali *et al.* (1998), Ahmed (2000) and Van *et al.* (2000).

In conclusion, T_6 (Seed inoculation+50-50-0 kg NPK ha^{-1}) exhibited superior performance for exploiting maximum potential of mungbean, while T_7 has better residual effect on rice crop as it produced 16% more paddy yield over control. Alone inoculation is not sufficient for getting higher yield of both crops and mungbean can be successfully grown between wheat and rice crop.

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