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Effect of *Rhizobium* Inoculation and Nitrogen Fertilizer on Yield and Yield Components of Mungbean

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ABSTRACT

Mungbean (*Vigna radiata* L.) is capable of fixing atmospheric nitrogen through *Rhizobium* species living in its root nodules. To evaluate the effect of inoculations and nitrogen levels on performance of mungbean, a pot experiment was conducted during spring 2004. Mungbean variety NM-98 was sown at 20 kg ha^{-1} in pots. Seed and soil inoculation, and nitrogen levels at 15, 30 and 45 kg ha^{-1} were applied. Data on recorded on number of pods per plant, number of seeds per plant, 100- seed weight and seed yield were recorded. Yield and yield components of mungbean crop were significantly affected by both inoculation and fertilizer application. Seed inoculation was more affective and gave better results than soil inoculation.

Key Words: Mungbean; *Vigna radiata* L.; *Rhizobium*; Yield components; Nitrogen levels

INTRODUCTION

Legume crops are not only used as human diet but also for improving soil fertility through biological nitrogen fixation. Among the grain legumes, mungbean (*Vigna radiata* L.), commonly known as green gram, is one of the important conventional pulse crop of Pakistan. It ranks second to chickpea (*Cicer arietinum*) amongst grain legumes from production point of view. Its seed is more palatable, nutritive, digestible and non-flatulent than other pulses grown in country. Its seeds contain 24.2%protein, 1.3% fat and 60.4% carbohydrates, calcium and phosphorous are measured as 118 mg and 340 mg per 100 g of seeds, respectively. It is rich in vitamin A. It is considered as a substitute of animal protein and forms a balanced diet when used with cereals (Consideine, 1992). It is a short duration crop therefore has less water requirement and can be grown twice in a year. Moreover, it is drought resistant crop that can withstand adverse environmental conditions, and hence successfully be grown in rainfed areas. The area sown under this crop in the year 2004-2005 was 245 thousand hectare with a production of 130 thousand tonnes (Govt. of Pakistan, 2005)

Mungbean is capable of fixing atmospheric nitrogen through *Rhizobium* species living in root nodules. However, under our agro-ecological conditions, the nodulation of mungbean is poor and is a major cause of its lower yield. Inoculation of mungbean with *Rhizobium* increased plant height, leaf area, photosynthetic rate and dry matter production (Thakur & Panwar, 1995). Brar and Lal (1991) found an increase in number of nodules $plant^{-1}$ and seed yield with inoculation of *Rhizobium*. They obtained seed yield of mungbean, 0.76 t ha^{-1} without inoculation to 0.81 t ha^{-1} with *Rhizobium phaseolina* inoculation. Tripathi *et al*. (1994) obtained the seed yield of mungbean with *Rhizobium* inoculation similar to that of 20 kg N ha^{-1}.

The present studies were conducted to evaluate the beneficial effect of soil and seed inoculation alone and in combination with different nitrogen levels on yield and yield components of mungbean crop and to compare the affectivity of seed inoculation against soil inoculation for mungbean production.

MATERIALS AND METHODS

For evaluating the response of mungbean to soil and seed inoculation and use of N-fertilizer, a pot experiment was conducted at University of Arid Agriculture; Rawalpindi. The plants were sown by using ten seeds per pot during spring of year 2004 and 6kg soil was added in each the pot. The experiment was laid out in completely randomized design with three replications. Phosphorous was applied 40 g pot^{-1} in (60 kg P/ha) the form of single super phosphate to the plants. Three levels of nitrogen at 10, 20 and 30 g per pot (15, 30 and 45 kg N/ha) were applied in the form of urea. Both the fertilizers were applied at the time of sowing. Seed and soil inoculation methods were compared. For seed inoculation, seeds were coated with paste of inoculum containing 10^7 per g and sown in the pots. For soil inoculation one L solution of *Rhizobial* inoculum containing 10^7 *Rhizobia* L^{-1} was added to the soil in each pot before sowing then seeds were sown in the inoculated pots. Five to six plants were kept in each pot. All agronomic practices were kept uniform and normal for all treatments. Mungbean genotype NM- 98 was used as a test crop. Twelve treatments as each seed and soil inoculation alone, nitrogen added to each of seed and soil inoculated plots at 15, 30 and 45 kg N ha^{-1}, and the same nitrogen rates were used alone. A control without inoculation and nitrogen application was included for comparison. Data on number

Table I. Effect of *Rhizobium* inoculation and nitrogen fertilizer on yield and yield components of mungbean.

Treatments	Number of pods per plant	Number of seed plant^{-1}	100- seed weight (g)	Seed yield per plant (g)
Control	15.33bc	95.66 I	3.93 f	3.83 c
Seed inoculation only	16.67bc	109.24 h	4.11 cd	4.55 ab
Soil inoculation only	17.00abc	140.59 cd	4.28 b	4.30 bc
Seed inoculation + 15 kg N ha^{-1}	20.67a	191.90 a	4.46 a	5.01 a
Seed inoculation + 30 kg N ha^{-1}	18.00ab	144.83 bc	4.05 de	4.05 bc
Seed inoculation + 45 kg N ha^{-1}	15.67bc	153.50 b c	4.19 bc	4.39 b
Soil inoculation + 15 kg N ha^{-1}	13.00c	136.98 cd	3.98 ef	4.35 bc
Soil inoculation + 30 kg N ha^{-1}	13.67c	131.96 de	4.01 def	4.15 bc
Soil inoculation + 45 kg N ha^{-1}	16.33bc	125.31 ef	3.97 ef	3.97 bc
15 kg N ha^{-1}	16.67bc	121.28 fg	4.31 b	4.30 bc
30 kg N ha^{-1}	14.33bc	111.50 gh	4.13 cd	4.60 ab
45 kg N ha^{-1}	14.00bc	93.66 i	4.07 de	4.06 bc
LSD (0.05)	3.59	10.21	0.11	0.55

of pods, seed yield, number of seeds per plant and 100-seed weight was recorded. Number of pods per plant was calculated by taking the pods of five selected plant at the time of crop maturity, then averaged. Grain yield was taken by weighing seeds of all plants in pot at harvest and seed yield per plant was computed. Five plants were selected from each pot, seed were counted and then average number of seeds per plant was determined. 100- seed weight, a sample of 100 seeds was taken from each pot then 100-seed weight was determined by weighing with the help of an electrical balance. The data was subjected to Fisher's analysis of variance techniques and least significant difference test at 5% probability level to compare the differences among the treatment means (James *et al.*, 1997).

RESULTS AND DISCUSSION

Seed inoculation +15 kg N ha^{-1} significantly increased number of pods per plant as compared to control, while all other treatments were at par (Table I). However, soil inoculation +15 and 30 kg N ha^{-1} produced significantly fewer number of pods per plant than control. Maximum number of pods per plant (20.67) was produced by seed inoculation +15 kg N ha^{-1} followed by treatment, seed inoculation +30 kg N ha^{-1}. Minimum numbers of 13 pods per plant were recorded with soil inoculation +15 kg N ha^{-1}. These results are in line with the finding of Patel and Parner (1991) who reported that number of pods per plant of mungbean was increased with the application of nitrogen fertilizer. Basu and Bandyapadhyay (1990) reported that inoculation and nitrogen fertilizer rates up to 30 kg ha^{-1} increased number of pods per plant of *vigna radiata*. Hoque and Haq (1994) reported that seed inoculation increased number of pods plant^{-1} the lentil. Rashid *et al.* (1999) reported that *Rhizobium* inoculation +20 kg N ha^{-1} increased pod yield significantly.

Number of seeds per plant (Table I) showed significant response to inoculation and fertilizer applications except 45 kg ha^{-1}. The maximum number of seeds per plant (191.90) was recorded for seed inoculation +15 kg N ha^{-1} and was followed by seed inoculation +45 kg N ha^{-1}. Hundred seed weight (Table I) was significantly affected by inoculation and fertilizer applications. Soil inoculation +30 and 45 kg N ha^{-1} failed to enhance 100-seed weight. Maximum 100-seed weight (4.46 g) was produced by seed inoculation +15 kg N ha^{-1}; whereas, it was 4.28 g with soil inoculation alone. Elsheikh and Elzidany (1997) reported that *Rhizobium* inoculation significantly increased 100-seed weight of faba bean. Chetti *et al*. (1995) studied the effect of nitrogen and *Rhizobium* inoculation on the productivity of groundnut genotype and reported that both nitrogen application and inoculation had significant positive effects on 100-seed weight.

Seed yield per plant (Table I) was significantly affected by *Rhizobium* inoculation and fertilizer applications. Seed inoculation alone, 30 kg N ha^{-1} and seed inoculation +15 kg N ha^{-1} significantly increased the seed yield as compared to control, however, there was no significant difference amongst. Maximum seed yield of 5.01 per plant was produced with seed inoculation +15 kg N ha^{-1} and was followed seed inoculation alone with seed yield of 4.55 g per plant. The lowest seed yield of 3.83 g per plant was produced in control. Chatterjee and Bhattacharjee (2002) reported that the percentage increase in grain yield over control was observed to be significantly higher in plants inoculated with Rhizobium strains and phosphate solubilizing bacteria. It is concluded that yield and yield components of mungbean crop were significantly increased due to inoculation and fertilizer applications. Overall seed inoculation was more effective and gave better results than soil inoculation.

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