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## Response of Inoculum and Fertilizers on Nodulation and Economic Yield of Soybean Cultivars

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**Abstract:** The experiment was conducted to study the response of improved soybean cultivars towards inoculum and NPK fertilizer. The different treatments produced non significant results except grain yield and 1000-seed weight which were highest where recommended dose of fertilizers along with inoculum was applied. Malakand-96 produced maximum number of nodules per plant, 1000 seed weight and grain yield  $\text{ha}^{-1}$  while Wahab-93 resulted in maximum number of seeds per plant. The interaction between cultivars and treatments was found non significant.

**Key words:** Soybean, inoculum, fertilizers, yield

### Introduction

It is an admitted fact that artificial seed inoculation of soybean in soils lacking effective rhizobia is a useful practice for improving nodulation on the roots and yield of the crop (Dubey, 1993). Increase in legumes seed yield, number of branches per plant and nodules number has been obtained by applying NPK fertilizer and inoculation of seed with rhizobium (Haque *et al.*, 1988). It has also been reported that application of fertilizer to soybean crop at the rate of 60 kg N and 120 kg P  $\text{ha}^{-1}$  gave the highest seed yield but had no effect on 1000-seed weight (Mishra *et al.*, 1994). Jain *et al.* (1988) concluded that seed yield, number of branches per plant and seeds per pod increased with increase in N application rate from 0-90 kg  $\text{ha}^{-1}$ .

The present investigation was undertaken to study the response of improved soybean cultivars towards inoculum and NPK fertilizer.

### Materials and Methods

A field experiment was carried out to study the nodulation and productivity of soybean cultivars as affected by fertilizers and inoculum at Agricultural Research Institute, Swat, during the year 1998. The soil was well prepared before sowing of the crop. Soybean varieties Webber, Wahab-93 and Malakand-96 were sown in RCB (Factorial) design with four replications. The plot size was kept 7.2  $\text{m}^2$  and there were 4 rows in each plot, 45 cm apart and 4 m long. The seed was treated with rhizobium inoculum and recommended dose of NPK fertilizer was used in various combinations with the inoculum (Table 1). All the recommended cultural practices were followed throughout the growing season. The crop was harvested after maturity and the following parameters were studied.

1. Nodules per plant
2. Number of seeds per pod
3. 1000-seed weight
4. Grain yield  $\text{ha}^{-1}$

The data obtained were statistically analysed using standard method of analysis (Steel and Torrie, 1980).

### Results and Discussion

**Number of nodules per plant:** Data pertaining to number of nodules  $\text{plant}^{-1}$  are presented in Table 2. No significant differences were recorded among the treatments, however, the cultivars showed significantly different results. Malakand-96 produced maximum number of nodules  $\text{plant}^{-1}$  followed by Wahab-93 with 17.12 nodules while Weber was the least

nodules producing variety having only 11.25 nodules  $\text{plant}^{-1}$ .

Table 1: Physico-chemical characteristics of soil

Textural Class	Silt loam
% organic matter	2.31
% N	0.115
% $\text{CaCO}_3$	1.00
$\text{P}_2\text{O}_5$ mg/kg	17.80
$\text{K}_2\text{O}$ mg/kg	180.00
pH	7.32

Seed inoculations did increase the number of nodules of soybean plants. Treatment having inoculum + fertilizers resulted in maximum nodules per plant i.e. 23.50 followed by the treatment getting only inoculum. The control treatment and where only fertilizer was applied, gave similar results each having 22.17 nodules per plant. The interaction between varieties and treatments was non-significant. Based on these results it appears that addition of inoculum along with basal dose of fertilizers could be an ideal fertilizer management technique for the soybean crop. Dubey (1993) reported that seed inoculation of soybean had higher nodules in rainy season which supports the present studies while Dou *et al.* (1989) proved that different cultivars showed different response to inoculum.

**Number of Seeds Per Pod:** Data in respect of number of seeds per pod as influenced by different varieties and treatments are presented in Table 2. It is clear from the data that the number of seeds per pod produced by all the three varieties are not significantly different among each other. However, the Table shows that maximum number of seeds per pod were produced by Wahab-93 followed by Weber while minimum number of seeds per pod were produced by Malakand-96. It is evident from the data that the effect of different treatments had a non-significant effect on the seed number. Inoculum alone produced maximum seeds per pod while minimum were recorded in control plots. The interaction between varieties and treatments was also found non-significant. The minimum number of seeds per pod in control treatment underlines the need for inclusion of inoculum in the fertilizers system in order to get maximum seeds per pod. Lamb *et al.* (1990) reported that applying inoculum along with fertilizers did increase the number of seeds per pod of soybean but not significantly. The results are also in close agreement to that of Mikanova and Kubat (1994).

**Qasim *et al.*: Soybean response to inoculum and fertilizers**

**Table 2: Number of nodules plant<sup>-1</sup> and seeds pod<sup>-1</sup> as affected by inoculum and fertilizers**

Treatment	Varieties						Mean	
	Weber		Wahab-93		Malakand-96		Nodules plant <sup>-1</sup>	Seeds pod <sup>-1</sup>
	Nodules	Seeds	Nodules	Seeds	Nodules	Seeds		
Control	11.7	2.5	16.7	2.6	35.0	2.4	21.2	2.5
Inoculum	11.7	2.7	18.7	2.7	38.0	2.4	22.8	2.6
Fertilizer	10.2	2.4	14.2	2.6	39.0	2.6	21.2	2.6
Inoc. + Fert.	11.7	2.7	18.7	2.6	40.0	2.4	23.5	2.6
Mean	11.2 c	2.6	17.1 b	2.7	38.0 a	2.5		

Means sharing different letters differs significantly at 5% probability level

**Table 3: 1000-grain weight and grain yield as affected by inoculum and fertilizers**

Treatment	Varieties						Mean	
	Weber		Wahab-93		Malakand-96		1000 grain wt.	grain yield
	grain wt.	grain yield	grain wt.	grain yield	grain wt.	grain yield		
Control	200.0	486.1	214.0	1278.0	209.2	1875.0	207.7b	1213.0a
Inoculum	200.6	416.7	211.0	1007.0	215.8	1285.0	209.1b	902.8b
Fertilizer	214.0	590.3	213.3	1285.0	220.9	1840.0	216.0a	1238.0a
Inoc. + Fert.	214.2	729.2	221.6	1285.0	223.4	1840.0	219.8a	1285.0a
Mean	207.2	555.6c	215.0	1214.0b	217.3	1710.0a		

Means sharing different letters differs significantly at 5% probability level

**1000 Grain Weight:** The most important character to effect the yield of a cultivar is grain weight because average yield ha<sup>-1</sup> depends upon this character. 1000 grain weight of soybean cultivars as effected by fertilizers and inoculum are presented in Table 3. It is obvious from the table that varieties differ non-significantly with regard to 1000 grain weight. Maximum weight was recorded in Malakand-96 followed by Wahab-93. The Table further indicated that different treatments had a significant effect on the 1000 grain weight. Maximum grain weight of 219.8 g was recorded in treatment receiving inoculum + fertilizers followed by fertilizer alone but the differences among these treatments were statistically non-significant. The interaction between varieties and treatments were also found non-significant. However, maximum 1000 grain weight was recorded in Malakand-96 with the application of inoculum + fertilizers as compared to all other interaction treatments. Our results suggest that application of inoculum along with recommended dose of fertilizers contributed much to increase the efficiency of all the major nutrients and thus led to the higher grain weight and confirm the findings of Mishra *et al.* (1994) who reported variations in 1000 grain weight by different cultivars with the application of different treatments.

**Grain yield:** It was observed that different treatments significantly effected grain yield of soybean. Adding the inoculum did not contribute much, however, seed inoculation along with the application of recommended dose of fertilizer significantly increased the yield of soybean which was statistically at par with the treatment getting fertilizer only. Statistically significant differences were also observed among the cultivars. Malakand-96 produced highest yield of 1710.0 kg ha<sup>-1</sup> followed by Wahab-93 and Weber. The interaction between treatments and cultivars was found statistically non-significant. However, highest grain yield of 1840.0 kg ha<sup>-1</sup> was produced by Malakand-96 with the application of fertilizers alone or in combination with inoculum. These results

support the hypothesis that application of inoculum could be more effective and beneficial in enhancing grain yield and agrees with the work of Haque *et al.* (1988) who observed that grain yield of soybean always increased with the application of fertilizer alone or when it was applied with inoculum. Jain *et al.* (1988) also produced similar results. It could be concluded from the present findings that use of inoculum along with recommended dose of NPK should be encouraged in order to get profitable yield of soybean under the prevailing agro-climatic conditions.

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