irrigated as and when required using sprinkler system.

Results and Discussion

Effect of Rhizobium

All the yield attributes of French bean were significantly affected with the seed inoculation with *Rhizobium* strains as compared to no inoculation during both years of study and on mean basis. Plant height, pod length, pods/plant and seeds/pod were significantly higher with the application of *Rhizobium* compared to the control treatment (Table 1). The difference among the *Rhizobium* strains was found to be non significant during both the years. Both *Rhizobium* strains were found to be effective when compared with the control in respect of all the yield attributes and plant height of French bean on the mean basis of two years.

Table 1. Effect of *Rhizobium* and nitrogen levels on the growth, yield attributes and yields of French bean

Treatments	Plant height (cm)			Pod length (cm)			Pods/plant			Seeds /Pod			Seed yield (kg/ha)		
Rhizobium Strains	2002	2003	Av.	2002	2003	Av.	2002	2003	Av.	2002	2003	Av.	2002	2003	Av.
Control	30.7	31.3	31.0	13.8	13.9	13.9	7.6	7.5	7.6	4.6	4.6	4.6	1750	2000	1875
F-HP-1	31.9	32.7	32.3	14.6	14.6	14.6	9.1	9.1	9.1	5.4	5.4	5.4	1930	2270	2100
F-HP -2	31.4	32.6	32.0	14.5	14.5	14.5	8.9	8.8	8.9	5.2	5.3	5.3	1920	2280	2100
CD (P=0.05)	0.5	0.5	-	0.2	0.2	-	0.3	0.3	-	0.2	0.2	-	74	60	-
N-Levels (kg/ha)															
20	30.4	31.3	30.9	13.6	13.6	13.6	7.4	7.3	7.4	4.4	4.5	4.5	1720	1980	1850
40	31.5	32.8	32.2	14.6	14.8	14.7	8.9	9.2	9.1	5.2	5.3	5.3	1910	2290	2100
60	32.1	32.5	32.3	14.8	14.7	14.8	9.1	9.0	9.1	5.5	5.6	5.6	1960	2280	2120
CD(P=0.05)	0.5	0.5	-	0.2	0.3	-	0.3	0.2	-	0.3	0.2	-	70	68	-

The seed yield was significantly higher with the application of *Rhizobium* compared to control treatment during both the years (Table 1). However, the differences between *Rhizobium* strains in respect of seed yields were not significant. Therefore, it was found out that *Rhizobium* has increased the yield to the tune of 12.0 per cent on the basis of mean of two years of study over the control.

The significant differences in the seed yields due to *Rhizobium* inoculation during both years have been manifested in getting higher gross returns, net returns and B:C ratio (Table 2). Similarly, net returns have increased from 13.6 per cent on the average basis with *Rhizobium* applications than control. B: C ratio was significantly higher (10.8%) with *Rhizobium* compared to no inoculation. Studies conducted by Asad *et al.* (2004) and Shamseldin *et al.* (2005) also observed the similar effects on the yield of French bean crop.

Table 2. Effect of *Rhizobium* and nitrogen levels on economics of French bean crop

Treatments	Gross returns (Rs. ha^{-1})			Net returns (Rs. ha^{-1})			B:C ratio		
Rhizobium Strains	2002	2003	Av.	2002	2003	Av.	2002	2003	Av.
Control	104933	122133	113533	80487	97687	89087	3.3	4.0	3.7
F-HP-1	115533	136067	125800	90905	111438	101172	3.7	4.5	4.1
F-HP -2	115267	136467	125867	90455	111655	101055	3.6	4.5	4.1
CD (P=0.05)	4463	7228	-	4463	7228	-	0.18	0.28	-
N-levels (Kg ha^{-1})									
20	103333	120533	111933	78732	95932	87332	3.2	3.9	3.6
40	114600	137133	125867	89957	112490	101224	3.6	4.5	4.1
60	117800	137000	127400	93157	112357	102757	3.8	4.6	4.2
CD (P=0.05)	4560	7029	-	4561	7540	-	0.2	0.3	-

Effect of nitrogen levels

Increasing doses of nitrogen from 20 to 60 kg ha^{-1} have significantly affected the yield contributing characters of French bean (Table 1). Plant height, pod length, pod/plant and seeds/pod were significantly higher in 40 kg N ha^{-1} than 20 kg N ha^{-1}, however, further increase from 40 to 60 kg N ha^{-1} had no significant effect on any of the contributing characters. Similar trend was observed during second year of study. Lemos *et*

al. (2003) investigated the effects of side dressed N fertilizer and inoculation with *Rhizobium* on development and yield of *Phaseolus vulgaris*. They observed that N application generally increased seed yield. Inoculation with *Rhizobium* strain CM 255 increased the yield of French bean.

Table 3.Interaction effects of *Rhizobium* X Nitrogen levels on seed yield of French bean

Rhizobium strains	Seed yield (kg ha^{-1})					
	N-levels (kg ha^{-1})					
	2002			2003		
	20	40	60	20	40	60
Control	1490	1850	1830	1610	2170	2150
F-HP-1	1820	1960	1950	2140	2350	2370
F-HP -2	1940	1970	1980	2260	2290	2300
CD (P=0.05)	(2002) = 129				(2003) =201	

The positive effect of nitrogen level of 40 kg ha^{-1} has been reflected in significant higher seed yields. The increase in the seed yields to the tune of 11.0% and 15.7% have been recorded with the application of 40 kg ha^{-1} over 20 kg N/ha. However, the differences in between 40 kg ha^{-1} and 60 kg ha^{-1}in respect of seed yields were non significant. This has showed that under dry temperate conditions French bean had responded up to 40 kg N ha^{-1}. Similar results have also been reported by Parmar *et al.* (1999).

Application of 40 kg N ha^{-1} resulted in an increase of Rs.13892 in net returns as compared to 20 kg N ha^{-1} on average basis of two years. B: C ratio was significantly higher with the application of 40 kg N/ha (4.1) as compared to 20 kg N ha^{-1}.

Interaction effects of Rhizobium and nitrogen levels

Combined effect of *Rhizobium* and nitrogen levels on seed yields of French bean showed that in the presence of *Rhizobium* (preferably strain F-HP-1) and with increase in the nitrogen level up to 40 kg N ha^{-1}has significantly increased the seed yield of French bean during both the years of study (Table 3). However, further increase in nitrogen up to 60 kg N ha^{-1} did not increase the seed yield significantly which remained at par with 40 kg N ha^{-1}. At lower N levels *Rhizobium* strain of F-HP-2 was superior to F-HP-1 during both the years, however, F-HP-1 was found to be better to F-HP-2 at 40 and 60 kg N ha^{-1}, respectively during second year of study.

Similarly, interaction effects of *Rhizobium* and nitrogen levels on net returns showed that combination of *Rhizobium* preferably strain F-HP-1 with 40 kg N/ha gave significantly higher net returns. Net returns were not significantly increased with further increase in nitrogen level up to 60 kgha^{-1}. Therefore, it may be concluded that French bean seed inoculation with *Rhizobium* along with 40 kg Nha^{-1} was found optimum for getting remunerative seed crop of french bean under high hills dry temperate conditions of H.P.

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