한작지(Korean J. Crop Sci.), 52(1): 100~103(2007)

Effect of Vermicompost in Combination with Bacterial and Mineral Fertilizers on the Yield of Vegetable Soybean

S. K Bajracharya†, D. P. Shercahn, and S. Bhattarai

Soil Science Division, Nepal Agricultural Research Council (NARC) Khumaltar Ward No 15, Lalitpur, Nepal

ABSTRACT A field experiment was conducted in Agronomy farm at an altitude of 1350 m. above sea level in a randomized complete block design with three replications and eight treatments on vegetable type soybean in 2005. The objective was to see the effect of vermicompost alone and in combination with Rhizobium inoculum and mineral fertilizers on the yield of vegetable soybean. The result showed higher number of nodules from the non inoculated plot, however, the nodules weight was highest from the inoculated plots. No significant difference was notice statistically on roots and shoots dry weight. Soybean grain was obtained highest (32.3%) over the non inoculated plot followed by vermicompost plus inoculated, however, there was non significant difference. There was a slight increment on grain and straw yield from the inoculated plots over the non inoculated.

Keywords : vermicompost, Rhizobium, mineral fertilizer, vegetable green soybean, nodulation

Vegetable soybean (*Glycine max*. L. Merr) is one of the most important legumes in Asia that contains high protein. Vegetable soybeans are the green soybean pods that are harvested at the mature green stage when the pods are almost filled. In Nepal it was introduced in 1994 from the Asian Vegetable Research and Development Center (AVRDC). Being its high yielding capacity with large size pod and attractive green seeds, disease resistant and suitable for vegetable purposes both tender seed as well as dry, vegetable soybeans are very popular in the Kathmandu valley (Upreti, 2003).

A number of field research works on chemical fertilizer have been done in Nepal but no work has been done on vegetable soybean to see the effect on the productivity through the application of Rhizobium inoculum (bacterial fertilizers) and vermicompost (Maskey and Bhattarai, 1995). Continuous application of chemical fertilizers has deteriorated soil physical properties, therefore, there is only one alternative option to improve the soil productivity through the use of organic manures and bacterial fertilizers. Bacterial fertilizer is a low cost technology and easily available for farmers. In addition, bacterial fertilizers and vermicompost are very cheap compared to chemical fertilizers which can be produced by farmers it self through using locally available waste materials. The traditional practice of production of compost and organic manures is time consuming but earthworms (*Eisenia foetida*) converts organic farm waste and household waste into good compost at a faster rate. Vermicomposts are rich in plant nutrient compared to the traditional compost (Bhattarai, 2003). Considering all these points in view the present study was undertaken to find out the effect of Rhizobium inoculum, vermicompost and mineral fertilizer alone or in combination on nodulation and grain yield of vegetable soybean.

MATERIALS AND METHODS

A field experiment was carried out during summer rainy season of 2005 at the Khumaltar agronomy farm situated at an altitude of 1350 m amsl. Soil was treated with 5% Malathion at the rate of 20 kg/ha to control cutworms. Vermicompost prepared from farm wastes was applied at the rate 10 t/ha. Rhizobium inoculum in the form of powdered peat was used at rate of 800 g/ha. Huaichin variety of green soybean was used for this experiment Plot size was 3 m × 2 m (6 m^2). Plant to plant distance was

†Corresponding author: (E-mail) sk_bajracharya@hotmail.com
<Received June 11, 2006>

kept 15 cm. Row to row distance was 50 cm. The mineral fertilizer at a rate of 60 : 40 : 30 kg N : P_2O_5 : K_2O/ha was applied as a basal dose before seeding according to the treatments designed. A randomized complete block design (RCBD) with eight treatments and three replications were used. The treatment details are given in Table 1.

Two plants at preflowering stage from each plot were sampled for nodulation count and other agronomic characters (other growth parameters) study. The rests of plants were harvested after 90 days of seeding to measure the seed yield.

Statistical analysis using a general linear model was used to compare the treatments effect on the grain, straw yields and agronomic parameters. The statistical package was Minitab Release 12. Summary of important parameters an yields and statistical results are given in the annex 1.

RESULTS AND DISCUSSION

Number of nodules per plant was counted highest in number with the control plot that indicated the native Rhizobium strain was quite competent to the local soil environment compared to the plot inoculated with new strain. The lower count of nodules with the inoculated plot revealed competition between the local indigenous and new strain. Statistically number of nodules between the plot treated with the vermicompost and chemical fertilizers alone or in combination was higher than the inoculated

Table 1. Treatment.

Symbol	Treatment	Description of treatment
Ct	Control	No compost and chemical fertilizers
RI	Rhizobium inoculum	Equivalent to 800 g/ha
CF	Chemical fertilizers	Equivalent to 60 : 40 : 30 kg N : P_2O_5 : K_2O/ha
RICF	Rhizobium inoculum + Chemical fertilizers	Equivalent to 800 g/ha + 60 : 40 : 30 kg N : P_2O_5 : K_2O/ha
VC	Vermicompost	Equivalent to 10 t/ha
VCRI	Vermicompost + Rhizobium	Equivalent to 10 t/ha + 800 g/ha
CFVC	Chemical fertilizer + vermicompost	Equivalent to 60 : 40 : 30 kg N : P_2O_5 : K_2O/ha + 10 t/ha
RICFVC	Rhiz. + Chemical fertilizers + Vermicompost	Equivalent to 800 g/ha + 60 : 40 : 30 kg N : P_2O_5 : K_2O/ha + 10 t/ha

Annex 1. Effect of different treatments on grain, straw yield, agronomic characters and other properties (mean of three replications).

Symbol	Treatment Descriptionl	Grain yield (kg/ha)	Straw yield (kg/ha)	Number of nodules per plant	Root dry weight (g/plant)	Shoot dry weight (g/plant)	Nodules dry weight (g/plant)
Ct	Control	569.33	2153	249	2.43	11.23	0.42
RI	Rhizobium (800 g/ha)	611.0	2486	85.7	3.765	13.09	0.96
CF	NPK (60 : 40 : 30 kg/ha)	500.0	2597	63.3	3.275	12.98	0.45
RICF	Rhizobium + NPK	666.7	2347	45.3	2.857	12.16	0.23
VC	Vermicompost	753.0	3383	145.3	2.65	12.3	0.557
VCRI	Vermicompost + Rhizobium	698.0	3375	38.7	3.42	11.64	0.287
CFVC	NPK + Vermi compost	617.0	3025	135	3.64	13.38	0.510
RICFVC	Rhizobium + NPK + Vermicompost	667.0	3305	112	3.17	17.11	0.87
	F test	Ns	Ns	*	Ns	Ns	Ns
	Probability	0.469	0.569	0.039	0.5718	0.379	0.09
	Sed	111.2	643.25	56.53	0.6174	2.3794	0.2425
	CV%	21.4	27.7	63.3	23.5	22.5	55

Note: Ns = non significan , * = significant at p=0.05, Sed = Stadndard error of difference

with the new rhizobium strain (Fig. 1). Number of viable nodules was at par from vermicompost and vermicompost plus chemical fertilizers treated plots. Though there was no significant difference at 5% level, however, there was an indication that the plot inoculated with the new strain showed heavier weight per plant because of bigger and viable nodules. Efficiency of the of Rhizobium was not noticed when inoculated along with vermicompost and chemical fertilizers (Fig. 2).

Statistically a non significant different between the treatment on roots dry weight was found at 5% level of probability (Fig. 3). The same result was also found on shoot dry weight. However, there was a strong indication that heaviest weight of dry shoot was found when Rhizobium inoculums plus chemical fertilizers (NPK) and vermicompost was applied (Fig. 4).

Grain and Straw yield

There was non significant difference between the treatments on grain and straw yields. However, the plot treated with the vermicompost alone gave highest (32.3%) yield than the rest of the treatments (Figs. 5 and 6.) followed by vermicompost plus inoculated plot. Both the indigenous and inoculated plots gave same grain yield. There was no yield advantage from the new rhizobium inoculum on grain yield.

Straw yield was found not being affected by different treatments statistically at 5% level of probability. However, plots treated with vermicompost, vermicompost plus rhizobium inoculated, and combination of chemical fertilizers and vermicompost showed higher weight compared to the control, inoculated and sole chemical fertilizers treated plots (Fig. 6).

Soybean crop is very much sensitive to environment. The lower productivity would be due to unable to plant on right time. The national productivity of soybean varies from 640 to 1068 kg/ha, however, the productivity is higher in the terai region. Soybean crop is not a new crop where the experiment was conducted. As a result the native or inherent soil Rhizobium could be quite competent to fix the atmospheric nitrogen since the number of nodules is quite high. Lodging was noticed though it was not very serious. Chemical fertilizers mainly nitrogen applied at a rate 60 kg/ha and vermicompost 10 t/ha might would

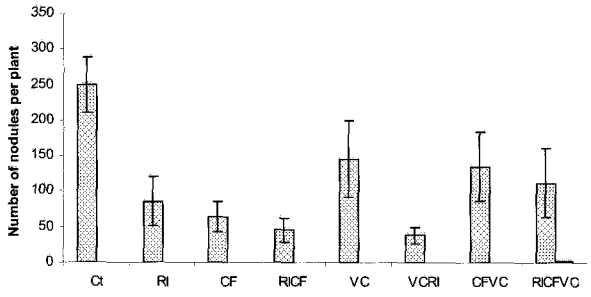

Fig. 1. Number of nodules per plant.

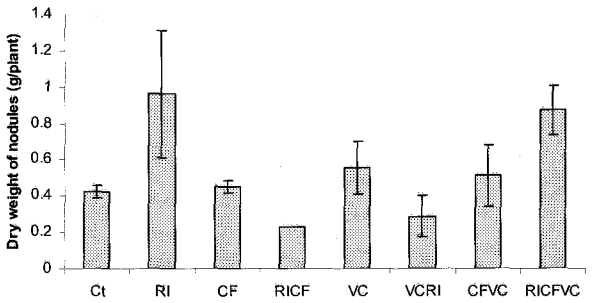

Fig. 2. Dry weight of nodules per plant.

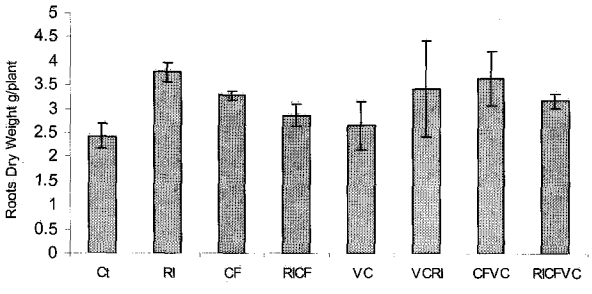

Fig. 3. Roots dry weight (g/plant).

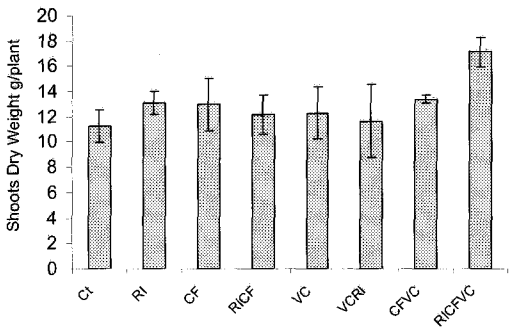

Fig. 4. Shoots drt weight (g/plant).

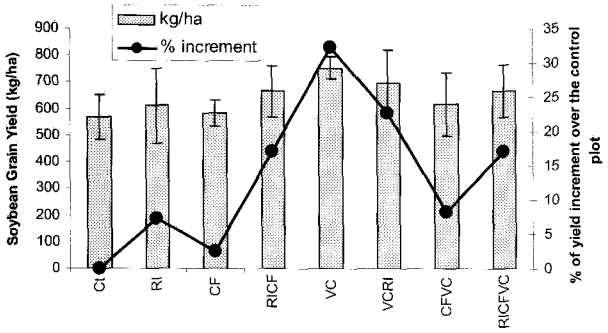

Fig. 5. Grain yield of vegetable soybean.

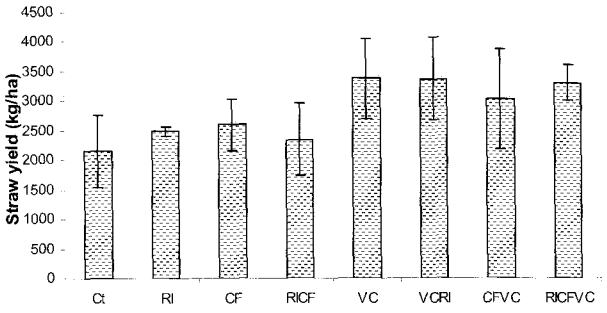

Fig. 6. Straw yield of soybean (kg/ha).

have been a bit higher doses. Diep *et al.*, (2002) recommended Rhizobium inoculum along with nitrogen 25 kg/ha for higher soybean seed yields in the Mekong Delta. However, Maneechute (1991) reported quite high amount of chemical fertilizers to get high yield of vegetable soybean. Important parameters were statistically non significant. .....have also reported similar findings. Application of vermicompost either alone or incombination with right type of inoculum would be quite profitable compared to chemical fertilizers. Since varieties is also a factor, therefore screening of varieties that fits into the Nepalese environment in the hills and terai would be future work.

CONCLUSION

The result shows that vermicompost is the best organic fertilizer for higher grain yield, higher straw yield and good nodulation. However vermicompost alone and in combination with Rhizobium inoculum and mineral fertilizer had positive effect in yield of vegetable green soybean.

To obtain high yield and good nodulation combined application of vermicompost; Rhizobium and starter amount of nitrogen and basic dose phosphorus and potash fertilizers is recommended.

ACKNOWLEDGEMENTS

We would like to thank Mrs. D. Gautam, Mr. Shrikrishna K. C. and Mr. G. Raut for their support in field and laboratory work.

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