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Effect of Seed Inoculation with *Rhizobium* on Yield and N Content of Green Manure Crops

by

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Inoculation of legumes, with effective strains of *Rhizobium*, has been a major factor in improving their yield and quality (Erdman, 1953). Studies conducted for the past several years have conclusively shown that the naturally occurring *Rhizobium* inhabiting the soils for a number of years, gradually loses its efficiency with time, and hence an introduced efficient strain of *Rhizobium* can establish better in the root-zone of the legume in competition with the local strain (Manil and Bonnier, 1949). The necessity for selecting suitable strains of *Rhizobium* to bring about maximum benefit to the legume crop has also been brought out in their studies with *Cajanus cajan* (Ramaswami and Nair, 1965). Data also show that a more effective strain of legume bacteria can increase yield or protein content of legumes as much as 20% on the average, over the natural legume bacteria in the soil (Erdman, 1953).

Since the strains that prove to be of highest benefit under field conditions, will be the ones in great demand by farmers, the search for new and better

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strains of legume bacteria is an important feature in the preparation of effective legume cultures.

Field studies were therefore, conducted to test the efficacy of strains of *Rhizobium*, isolated from the root nodules of four crops viz., *Daincha*, *Phillipesara*, *Sesbania* and *Sunnhemp*, as compared to the native strains and the results of the study, are reported in this paper.

Materials and Methods: Six strains of *Rhizobia*, were isolated from the nodules of each of the four green manure crops, *Daincha* (*Sesbania aculeata*), *Phillipesara* (*Phaseolus trilobus*), *Sesbania speciosa* and *Sunnhemp* (*Crotalaria juncea*), and after purification and preliminary screening one strain which showed profuse growth in artificial culture media, was selected for each crop, for field study. The crops were raised in plots of one cent size, in 'M' Block, Wetlands, Central Farm, during 1967-68 with the two treatments, replicated four times.

- Treatments:** (1) Inoculated with *Rhizobia* (I)
(2) Uninoculated (Control) (UI)

At the time of flowering, five plants randomly selected for each crop, were carefully lifted from each plot and after washing the root systems, the number of nodules were counted; the average weight of the nodules were calculated after drying the nodules to constant weight at 100°C. The plants were dried, and representative samples of the whole plants were analysed for total nitrogen by the Kjeldahl method. The crops in the fields, were harvested at the flowering stage of growth, and the green matter yield as well as the yields of dry matter were recorded.

The experiment was repeated adopting the same procedure indicated above with the same crops during the subsequent season also.

Soil samples (0 - 9") were collected from all the plots, before commencement of the experiment, and immediately after harvest of the crop. Counts of bacteria, were estimated in the soils, by plating 1:10,000 soil dilution using thornthons Agar (1922).

Results and Discussion: The data obtained for the two seasons in four green manure crops were subjected to pooled analysis and the results are summarised in Table.

The results in Table indicate that *Daincha*, inoculated with an effective strain of *Rhizobia* has recorded significantly higher nodulation and yield of dry matter. The N fixed by the plant is also higher, as compared to the control. Inoculation has resulted in an additional fixation of 44 kg of N per hectare, and also increased the yield of dry matter by about 17.5%.

TABLE. Effect of seed inoculation on yield and N content

Treatment	Mean number of nodules per plant	Mean dry weight in milligram per plant	Mean dry matter weight (kg/ha)	Mean nitrogen uptake (kg/ha)
i) <i>Daincha</i> (age 60 days)				
Uninoculated (Control)	69	290	6620	183
Inoculated with <i>Rhizobia</i>	91	392	7332	227
Percentage increase due to inoculation	31.9	35.2	17.5	19.4
Conclusion	**	**	**	**
ii) <i>Pillipesara</i> (age 60 days)				
Uninoculated (Control)	31	84	4396	132
Inoculated with <i>Rhizobia</i>	48	129	5228	154
Percentage increase due to inoculation	48.4	53.6	15.9	14.3
Conclusion	**	**	**	**
iii) <i>Sesbania</i> (age 90 days)				
Uninoculated (control)	50	290	10823	163
Inoculated with <i>Rhizobia</i>	53	333	11309	178
Percentage increase due to inoculation	6.0	14.8	4.5	8.6
Conclusion	NS	*	NS	*
iv) <i>Sunn hemp</i> (age 55 days)				
Uninoculated (control)	11	—	3825	102
Inoculated with <i>Rhizobia</i>	17	—	4297	110
Percentage increase due to inoculation	54.5	—	11.0	7.3
Conclusion	*	—	**	*

** P=0.01

* P=0.05

NS = Not significant

The trend of results obtained with *Pillipesara*, is almost similar to that observed in *Daincha*. Inoculation with the new strain has resulted in increasing the dry matter yield by about 15.9%, and fixed 22 kg more of N per hectare.

The yield of dry matter as well as nodulation in the inoculated *Sesbania speciosa*, did not significantly differ from the uninoculated plants presumably because the native strain of *Rhizobia*, already present in the uninoculated field, is equally efficacious. However, a slight increase in the quantity of N fixed was obtained, due to inoculation.

The response to inoculation in *Sunn hemp* was not quite encouraging. Because of few number of nodules, the dry weight could not be recorded. As in the case of *Sesbania speciosa*, only a slight increase in N fixation was obtained due to inoculation. However, the production of dry matter was significantly higher in the inoculated plants.

Summary and Conclusion : Field trials were conducted in the Central Farm Coimbatore during 1967-68, to study the performance of a few strains of *Rhizobia* on nodulation, yield and N fixation in *Daincha*, *Pillipesara*, *Sesbania speciosa* and *Sunnhemp*. Data obtained for two seasons indicated that inoculation of the crops with *Rhizobia*, was beneficial. While the response to inoculation varied with the kind of legume, an increase in the N fixation by all the plants was indicated. The N fixation varied from 8 to 14 kg per hectare. The production of dry matter was also significantly increased due to inoculation, except in the case of *Sesbania speciosa*, in which case, the benefit of inoculation, was seen by way of increased N content of the crop.

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Studies on the Effects of Foliar Application of Molybdenum on Nodulation and Quality of Garden Pea (*Pisum sativum* L.)

by

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Garden pea (*Pisum sativum* L.) besides being used as vegetable, plays an important role in the improvement of soil fertility by the addition of N with the help of symbiotic bacteria (*Rhizobium* sp) present in the root nodules. The symbiotic bacteria penetrate the rootlets and induce the plants to produce nodules at points of entry. Molybdenum has been found by many workers essential for nodulation and N fixation in some leguminous crops (Blomfield, 1954; Crofts, 1954). It has also been found to have markedly improved the quality of pea (Zurovska, 1958; Chu *et al.* (1963). The present study aims to find out the appropriate concentration of molybdenum that may be used as foliar spray for better nodulation and quality of garden pea.

Materials and Methods: The present investigation was conducted at the Horticultural Garden, Government Agricultural College, Kanpur with the variety of pea T61 obtained from vegetable Research Station, Kalianpur,

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