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*, *Sesbanic 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.

REFERENCES

Erdman, L. W. 1953. Legume inoculation. Bull. No. 2003, USDA.

Manil, P. and C. Bonnier. 1949. Symbiotic nitrogen fixation in lucerne, *Medicago sativa*. *Bull. Inst. Agron. Gen. Clow.*, **17** : 123.

Ramaswamy, P. P. and K. S. Nair. 1965. Symbiotic variation of *Rhisobium* from nodules of Redgram. *Madras agric. J.*, **52** : 239-40.

Thornton, H. G. 1922. The development standardised agar medium for counting soil bacteria. *Ann. Appl. Biol.*, **9** : 241.

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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Kanpur, U. P. Randomized block design was used with six treatments and replicated three times. Healthy seeds of pea var. T61 were sown 2×1.5 feet apart.

Ammonium molybdate was disolved in distilled water and 1 litre in each of the concentration as given in Table 1 was prepared.

TABLE 1. *Details of treatments.*

Treatment	Concentrations %	Ammonium molybdate (g)
T_0	0.00	0.0
T_1	0.06	0.6
T_2	0.08	0.8
T_3	0.10	1.0
T_4	0.12	1.2
T_5	0.14	1.4

Molybdenum solution was sprayed directly on the foliage of the whole plant by a bottle sprayer. At the time of spraying the plants had 6–7 leaves. The ground beneath the plants was covered with polythene sheets so that the solutions did not come in contact with the soil at the time of spraying. Seven plants from each plot were selected at random and observations were taken after every 10 days throughout the life cycle of the crop;

(a) *Nodulation:* The number of root nodules on the roots were counted with the help of a hand lens at ten days interval. The plants were lifted along with the ball of earth and were soaked in water for one hour in order to remove the soil from the roots without causing much damage.

(b) *Quality:* Ten pods were taken at random from each treatment per picking. Measurements on pods such as length, diameter and fresh weight and number of grains per pod were made from them.

Moisture percentage in seeds: 100 g fresh grains of pea under each treatment were weighed separately and kept in oven at 100°C. After complete dehydration the grains were weighed and the moisture percentage was found out.

Total soluble solid content in grains: The grains taken from twenty pods were macerated with the help of pestle and mortar and the juice was extracted from crushed material with the help of fine muslin cloth. This juice was kept on the surface of refractometer Ermo, Japan at 20°C.

Experimental Results: *Nodulation:* Average number of nodules per plant were counted at ten days interval (20 days after foliar spray) to find out the effect of nodulation. It is obvious from the results that all the treatments differed significantly from one another showing that the molybdenum application greatly affected the formation of nodules. Highest number of nodules were obtained in treatment T_3 (.1%) followed by T_2, T_4, T_1 and T_5. The lowest number of nodules (828.70) was noted in T_0 as clear from plate 1.

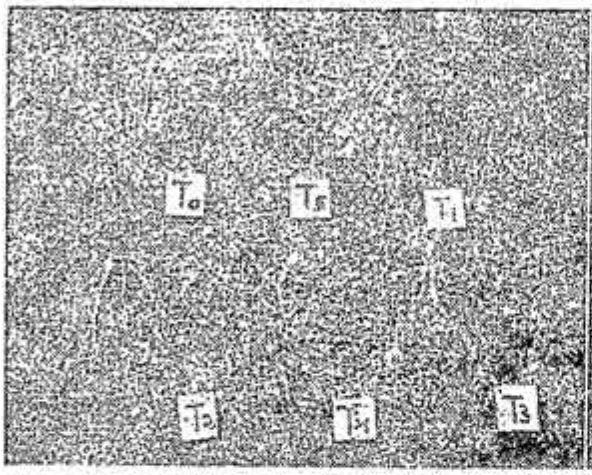

PLATE 1. Number of root nodules under different treatments

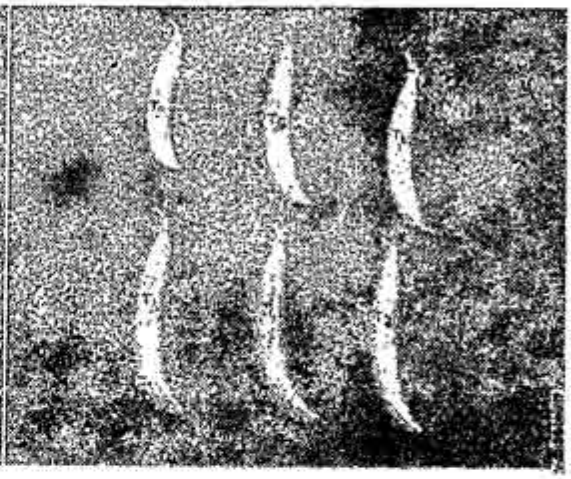

PLATE 2. Pod length under different treatments

(b) *Quality: Size of pods:* The maximum length was recorded in treatment T_3 (9.37) followed by T_2, T_4, T_1 and T_5. Control plants produced pods having lowest length as clear from plate 2. The length of the pods in all the treatments was reduced at the time of last picking. There was no considerable difference in the average diameter of pod under different treatments.

However, the maximum diameter was obtained in treatment T_3 (1.13 cm) and minimum in control (1.07 cm). Molybdenum application increased the weight per pod significantly from control. The highest average of fresh pod weight was recorded in treatment T_3 (6.46 g) and lowest in control (5.35 g). Treatments T_2 and T_4 did not differ significantly from each other. The T_5 was better than control in respect to fresh weight per pod.

Average number of grains per pod: The application of molybdenum increased the average number of grains per pod from 6.4 to 9.4. The highest number of grains were obtained in T_3 and lowest number was found in control (T_0). T_1 and T_5 did not show any difference in this respect, but were superior to control (Table 2 and Plate 3).

TABLE 2. *Effects of Foliar Application of Molybdenum on Nodulation and Quality of Garden Pea (pisum sativum L)*

Treatments	Average number of root nodules/ plant	Quality					
		Average length/ pod (cm)	Average diameter/ pod (cm)	Average fresh weight/ pod (g)	Average number of grains/ pod	Average moisture content of grains (%)	T.S.S. content of grains in (mg/100 g)
T_0	828.70	8.63	1.07	5.35	6.4	77.1	15.2
T_1	965.47	8.90	1.09	5.40	7.2	76.5	15.8
T_2	1012.67	8.94	1.10	6.24	8.5	76.5	16.0
T_3	1172.70	9.37	1.13	6.46	9.4	74.5	16.8
T_4	983.76	8 94	1.11	5.52	8.6	75.5	16.2
T_5	848.72	8.67	1.11	5.40	7.2	76.8	15.0
C.D. at 5% level	7.30	0.228	0.05	0.12	0.26	0.73	1.29

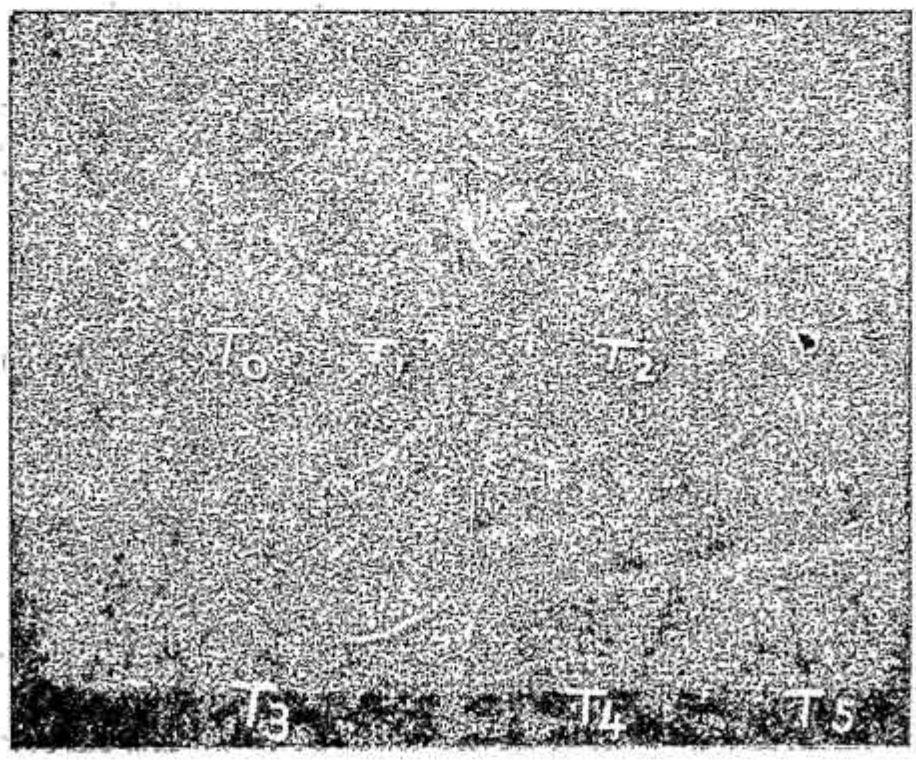

PLATE 3. Photograph showing average number of grains per pod

Average moisture percentage in grains: The highest moisture content has been observed in T_0 and minimum in T_3. The quality of grain produced may be superior due to reduced moisture content and increase in average dry matter content. The moisture percentage decreased gradually as the crop advanced towards maturity.

Average total soluble solids content in grains: Treatments T_3, T_2 and T_1 did not differ significantly from each other in respect to T.S.S. content. The treatments T_4, T_1 and T_3 also did not vary significantly. T_5 and T_0 were same in T.S.S. content. It ranged from 16.8 (T_3) to 15.2 (T_4). T.S.S. content in grains obtained from T_3 maintained the superiority over all the treatments.

Discussion: Average number of root nodules per plant increased gradually and were maximum at the ultimate stage. The highest average number of nodules per plant was (1172.7) achieved in treatment T_3 and lowest (828.7) in control. The nodules were more pinkish in treated plants than control. The results obtained by the application of molybdenum by Boliko and Savvina (1940) and Hagstrom and Berger (1963) are in accordance with the present investigation.

Similar advantageous findings by molybdenum spray have been obtained with regard to the quality of grains obtained from the treated plants. Application of molybdenum as foliar spray increased the average length per pod which varied from (8.63 cm) in T_0 to (9.37 cm) in T_3 (Table 2, Plate 2). Diameter of pods was also affected by the use of molybdenum as is obvious from Table 2. Treatment T_3 (1.13 cm) was significantly superior to other treatments and pods from control plants gave an average of 1.07 cm diameter. Molybdenum also increased the number of grains per pod significantly The average number of grains were 9.4 in T_3 and 6.4 in control. Fresh weight per pod ranged from 5.35 g in control to 6.46 g in treatment T_3. The above advantage of improvement in quality is in conformity with the results reported by Chu, *et al.* (1963). The moisture percentage (77.1) was the highest in control showing the poor quality of grains as compared to the grains from treated plants. The lowest moisture content was recorded in T_3 which means increase in dry matter and consequently the improved quality of grain. The moisture percentage gradually decreased as the plants approached maturity.

Considerable increase in T.S.S. content of grains was also recorded because of the foliar application of molybdenum. T.S.S. content increased gradually and was highest at the time of last picking. T_3 showed the best T.S.S. having 16.8 mg/100 g while the control accounted for 15.2 mg/100 g only.

In this way molybdenum treatment increased the carbohydrate content despite their increased rate of protein synthesis, which indicates efficient and stimulated photosynthesis. The views expressed by Minina (1960) and Zurovska (1958) are in conformity with the above findings.

Summary: Application of foliar spray with 0.0, 0.06, 0.08, 0.1, 0.12 and 0.14% ammonium molybdate at the age of 40 days after sowing on pea

seedlings variety T_{61} showed that foliar application with 0.1% molybdenum significantly increased responses in respect of number of root nodules and also increased the length, diameter, fresh weight, number of grains per pod, and T.S.S. content of grains significantly.

REFERENCES

Blomfield, P. D. 1954. Note on molybdenum response on peas in Nelson. *N. Z. J. Sci. Tech.*, 36 : 46.

Boliko and A. G. Savvina. 1940. Role of molybdenum in plant development. *Compt. rend. acad. Sci. V. R. S. S*, 29 : 507-9.

Chu, E, C. W. Lieng and E. E. Chen. 1963. Effect of minor elements on the growth and yield of Soyabean in some important soil types of China. *Soils & Fert.*, 27 : 1817.

Crofts, F. C. 1954. Superphosphate and molybdenum responses in peas at Wollonghar. *Agric. Gaz. N. S. W.*, 65 : 185-86.

Hagstrom, G. R. and K. C. Berger. 1963. Molybdenum status of three wisconsin soils and its effect on four legume crops. *Agron. J.*, 55 : 399-401.

Minina, E. I. 1960. A contribution to the problem of the physiological role of molybdenum in plants (Russian). *Doklady. Akad Nauk. SSSR.*, 130 : 461-64.

Zurovska, V. J. A. 1958. The effect of molybdenum on the yield and quality of peas. *Tr. Akad. Nauk Lat VSSR.*, 9 : 151-64.

Studies on the Productivity Rating of Alluvial Soils

by

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An appraisal of nutrient status of soils and crop productivity was made at the Pennar alluvial deposits at the Sugarcane Research Station, Cuddalore. With the recognition of availability concepts of soil nutrients, soil chemists tried to correlate crop productivity with nutrient contents and attempted to fix optimum concentration of these nutrients in soils at which the yields will be optimum without the addition of nutrients. Some of the major contributions on this aspect with reference to sugarcane is summarised (Ranganathan 1966).

The availability concept is used for predicting crop requirements based on soil analysis at the soil testing laboratories for improving crop production.

Though under a given set of conditions, nutrient status is a good index of crop productivity, its absolute magnitude is profoundly influenced by physical characteristics of soil such as texture, depth and slope, climatic conditions and drainage conditions of the area. Storie (1950) developed a system of rating soils for their inherent crop productivity by an inductive process where several profile characteristics were weighed in relation to the production of a specific crop. Raychaudri and Anjaneya Reddy (1963)

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