

PERFORMANCE OF SINGLE STRAIN *RHIZOBIUM JAPONICUM* INOCULANTS ON SOYBEAN (*GLYCINE MAX* (L.) MERRILL)

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ABSTRACT

A field experiment was conducted to test the efficiency of various local isolates and standard inoculant strains. The inoculated plots along with the nitrogen controls resulted significantly in higher yields. Significant yield differences between various inoculated strains were also observed. Serological studies indicated that all the nodule isolates which were made from the plants inoculated with local strains belonged to one serogroup.

INTRODUCTION

Biological nitrogen fixation has an important bearing on the process of yield improvement of legumes (Arunachalam *et al.*, 1984). Inoculation with efficient strains of *Rhizobium japonicum* may increase yield of *Glycine max* in areas where the bacteria are absent or not present in sufficient quantity (Ham *et al.*, 1971). Inoculation is a way of providing an adequate number of the proper bacteria to the plant root zone at the time of planting (Frederic, 1976).

Importation of rhizobial inoculants is an expensive process. Therefore, importance should be stressed on promoting local inoculum production. Effective strain selection is an important criterion in the process of inoculum production.

The present study was conducted to evaluate *R. japonicum* strains under field conditions in order to recommend strains for inoculum production and to assess whether inoculation is beneficial when seed is planted in a soil where effectively nodulated plants have been produced previously.

MATERIALS AND METHODS

A field experiment was conducted with eight single strain *R. japonicum* inoculants on *G. max* (variety Pb—1). The field experiment was a randomized complete block design with three replications. All the

treatments received a uniform application of superphosphate (140 kg/ha) and muriate of potash (50 kg/ha) at the time of planting. The nitrogen control plots received 150 kg of urea per hectare without inoculation.

Rhizobium strains 61A 118, 61A 148 and 61A 124 were obtained from the Nitragin Co., U. S. A. SLM strains 112, 113, 111, 101 and 115 were isolated from various parts of the country. The uninoculated treatment served as the control.

The soil of the experimental site was silty loam in texture and contained 0.84 % N. The soil pH was 5.18. Soil rhizobial population was determined by the M. P. N. count as described by Vincent (1970).

Early sampling of plants was conducted at 50 % flowering stage. The nodule number per plant, nodule dry weight, plant top dry weight and plant top nitrogen content were recorded. Grain yield was used as the final criterion for evaluation of strains.

The locally produced antisera for the current Nitragin Co. strains 61A101c, 61A118b, 61A124a and 61A148 was obtained. Isolation of nodule strains and the immunodiffusion studies were carried out as described by Vincent (1970). At 50 % flowering stage isolation of strains was made from nodule samples obtained from all plots. These isolates were purified and authenticated. Isolates were reacted with the antisera produced for the Nitragin Co. strains as well as the antisera obtained from NifTAL, U. S. A. for strains TAL 379 and TAL 102.

RESULTS AND DISCUSSION

The evaluation of nodulation data revealed that under uninoculated control conditions also there were nodules which would have been caused by the naturalized rhizobia present in the soil. The M. P. N. soil bacterial count gave the number of rhizobia per gram of soil as 10^4 .

At early sampling, no significant differences in plant top dry weight between the inoculated and the uninoculated control were found (at $p=0.05$). The plant top dry weight of urea treated plots were significantly better than all other treatments. However, as Table 1 depicts the plant top dry weight, nodule number per plant and nitrogen content per plant were low in the control compared to the other treatments. A positive correlation ($r=0.75$) was observed between plant top dry weight and plant nitrogen content (Fig. 1).

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As shown in Table 2 all treatments gave a yield increase over the uninoculated plots. Out of the local isolates, strain SLM 101 and 115 performed well with the Nitragin Co. strains (LSD at $p=0.01$, Fig. 2). The higher ranking strains are 61A 124, 61A 148, 61A 118, SLM 101 and SLM 115 and could be used for inoculum production.

In the immunodiffusion reactions all local strains gave single uniform precipitin bands with the serum of 61A 101c. Isolates from the uninoculated plots also formed bands with the serum of 61A 101c. However, the nodule isolates of the urea control did not give any positive precipitin bands with any antiserum.

In conclusion, all local isolates may belong to the same serogroup as strain 61A 101c. As the indigenous rhizobia population also reacted with the same antiserum this particular strain would be having ability to survive in soil over a long period. However, further studies are necessary to resolve such problems in detail. This experiment has shown that soybean inoculation with efficient strains results in significant yield increases even though the soil contains a rhizobial population. Inoculation of soybean is a cheap measure of insurance and it should be popularized and promoted among the farmers in Sri Lanka for better crop production. Strains 61A 118, 61A 124 and 61A 148 are recommended for commercial inoculant production.

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Table 1. Ancillary observations at 50% flowering stage.

<i>Treatment</i>	<i>Nodulation No of nodule plant</i>	<i>Dry wt. of nodules</i>	<i>Plant dry wt. (g)</i>	<i>N content / plant (mg)</i>
61A 118	13	0.08	1.45	7.0
61A 148	22	0.12	1.33	6.0
SLM 112	15	0.15	1.18	1.0
61A 124	14	0.10	1.25	4.0
SLM 113	16	0.09	1.13	4.0
SLM 111	15	0.11	1.18	6.0
SLM 101	17	0.09	1.13	3.0
SLM 115	20	0.12	1.06	3.0
Urea	20	0.17	2.43	8.0
Control	10	0.07	0.88	2.0

Table 2. Grain yield (kg / ha)

<i>Treatment</i>	<i>Grain yield</i>	<i>% increase over control</i>
61A 118	897	31.33
61A 148	953	39.53
SLM 112	849	24.30
61A 124	1048	53.44
SLM 113	792	15.95
SLM 111	873	27.82
SLM 101	984	44.07
SLM 115	888	30.01
Urea	1437	110.39
Control	683	—

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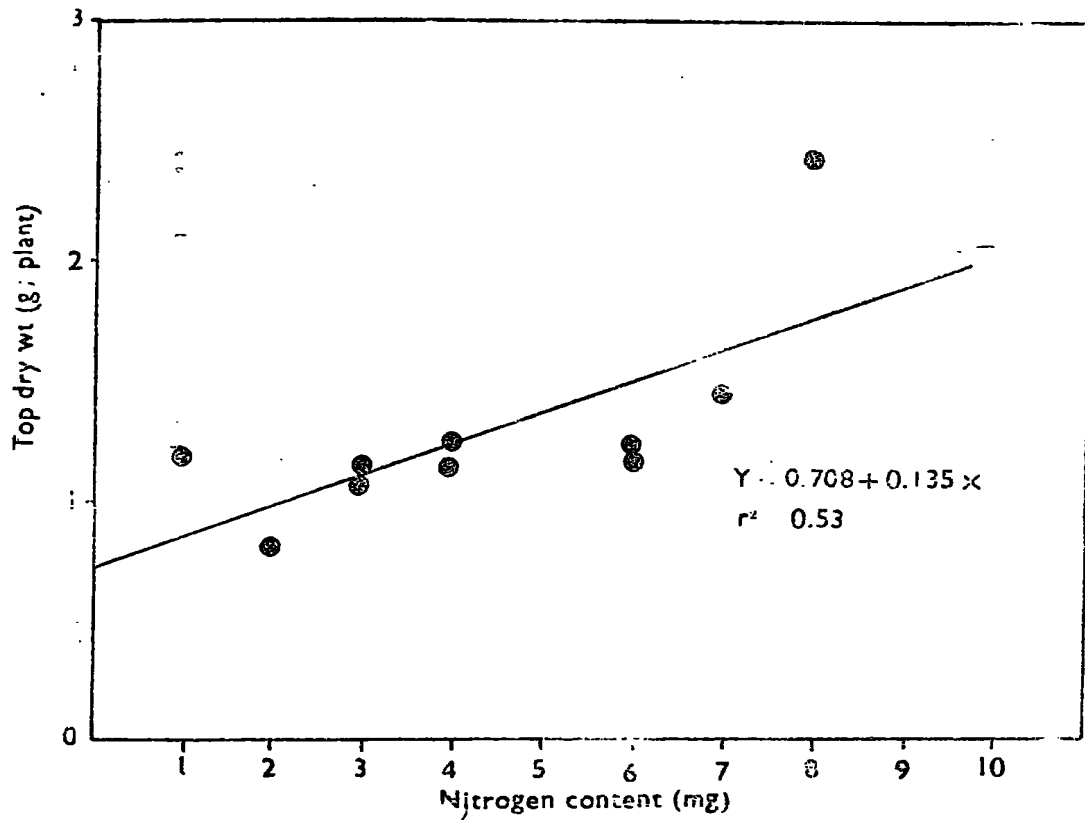


Fig. 1. Correlation between plant top dry wt and nitrogen content.

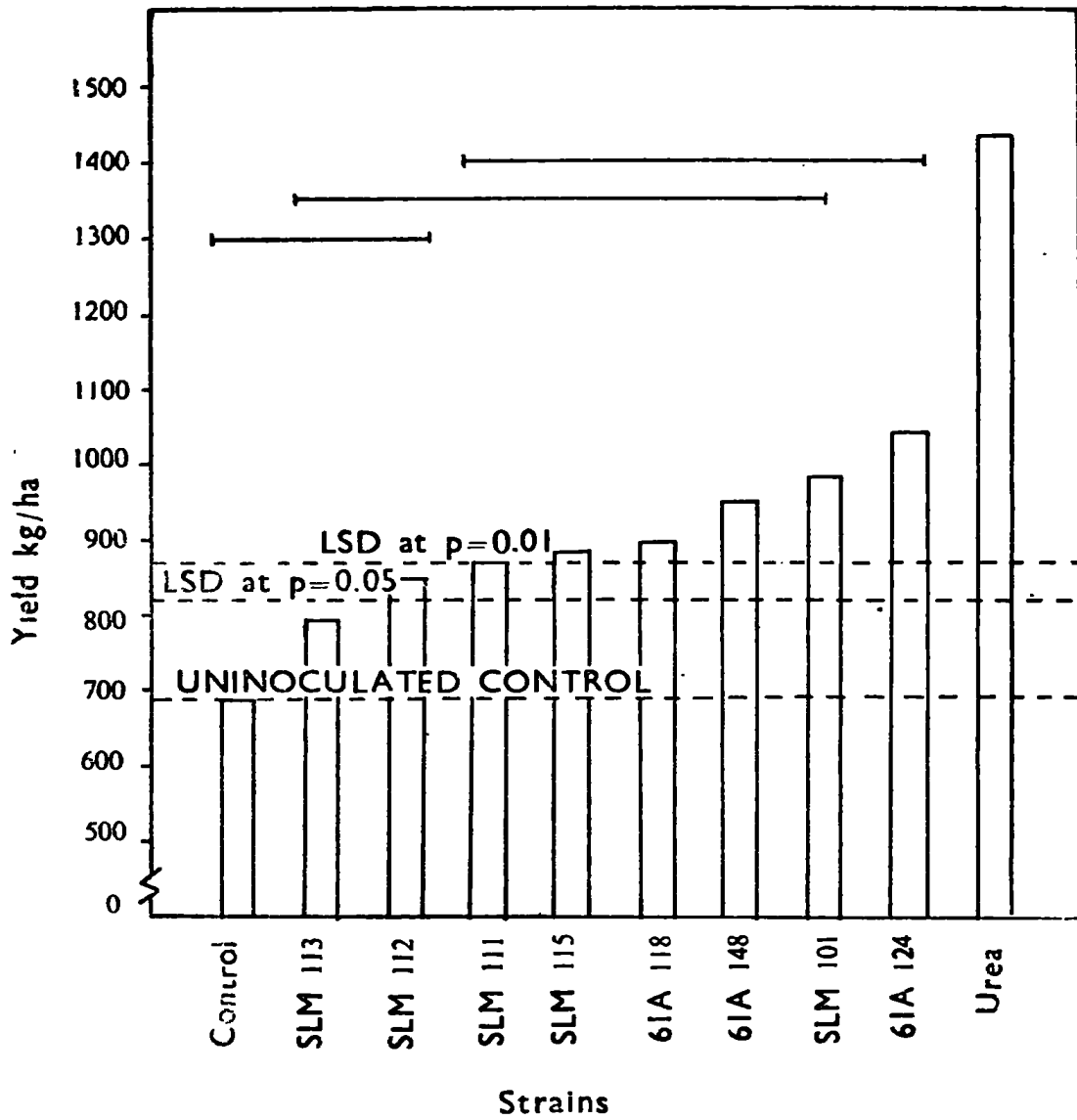


Fig. 2. Effect of *Rhizobium japonicum* strains on grain yield of *Glycine max* (variety Pb-1). Lines at the top indicate Duncan's multiple range test at $p = 0.05$.