TECHNICAL NOTES

NOTES ON THE SYMBIOSIS OF SELECTED STRAINS OF RHIZOBIA AND *GLYCINE JAVANICA*

As glycine (*Glycine javanica*) has proved a successful pasture legume in Queensland, it seemed pertinent that its associated rhizobia and the conditions governing its successful symbiosis be studied. Accordingly nodule samples from glycine were obtained with the assistance of officers of Research Stations and Agricultural Advisers from several places throughout the State and isolations made. These strains and some from other sources were screened on glycine in a glass-house trial, the result of which is reported here.

Procedure

Plants of *G. javanica* were grown in the Leonard jar assembly (Leonard 1943) and watered with nitrogen-free nutrient solution. Seed was sterilized with mercuric chloride. Seedlings were thinned to four per pot and inoculated with a heavy suspension of the bacteria.

Eighteen bacterial strains were compared, using three replications. Planting date was December 20, 1960, inoculation date, December 22, 1960, and harvest date, February 27, 1961.

At harvest, plants were assessed on colour; oven-dried weights of tops, roots and nodules; nodule number; and nodule size. Effectiveness was assessed on the dried weight of the tops as compared with the uninoculated control.

The nodule pattern produced by the bacterial strains, under this particular set of environmental conditions, was examined and results tabulated as the mean number of nodules per plant for each strain and also the mean number of nodules in the crown, mid and distal positions on the root. The average nodule size of each strain was examined by grouping nodules into three sizes as well as determining the mean size for each strain. A selection of these figures is given in Table 1.

Infection

Rhizobium isolates from several sources of naturally infected *Glycine javanica, G. max, G. tomentosa, G. tabacina, Centrosema pubescens* and *Vigna sinensis* proved highly infective on *G. javanica* (Table 1). This was in accordance with Bowen's conclusions (Bowen 1959) that glycine is not specific with regard to infection. Bowen suggested from his work with centro a correlation between cross-pollination and a promiscuous nodulating habit on the one hand and self-fertility and specificity in nodulation on the other hand. Hutton (1960) records that *Glycine javanica* is closely self-pollinated. *Phaseolus atropurpureus,*

TABLE 1

SUMMARY OF RESULTS FROM GLYCINE RHIZOBIUM STRAIN TRIAL, 1960–61

Strain	Host of Isolation	Locality	Mean No. of Nodules/ Plant	Mean No. of Nodules on Crown	Mean Oven-dried Weight Nodules/ Plant (mg)	Mean Oven-dried Weight Plant Tops (mg)
QA922 ..	*Glycine javanica* ..	Ayr	10·1	5·0	12	394
QA888 ..	*Glycine max*	U.S.A. ..	16·4	8·1	14	390
QA878 ..	*Glycine tomentosa* ..	Mount Gillies	19·3	12	21	350
QA954 ..	*Vigna sinensis*	Brisbane ..	13·7	6	18	330
QA949 ..	*Glycine javanica* ..	Ayr	11·2	5·1	13	325
QA618, 2a ..	*Glycine javanica* ..	Coolum ..	12·0	5·4	11	315
QA619 ..	*Glycine javanica* ..	Coolum ..	10·6	5	13	298
QA955 ..	*Glycine javanica* ..	Millaroo ..	9·2	6·3	8	291
QA950 ..	*Glycine javanica* ..	Kairi ..	5·9	1·8	8	276
QA956 ..	*Glycine javanica* ..	Kairi ..	11·5	3·6	10	266
QA957 ..	*Glycine javanica* ..	Kairi ..	8·3	5·5	11	258
QA958 ..	*Glycine javanica* ..	Atherton ..	15·4	8·5	14	252
QA959 ..	*Glycine javanica* ..	Kairi ..	8·6	4·2	9	251
QA962 ..	*Glycine javanica* ..	Atherton ..	8·4	4·5	7	212
QA961 ..	*Centrosema pubescens*	Coolum ..	6·3	3·8	6	210
QA626 ..	*Glycine tabacina* ..	Coolum ..	5·4	2·7	5	180
QA960 ..	*Glycine javanica* ..	Ayr	11·2	7·5	5	178
QA898 ..	*Vigna sinensis*	Brisbane ..	7·5	5·8	6	170
Uninoculated						31

Phaseolus lathyroides and *Stylosanthes gracilis* are also closely self-pollinated (Hutton 1960) and are known to nodulate very easily with a wide variety of strains. The possession of self-fertility and specificity in nodulation as illustrated by *Centrosema pubescens* (Bowen 1959) and *Lotononis bainesii* (Norris 1958) may be the exception rather than of general application.

Effectiveness

As well as rhizobium strains isolated from naturally infected plants of *Glycine javanica, G. max, G. tomentosa and G. tabacina,* isolates from centro and cowpea were effective on *G. javanica.* Although there was a wide range of relative effectiveness among the strains, showing the necessity of selecting for a strain suitable for a general inoculant, all strains were highly effective when compared with the uninoculated control.

The more effective strains were characterized by a larger number of nodules in the crown area. These nodules were usually larger in size. Strain QA878 produced a very abundant number of nodules which were smaller than average. The more general pattern with rhizobium is one of abundant smaller nodules and sparser large nodules (Nutman 1959).

When the mean number of nodules per plant was plotted against nodule size (average diameter) for each strain there was a slight correlation only. However, when the results were examined, as Andrew and Norris (1961) suggested, as the mean nodule weight and mean nodule number per gram of root weight there was a better correlation (Table 2).

TABLE 2

RELATIONSHIP BETWEEN NODULE NUMBER, NODULE WEIGHT AND ROOT WEIGHT IN STRAINS OF RHIZOBIUM INFECTING GLYCINE

Strain	Mean Nodule Number per g Root Weight	Mean Nodule Weight per g Root Weight
QA922	0·14	0·164
QA888	0·26	0·222
QA878	0·35	0·382
QA954	0·26	0·340
QA949	0·16	0·186
QA618 (2a)	0·20	0·186
QA619	0·17	0·213
QA955	0·13	0·106
QA950	0·08	0·104
QA956	0·17	0·145
QA957	0·15	0·200
QA958	0·28	0·250
QA959	0·16	0·170
QA958b	0·23	0·184
QA961	0·10	0·096
QA626	0·15	0·135
QA960	0·16	0·072
QA898	0·17	0·136

The nodular volume for each strain was calculated and the more effective strains were found to exceed the less effective strains by 300 per cent. There was a fairly good correlation of nodular volume with plant weight. When plotted, the points lay about the curve rather broadly but were definite enough to show a decline of plant weight with decline in nodular volume. This would agree with the observation of Nutman (1959) that the measurement of specific nodule volume may provide a means of comparison of the efficiencies of fixation of various strains of bacteria. A similar correlation was found to exist between the plant weight and the nodule weight.

The nitrogen content was judged on the plant colour just prior to harvest. This rates QA922 and QA878 as the highest.

From a consideration of the overall results and under this set of environmental conditions, QA922, QA878 and QA888 have proved the best of the tested strains available for glycine. QA922 is an isolate from *Glycine javanica* and QA878 and QA888 isolates from other species of *Glycine*.

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