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## INOCULATION WITH Rhizobium USING THE FLUID DRILL

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Currah, Gray and Thomas (1974) have described a seed drill which uses a fluid carrier to transport seed, either dry or pre-germinated, safely into the soil. Some uses of this drill have been reviewed by Bleasdale (1976). We thought that if Rhizobium inoculum could survive being mixed with the fluid, then it should be possible to use the fluid drill to obtain better inouclation of the bean crop. A preliminary experiment confirms this suggestion. In samples taken four weeks after drilling, the fluid drill technique achieved 7.0 nodules per plant, compared with 2.1 nodules per plant from the tradition-al technique using dry seed pelleted in a peat mix of Rhizobium (S.E.D. = 0.89, P = 0.01). Uninoculated controls had only 0.64 nodules per plant.

The work is described more fully in Experimental Agriculture (1978), 14:17-21.

Bibliography

Bleasdale, J.K.A. 1976. American Vegetable Grower 24: 10.

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## RESPONSE OF TWO BEAN CULTIVARS TO ARTIFICIAL DEFOLIATION

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There are in Brazil several pests that attack bean leaves, such as beetles of the Crysomelidae family, the Brazilian ant (Atta sexdens sexdens), the slub (Vaginula langsdorfii), the soybean caterpillar (Anticarsia gemmatilis) and many others. They can be controlled by appropriate pesticides, but there is no information about when the pesticide should be used in relation either to the foliar area destroyed or the growth stage of the bean plants.

In order to get this kind of information two experiments, in which artificial defoliation was used to simulate the pest attack, were carried out at the Federal University of Vicosa.

Two cultivars were used, 'Manteigao 977' and 'Manteigao Fosco II', both of the bush type (determinate growth); the former takes approximately 70 days to mature while the latter needs 80 days. For each cultivar a factorial with three growth stages x four levels of defoliation was employed, the treatments being distributed in a randomized complete-block experiment with four replications. Row spacing was 50 cm with 10 plants per meter of row.

Table 1. Effects of defoliation on bean cv. 'Manteigao 977' (*)

| Growth stage (**) | Defoliation percentage | Yield, $g/m^2$ (Y = XYZ) | No. of pods/ $m^2$ (X) | No. of seeds/ pod (Y) | Seed weight, g (Z) |
|---|---|---|---|---|---|
| First | 0 | 109.9 a | 131.6 a | 2.6 bc | 0.32 a |
| | 33 | 104.5 a | 116.6 a | 3.0 ab | 0.29 ab |
| | 66 | 115.6 a | 117.9 a | 3.2 a | 0.30 ab |
| | 100 | 24.9 b | 35.8 b | 2.5 c | 0.27 b |
| Second | 0 | 120.0 a | 146.6 a | 2.6 a | 0.30 ab |
| | 33 | 121.2 a | 121.9 ab | 3.0 a | 0.33 a |
| | 66 | 76.2 b | 82.7 bc | 2.7 a | 0.32 ab |
| | 100 | 17.7 c | 65.1 c | 1.3 b | 0.29 b |
| Third | 0 | 133.3 a | 142.6 a | 2.9 a | 0.34 a |
| | 33 | 108.3 b | 137.1 a | 2.5 a | 0.31 ab |
| | 66 | 86.0 b | 149.0 a | 1.8 b | 0.31 ab |
| | 100 | 38.2 c | 133.7 a | 0.9 c | 0.30 b |

(*) Means followed by different letters within the same series of data are significantly different at P 0.05.

(**) Respectively, 20, 30, and 40 days after seedling emergence.

Table 2. Effects of defoliation on bean cv. 'Manteigao Fosco II' (*)

| Growth stage (**) | Defoliation percentage | Yield $g/m^2$ (Y = XYZ) | No. of pods/ $m^2$ (X) | No. of seeds/ pod (Y) | Seed weight, g (Z) |
|---|---|---|---|---|---|
| First | 0 | 106.5 a | 92.3 a | 3.5 a | 0.32 b |
| | 33 | 87.7 a | 79.2 a | 3.5 a | 0.31 b |
| | 66 | 109.7 a | 90.8 a | 3.7 a | 0.32 b |
| | 100 | 19.5 b | 17.1 b | 3.1 b | 0.36 a |
| Second | 0 | 112.5 a | 89.5 a | 3.7 a | 0.33 b |
| | 33 | 97.5 a | 82.7 a | 3.3 b | 0.34 ab |
| | 66 | 118.7 a | 85.4 a | 3.7 a | 0.37 a |
| | 100 | 24.5 b | 23.8 b | 2.6 c | 0.36 ab |
| Third | 0 | 110.0 a | 99.8 a | 3.3 a | 0.33 a |
| | 33 | 117.4 a | 106.2 a | 3.2 a | 0.34 a |
| | 66 | 79.0 a | 88.7 ab | 2.6 b | 0.34 a |
| | 100 | 17.0 b | 60.2 b | 0.7 c | 0.36 a |

(*) Means followed by different letters within the same series of data are significantly different at P 0.05.

(**) Respectively, 20, 30, and 40 days after seedling emergence.

The growth stages were 20, 30, and 40 days after the seedling emergence. The degrees of defoliation were 0, 33, 66, and 100%, which were obtained by cutting with scissors 0, 1, 2, and 3 leaflets of each leaf of each entire plant, respectively.

Table 1 shows that for 'Manteigao 977' only 100% defoliation caused yield decrease in the first growth stage. In the second growth stage, the total defoliation was again the most detrimental, followed by 66% defoliation. In the 3rd growth stage, the damage caused by defoliation obeyed the following order: 100%, 66%, and 33%. Therefore, total defoliation always brought about a strong decrease in yield at any age, and the other levels of defoliation were increasingly detrimental as the bean plants became older.

Table 2 shows that the results obtained with the cv. 'Manteigao Fosco 11' followed the tendency observed in the other cultivar, but 'Manteigao Fosco 11' was much more tolerant to defoliation. This cultivar presents very large, horizontal leaflets, that strongly shade the lower leaves. Thus, apparently, the lower leaves do not "function," hence the smaller effect of leaf removal in this cultivar.

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## PERFORMANCE OF MAIZE AND BEANS IN A SYSTEM OF MULTIPLE CROPPING

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Multiple cropping is a common practice among small farmers in Brazil. Beans are produced principally in association with maize, in intercropping, mixed cropping or relay cropping. The last is the most common: maize is planted in October, when the rainy season starts, and beans are sowed among the maize plants when this crop starts to dry, i.e., in February. In this note an experiment of relay cropping involving maize and four bean cultivars will be briefly described.

The following bean cultivars were used: 'Ricobaio 1014' (indeterminate growth habit, small guide), 'Ricopardo 896' (indeterminate, long guide), 'Manteigao Fosco II' (determinate), and 'Preto 1641' (climbing). They were planted, at a density of 250 thousand seeds/ha, among the following maize populations: 20, 30, and 40 thousand/ha.

Some of the results are on Table 1. There were no significant differences in bean yield caused by maize populations in any bean cultivar. The maize yield was not affected significantly either by its own populations or by the treatments. Maize alone produced significantly less protein and calories than any association of maize and bean. The mean land equivalent ratio was approximately 1.5; this ratio was not estimated for 'Preto 1641', because climbing beans are never planted as a monocrop.

It was concluded that beans, when planted in February, do not affect the maize yield. The bean yield was relatively low for land that produced around 5,000 kg/ha of maize. It seems that the shade of the maize plants decreased