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RELATIVE PERFORMANCE AMONG CROSSING TECHNIQUES UNDER FIELD  
AND GREENHOUSE CONDITIONS ON BEANS

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Comparison between field and greenhouse conditions in terms of hybridization efficiency are of paramount importance in defining breeding strategies when both conditions are available.

This study was conducted to a) elucidate if crossing under field conditions was a viable alternative, b) what would be the relative performance when compared with greenhouse work, and c) which technique would be more suitable for each of the environments under study.

The parameters used to measure the relative efficiency of the techniques were number of pollinations that produced a pod, total pods produced, hybrid seed per pod, and selfed seed per pod.

MATERIALS AND METHODS. The cross under study was 'Tayhu' x 'Cuva 168-N'. Plantings were made under field and greenhouse conditions in August, 1978 and in the field in March, 1979.

The seedlings of the female parent had white flowers and green pigmentation in the hypocotyls, primary veins and cotyledons. The seedlings of the male parent had purple flowers and purple pigmentation in the same plant parts. A very high correlation has been reported between purple pigmentation of seedling parts and purple flower. Cardenas reported that Azzan and Frazier, and Casas, have shown that purple pigmentation of the hypocotyl was dominant over non-pigmented plants in the F<sub>1</sub>. Therefore, this characteristic was used to identify hybrid individuals at seedling stage.

The techniques used were:

1. Emasculation of the bud maintaining the stigma covered (EC)
2. Emasculation of the bud maintaining the stigma uncovered (EU)
3. Non-emasculation of the bud with rubbing (NR)
4. Non-emasculation of the bud with clamping (NC)

### 5. Emasculation of the bud using a pencil (EP)\*

Pollinations were made by four and the three operators in 1978 and 1979, respectively. Each person constituted a replication.

Twenty flowers were pollinated by each person using a given technique (ten flowers were pollinated in each of two plants). Pollinations were carried out early in the morning (from 8:00 to 10:00 AM). Each pod was harvested individually and seed were planted in trays.

Each seedling with purple pigmentation in the hypocotyl, and veins of the primary leaves and cotyledons after 7 to 13 days was considered a hybrid.

RESULTS AND DISCUSSIONS. The 1978 experiments presented significant differences among the methods for number of pollinations that produced a pod (Success), hybrid seeds per pod, and total pods produced within each method under greenhouse conditions (Table 1). Methods NR and NC showed higher efficiency than EC, EU and EP for success while NR showed to be the best, although not significantly different from NC and EC for hybrid seed per pod. NR was again the best for total number of pods produced although significantly different solely from EP.

Despite the fact that no significant differences were detected among the methods for any of the characteristics under study in the field, methods NR and NC showed the highest number of hybrid seeds per pod and the lowest number of selfed seed per pod.

Similar results were obtained from the experiment conducted in March 1979 when methods NR and NC were among the best for success, numbers of hybrid seeds per pod (being not significantly different from EC for these parameters), and total pods produced. Although number of selfed seeds per pod showed no significant differences among the methods, NR and NC showed the lowest values.

The analysis of variance for number of selfed seeds per pod, hybrid seeds per pod, and pods produced by method, shown in Table 2, revealed that locations differed significantly ( $P < 0.01$ ) for all parameters, with field conditions being superior to greenhouse conditions. Treatment differences were significant only for number of pods produced by method, with NR and NC being significantly different from EP but not from EC or EU.

This study demonstrated that field conditions are feasible for crossing of beans in Goiania and that there is no need for bud emasculation in artificial crosses of beans. Non-emasculation methods resulted in a lower number of selfed seeds per pod, higher number of hybrid seeds per pod, and higher number of pollinations that produced a pod. These results and the fact that pollinations without emasculation are time saving were strong arguments to adopt such techniques.

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\* Due to bad results obtained with this technique, it was discontinued in 1979.

Table 1. Comparison among hybridization methods under field and greenhouse conditions for number of pollinations that produced a pod (Success), selfed seed per pod, hybrid seed per pod and total pods produced per method.

Environment	Planting date	Procedure	Success	No. of Selfed seed/pod	No. of Hybrid seed/pod	Total No. of pods produced
Greenhouse	August/78	EC	2.14 ab**	1.29 a	2.27 abc**	1.56 ab
		EU	1.80 ab	1.22 a	1.94 bc	1.47 ab
		NR	3.82 a	0.71 a	3.53 ab	2.34 a
		NC	3.57 a	0.84 a	2.75 ab	1.85 ab
		EP	1.24 b	0.71 a	1.22 c	0.97 b
Field	August/78	EC	3.68 a	3.57 a	4.94 a	3.28 a
		EU	3.84 a	3.64 a	5.74 a	3.24 a
		NR	3.30 a	2.80 a	5.92 a	3.37 a
		NC	3.84 a	3.15 a	6.77 a	3.75 a
		EP	2.85 a	2.02 a	3.88 a	2.47 a
Field	March/79	EC	2.42 abc	1.56 a	2.12 ab	1.85 bc
		EU	1.52 c	0.88 a	1.10 b	1.10 c
		NR	3.92 ab	1.60 a	4.15 ab	2.57 ab
		NC	3.56 a	1.64 a	4.68 a	2.95 a

\*\* Means followed by the same letter within an environment do not differ significantly at the 5% level according to Duncan's multiple range test.

Table 2. Mean squares for number of selfed seed per pod, hybrid seed per pod and total of pods produced per method for the three experiments combined.

Source of variation	DF	No. of selfed seed/pod	No. of hybrid seed/pod	Total No. of pods produced
MS				
Local (L)	1	43,2432**	96,5967**	25,0272**
Treatments (T)	4	1,6725	6,6727	1,6642*
L x T	4	0,4016	1,1216	0,2315
Exp. Error	24	1,1378	1,0662	0,2614

\* Significant at the 0.05 level

\*\* Significant at the 0.01 level