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### Effect of artificial defoliation on the yield of two indeterminate bean (*Phaseolus vulgaris* L.) cultivars

**Resumo.** Dois cultivares de feijão de hábito de crescimento indeterminado "S-182-N" e "Carioca" foram submetidos a 33 e 66% de desfolhamento artificial, quando as plantas tinham 20, 30, 40, 50 ou 60 dias de idade. Verificou-se que 66% de desfolhamento é muito prejudicial ao rendimento da cultura, quando realizado nos estádios de florescimento e formação das vagens. O cv. "Carioca" é algo mais tolerante ao desfolhamento que o "S-182-N".

There are in Brazil several leaf-feeding pests that attack the common bean crop, such as the beetles *Diabrotica speciosa* (Germar), *Ceratomyza uncinata* (Germar) and *Lagriella villosa* F.; the slugs, and others. They can be controlled by appropriate pesticides but the farmers have no information on when the pesticide should be used in relation either to the foliar area destroyed or to the growth stage of the bean plants.

Leaf removal has been used to simulate pest or disease damage. Galvez *et al* (5) reduced the foliar area of two bean cultivars to 80, 60, 40, 20, and 0% when they reached the following growth stages: first three trifoliate leaves, flowering initiation, pod formation, and the beginning of maturation. They found that, for any stage, yield reduction followed the increase of percentage of defoliation, with the greatest yield losses when defoliation occurred at the flowering and pod formation stages. Chagas *et al* (3) removed 0, 1, 2, and 3 leaflets of each leaf from two determinate type cultivars. The defoliations were done once at each of the following ages: 20, 30, and 40 days after seedling emergence. Total defoliation at any age always brought about a strong decrease in yield. At the age of 20 days the other levels of defoliation were not detrimental to the bean yields; however, the removal of 2 leaflets was detrimental to the bean plants when they were 30 and 40 days old.

The tolerance to defoliation among bean cultivars is variable, as shown by several authors (1, 3, 4). According to Edje *et al* (4), seed yield reduction due to defoliation is much less in indeterminate than in determinate cultivars.

This communication reports the results of an investigation as to the effect of leaf removal on bean yield, carried out at Viçosa, state of Minas Gerais, Brazil. Two indeterminate cultivars were used, since in a previous investigation, at the same locality, two determinate cultivars were included (3).

### Material and methods

A factorial design with five growth stages x three levels of defoliation was employed, the treatments being distributed in a randomized complete-block experiment with four replications. Each plot included four rows, five meters long and 50 cm apart. The two external rows plus 20 cm of each end of the internal rows were considered as border. Seeds were planted 8-10 cm apart.

The defoliations were carried out 20, 30, 40, 50 or 60 days after seedling emergence. The degrees of defoliation were 0, 33, and 66%, which were obtained by cutting with scissors 0, 1, and 2 leaflets from each leaf of each entire plant, respectively.

Three experiments were carried out, two with the black bean "S-182-N" and one with the cv. "Carioca." The cultivar "S-182-N" has an indeterminate growth habit, erect main stem and limited guide development. According to CIAT (2) classification, it has the plant type II. "Carioca" also has an indeterminate growth habit, but with prostrate, long branches (type III).

### Results and discussion

In both experiments, "S-182-N" took approximately 40 days to flower and 85 days to mature; the cv. "Carioca" took 30 and 75 days, respectively. One of the experiments with the black

bean was carried out under the condition of water stress, which resulted in low yields.

Average results are given in Table 1. The three experiments showed that 66% defoliation is very detrimental to the yield when made during the flowering and pod-formation stages, principally under water stress. With one exception (33% at 20 days in the first trial with "S-182-N"), no significant difference was found between the yields of the check and the 33% defoliation treatments. No explanation was found for that exception, since normally young bean plants recover very well from defoliation damage. Considering the three experiments, the most damaging treatment was 66% at 40 days, i.e., severe defoliation when the plants were flowering.

The data also show that the cultivar "Carioca" was more tolerant to defoliation than the cv. "S-182-N." The maximum yield decrease in the former was 23%, whereas in the latter it was 37%, under conditions of good water supply. As pointed out before, this difference among cultivars has been reported by others.

In a previous investigation with two determinate cultivars (3) it was found that 66% defoliation at 40 days caused approximately 36% yield reduction in one cultivar and 28% in the other. Thus, the cv. "S-182-N" was less tolerant to leaf removal than one of the determinate cultivars. Apparently, there is no relationship between this tolerance and the growth habit. It seems that leaf number, leaf size and leaf orientation are the traits which determine the level of tolerance to defoliation.

Table 1. Effect of defoliation on the yield of the bean cultivars "S-182-N" and "Carioca."

Defoliation (%)	Plant age (days)	S-182-N(†)		S-182-N		Carioca	
		kg/ha	%	kg/ha	%	kg/ha	%
0 (check)		762	100	1742	100	1828	100
33	20	574*	75	1523	87	1734	95
	30	656	86	1793	103	1779	97
	40	656	86	1490	85	1768	97
	50	624	82	1619	93	1542	84
	60	638	84	1640	94	1576	86
66	20	593	78	1527	88	1614	88
	30	524**	69	1512	87	1458*	80
	40	417**	55	1096**	63	1410*	77
	50	504**	66	1417*	81	1409*	77
	60	618	81	1345**	77	1615	88

\*and \*\* significantly different from the check at the 5% and 1% level, respectively.

(†) Grown under water stress

## Summary

Two indeterminate bean cultivars "S-182-N" and "Carioca" were subjected to 33 and 66% artificial defoliation, when they were 20, 30, 40, 50, or 60 days old. It was found that 66% defoliation is very detrimental to yield when made during the flowering and pod-formation stages. The cv. "Carioca" is somewhat more tolerant to the leaf removal than the cv. "S-182-N."

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## Relación entre el rendimiento y la forma de la panoja en la quinua\*

**Summary.** Quinoa's panicle shape, which could be glomerulated or amarantiform, does not relate to yield neither to other yield components such as earliness, height of plant, panicle length and grain diameter

El mejoramiento genético de la quinua (*Chenopodium quinoa* Wild), que es un cultivo muy difundido en la meseta andina y los valles interandinos desde Colombia hasta el norte Argentino, ha merecido especial atención en los últimos años. Sin embargo, en los programas de mejoramiento no se ha tomado en cuenta la relación entre el rendimiento de grano y la forma glomerulada o amarantiforme de su inflorescencia, habiéndose seleccionado indistintamente cualquiera de las formas.

El carácter morfológico más importante de la planta de quinua para su clasificación, ha sido la forma de la panoja. De las 17 razas descritas por Gandarillas (3), diez son de inflorescencia glomerulada y siete amarantiforme. La forma ancestral fue la glomerulada, ya que todas las especies silvestres de este género tienen esta forma, lo cual significa que la amarantiforme es un mutante relativamente reciente de aquel (2)

Estudios efectuados por Espíndola (1) y Pereira (4), sobre la interrelación existente entre el rendimiento y otros caracteres de la planta que pudieran ser componentes de aquel, muestran correlaciones consistentes. Los autores mencionados encontraron que la altura de la planta, la longitud de la panoja y el diámetro del tallo, muestran una correlación positiva con el rendimiento

En el presente trabajo, se estudia la relación entre el rendimiento de grano y la forma de la panoja glomerulada y amarantiforme. Además, se hacen observaciones de algunos caracteres como la precocidad, altura de la planta, longitud de la panoja, diámetro del tallo y diámetro del grano con el objeto de observar su distribución entre las dos formas.

## Materiales y métodos

Para observar la relación entre el rendimiento y la forma de la panoja, se estableció un experimento muy simple en parcelas pareadas de 16 muestras glomeru-

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