

# WEED CONTROL IN CORN VIA INTERCROPPING WITH GLIRICIDIA SOWN BY BROADCASTING<sup>1</sup>

*Controle de Plantas Daninhas no Milho por Meio da Consorciação com Gliricidia Semeada a Lanço*

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**ABSTRACT** - There has been interest in reducing the use of herbicides for weed control in order to decrease environmental degradation problems. The objective of this study was to evaluate the effects of gliricidia planting density sown by broadcasting and intercropping on green ear and corn grain yield as well as on weed control. A randomized block design with split-plots and five replicates were adopted. Cultivars AG 1051, BM 2022, and BM 3061, assigned to plots, were submitted to the following treatments: no hoeing, two hoeings (at 20 and 40 days after sowing), and intercropped with gliricidia sown at densities of 10 and 20 seeds m<sup>-2</sup>. Thirty weed species occurred in the experiment area, with *Cucumis anguria* as the most frequent ones. Cultivar BM 2022 was the best for the total number of ears (TNE) and number (NMHE) and weight of marketable husked ears. Together with cultivar AG 1051, this cultivar had the highest total weight and marketable unhusked ear weight (MUEW). However, the cultivars did not differ with respect to grain yield (GY). The highest green ear and corn grain yield and weed control percentages were obtained with two hoeings; in MUEW, NMHE and GY, intercropping provided intermediate means in comparison with those obtained in hoed and non-hoed plots, indicating that gliricidia was partially beneficial to corn. Increased gliricidia seeding density heightened the benefits to corn (TNE and MUEW). The lack of hoeing produced the poorest green ear and grain yields.

**Keywords:** *Zea mays*, *Gliricidia sepium*, green ear yield, grain yield.

**RESUMO** - Existe interesse na redução do uso de herbicidas, visando-se a diminuição de problemas de degradação ambiental. O objetivo do trabalho foi avaliar os efeitos da densidade da gliricídia, semeada a lanço e em consorciação, sobre os rendimentos de espigas verdes e de grãos do milho e sobre o controle de plantas daninhas. Utilizou-se o delineamento de blocos ao acaso com parcelas subdivididas e cinco repetições. As cultivares AG 1051, BM 2022 e BM 3061, plantadas nas parcelas, foram submetidas aos seguintes tratamentos: sem capinas, duas capinas (aos 20 e 40 dias após a semeadura) e consorciação com a gliricídia, semeada nas densidades de 10 e 20 sementes m<sup>2</sup>. Trinta espécies de plantas daninhas ocorreram na área experimental, sendo ***Cucumis anguria*** a mais frequente. A cultivar BM 2022 foi a melhor quanto ao número total de espigas (NTE) e número (NEDC) e peso de espigas despalhadas comercializáveis. Essa cultivar apresentou, juntamente com a cultivar AG 1051, os maiores pesos total e de espigas empalhadas comercializáveis (PEEC). Todavia, as cultivares não diferiram quanto ao rendimento de grãos (RG). Os maiores rendimentos de milho verde e de grãos e de controle das plantas daninhas foram obtidos com duas capinas; a consorciação propiciou em PEEC, NEDC e RG médias intermediárias às obtidas nas parcelas capinadas e não-capinadas, indicando que a gliricídia foi parcialmente benéfica ao milho. O aumento da densidade de semeadura da gliricídia aumentou os benefícios para o milho (NTE e PEEC). A ausência de capinas propiciou os piores rendimentos de espigas verdes e de grãos.

**Palavras-chave:** *Zea mays*, *Gliricidia sepium*, rendimento de espigas verdes, rendimento de grãos.

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## INTRODUCTION

Herbicides have simplified weed control and started to be extensively used, replacing cultural weed control methods in several regions. However, the extensive use of herbicides has resulted in the selection of weed biotypes resistant to these products. Such biotypes already exist at low frequencies in cultivated areas, but being resistant to herbicides, at each generation they produce a higher number of offspring than non-resistant biotypes. Consequently, after a few generations, the proportion of resistant biotypes present in the weed population tends to increase. In addition, herbicides have become an environmental contamination factor. Cultural practices leading to a more sustainable weed control studied in the past have again become interesting and are once again being studied (Moraes et al., 2009), including intercrops (Borghini et al., 2008; Silva et al., 2009a, b).

A cover crop, that is, a crop used in intercropping for weed control purposes, accomplishes such control in a number of ways. A rapid occupation of free space between the plant rows of the main crop reduces weed germination, growth, and development. The germination of weed seeds can be inhibited due to light interception or secretion of allelochemicals in the cover crop. After weeds are established, competition for resources becomes the main mechanism of weed suppression in the cover crop (Hollander et al., 2007). The decrease in weed incidence in corn via intercropping is dependent on several factors, including cultivar, weather conditions (Kuchinda et al., 2003), sowing season, intercropped species (Skóra Neto, 1993), and fertilizer applied (Olasantan et al., 1994).

Another factor that influences weed control in intercrops is the planting density of the crop employed to control weeds via intercropping. All plant spacing tested between sweet potato (*Ipomoea batatas*) plants suppressed weed growth and increased grain yield in corn in comparison to non-hoed corn grown as a monocrop (Aladesanwa & Adigun, 2008). *Cucurbita maxima* intercropped with corn at various densities reduced total weed biomass and the biomass of the dominant weeds *Amaranthus retroflexus* and

*Convolvulus arvensis*, but corn yield was not necessarily reduced in the intercrop, except at the highest density of the cucurbit or under limited moisture (Fujiyoshi et al., 2007).

Gliricidia (*Gliricidia sepium*) is a tree legume native to Mexico (Drumond & Carvalho Filho, 2005). The use of gliricidia branches as soil mulch did not have an allelopathic effect on corn and bean (*Phaseolus vulgaris*), but significantly decreased the population of some weed species (Obando, 1987). Gliricidia branches used as soil mulch reduced weed density and weed biomass (Kamara et al., 2000). These results have encouraged an investigation on the effects of gliricidia as an intercrop on weed control in corn. That investigation showed that the legume controlled, to a certain extent, the weeds (Silva et al., 2009b). In that study, gliricidia was grown by transplanting to ensure uniform germination and fast establishment in the field. However, transplanting is costly since it involves labor for seedling production and transplanting. Therefore, it is interesting to evaluate whether direct sowing of gliricidia would still provide control of weeds.

Another management practice, which can help reduce the use of herbicides, is the use of cultivars that can tolerate or suppress weeds more effectively. Variety differences in weed controlling capacity have been reported for many crops, including corn (Begna et al., 2001). Plant height, leaf development rate, leaf area index, and leaf distribution in the canopy have been cited as the most important weed-suppressing traits (Sinoquet & Caldwell, 1995); but it is possible that other traits, including those related to the root system, may also influence suppression.

The objective of this study was to evaluate the effects of gliricidia seeding density by broadcasting, intercropped with corn, on weed control, green ear yield, and grain yield of corn cultivars.

## MATERIAL AND METHOD

The research was conducted at Fazenda Experimental "Rafael Fernandes" (Experimental Farm), Universidade Federal Rural do Semi-Árido – UFERSA, during the period from March to June 2008. The farm is

located in the district of Alagoinha, 20 km away from the municipal seat of Mossoró-RN (latitude 5°11'S, longitude 37°20'W, and 18 m elevation). According to Gaussen's bioclimatic classification, the climate in the Mossoró region is classified as type 4ath, or distinctly xerothermic, that is, tropical hot with a pronounced, long dry season, lasting from seven to eight months and with a xerothermic index between 150 and 200. The mean maximum temperature in the region is between 32 and 35 °C, with June and July being the coolest months, while the mean annual precipitation is around 670 mm (Carmo Filho & Oliveira, 1989).

The soil in the experiment area is classified as a Red-Yellow Argisol, according to the Brazilian Soil Classification System (Embrapa, 1999), and as a Ferric Lixisol, according to the Soil Map of the World (FAO, 1988). Weed control in the area where corn or cowpea (*Vigna unguiculata*) was previously grown has always been achieved by means of two hoeings, performed at 20 and 40 days after seeding. No phytosociological weed survey prior to the experiment installation was performed in the area. The analysis of a soil sample taken from the experiment area indicated the following: pH = 6.4; Ca<sup>2+</sup> = 1.50 cmol<sub>c</sub> dm<sup>-3</sup>; Mg<sup>2+</sup> = 0.60 cmol<sub>c</sub> dm<sup>-3</sup>; K<sup>+</sup> = 0.17 cmol<sub>c</sub> dm<sup>-3</sup>; Na<sup>+</sup> = 0.04 cmol<sub>c</sub> dm<sup>-3</sup>; Al<sup>3+</sup> = 0.00 cmol<sub>c</sub> dm<sup>-3</sup>; P = 38 mg dm<sup>-3</sup>; Org. Mat. = 10.0 g kg<sup>-1</sup>.

The soil was tilled with a tractor by means of two harrowings and received 1/3 of total N applied (90 kg<sup>-1</sup>), 60 kg P<sub>2</sub>O<sub>5</sub>, and 30 kg K<sub>2</sub>O per ha, as planting fertilization. The remaining N was applied in equal parts after each hoeing. Ammonium sulfate, single superphosphate, and potassium chloride were used as sources of N, P, and K, respectively. Plant rows were spaced 1.0 m apart, and pits in the same row were spaced 0.40 m apart. Seeding was accomplished manually using four seeds per pit. A thinning operation was performed 20 days after planting, leaving the two more vigorous plants in each pit; the experiment was thus left with a programmed sowing density of 50 thousand plants ha<sup>-1</sup>.

The fall armyworm (*Spodoptera frugiperda*), the main pest of the corn crop in the region, was controlled with sprays of

0.0-diethyl-0,3,5,6-trichloro-2-pyridinyl thiophosphate (0.4 L ha<sup>-1</sup>), using a backpack sprayer.

The experiment was carried out under dryland conditions, but received sprinkler irrigation as needed, with experimental plots arranged perpendicularly to the row of sprinklers. The water depth required for corn (5.3 mm) was calculated considering an effective depth of the root system of 0.40 m. Irrigation time was based on water retained in the soil at a tension of 0.40 MPa. Irrigations were performed three times a week, starting after seeding and finishing five days before harvesting the mature ears.

A randomized block experimental design with split-plots and five replicates were adopted. Each subplot consisted of four rows 6.0 m in length each. The usable area was considered as the space occupied by the two central rows, where we eliminated the plants from one of the pits at each end. Cultivars AG 1051, BM 2022, and BM 306, planted in the plots, were submitted to the following treatments, assigned to the subplots: no hoeing, two hoeings (at 20 and 40 days after planting), and intercropping with gliricidia. Cultivars were used in the plots and weed control treatments were applied to the subplots. Weeding was performed with a hoe. In the intercropped treatment, gliricidia was sown by broadcasting at corn planting between the corn rows at two sowing densities (10 and 20 seeds m<sup>-2</sup>). The gliricidia seeds, with a germination rate of practically 100%, were broadcast on the soil surface as uniformly as possible between the corn rows, and incorporated with a rake.

One of the two rows in the usable area of each subplot was selected at random to evaluate corn green yield, while the other one was used to evaluate mature corn yield. Green corn yield was evaluated by the total number and weight of ears and the number and weight of marketable ears, both unhusked and husked. Marketable unhusked ears were considered as those with appearance suitable for commercialization and length equal to or above 22 cm. Marketable husked ears were considered as those that displayed health and grain set suitable for commercialization, and length equal to or above 17 cm. Evaluations



were made in mature corn for grain yield and its components. The ears produced in the usable area of each subplot were harvested when the grain achieved a water content of about 20%, and were then placed to dry and subsequently threshed out manually. The numbers of ears thus obtained and their grain allowed to estimate the number of ears per hectare and grain yield. Number of kernels per ear was estimated based on the kernels counted in ten of those ears. One hundred-kernel weight was obtained from five samples containing 100 kernels each.

After harvesting the mature corn, data were obtained from corn plant height and corn ear height, gliricidia height, gliricidia stand, weed dry matter, and weed floristic composition. Plant height and ear height were measured in all plants of the row that had been selected to evaluate grain yield. The distance from ground level to the point of insertion of the tallest leaf blade was considered as plant height; ear height was measured from ground level to the base of the tallest ear (first ear, in the case of prolific plants). The gliricidia plants present in the area between the two central rows of each experiment unit were counted and measured. Gliricidia plant height was considered as the distance from ground level to the crown top of each plant. The weeds found in a 1.0 x 1.0 m area, established at random in the central part of the subplot, were cut even with the ground, identified, and weighed. Dry biomass was estimated by grinding samples weighing around 500 g, which were placed to dry in a forced air circulation oven adjusted to a temperature between 70 and 80 °C.

The occurrence index, defined by the ratio between the number of units where a given species occurred and the total number (60) of experimental units in the experiment, was calculated after the weed species found in each experimental unit had been identified.

The data were submitted to analysis of variance using software (SAEG) developed by Universidade Federal de Viçosa (Ribeiro Junior, 2001), while regression analyses were made with the software developed by Jandel (1992). The data were tested for homogeneity

of variances prior to the statistical analyses (Bartlett, 1937). Since count data tend to follow the Poisson distribution, gliricidia stand data were transformed to square root prior to the statistical analysis (Bartlett, 1947). The means were compared at 5% probability by Tukey's test whenever the F test values from the analysis of variance were significant. Regression analyses were run to detect potential effects of increased gliricidia seeding density (independent variable) on the traits evaluated (dependent variable). In these analyses, non-hoed plots were considered as "seeding density zero". A regression equation was selected based on the following criteria: biological explanation of the phenomenon observed, simplicity of the equation, significance of the coefficients at 5% probability by *Student's* t-test and value of coefficient of determination.

## RESULTS AND DISCUSSION

Thirty weed species occurred in the experiment (Table 1) where most of them belong to family Poaceae. The weed population in a given area depends on several factors (weed seed bank, soil, climate, previous crops, etc.), and although the population comprises different species, few of them are predominant, corresponding to 70 to 90% of the total species (Buhler, 1999). Some species occurred more frequently than others (Table 1). The species *Cucumis anguria*, for example, occurred in 80% of the experiment units, while most of the species occurred at frequencies around 2% (Table 1).

There were no effects of the cultivars x weed control interaction on the traits evaluated. For this reason, only means for the main effects of both treatment groups are presented here.

No differences were found between dry matters of the above-ground part of weeds that occurred in plots of the three cultivars (mean 194 g m<sup>-2</sup>, CV<sub>plots</sub> = 41.1%). Also, there were no differences between non-hoed and intercropped plots for dry matter of the aboveground part of weeds (mean 236.3 g m<sup>-2</sup>, CV<sub>subplots</sub> = 43.8%), but this mean was significantly higher than the mean obtained in hoed plots (68.7 g m<sup>-2</sup>).

**Table 1** - Index of occurrence (number of plots where a given weed species occurred/total number of experiment plots) of weed species with their respective families, identified in experiment plots of corn. Mossoró-RN, 2008

Order number	Species	Family	Index of occurrence (%)
1	<i>Acanthospermum hispidum</i> DC.	Asteraceae	1,7
2	<i>Adenocalymma</i> sp.	Bignoniaceae	1,7
3	<i>Alternanthera tenella</i> Colla	Amaranthaceae	73,3
4	<i>Amaranthus viridis</i> L.	Amaranthaceae	1,7
5	<i>Blainvillea acmella</i> (L.) Philipson	Asteraceae	8,3
6	<i>Borreria verticillata</i> (L.) G. Mey	Rubiaceae	1,7
7	<i>Cenchrus echinatus</i> L.	Poaceae	5,0
8	<i>Chamaecrista</i> sp.	Caesalpinaceae	1,7
9	<i>Commelina benghalensis</i> L.	Commelinaceae	60,0
10	<i>Cucumis anguria</i> L.	Cucurbitaceae	80,0
11	<i>Cyperus rotundus</i> L.	Cyperaceae	1,7
12	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Poaceae	1,7
13	<i>Desmodium glabrum</i> (Mill.) DC.	Fabaceae	3,3
14	<i>Digitaria sanguinalis</i> Scop.	Poaceae	10,0
15	<i>Euphorbia hirta</i> L. (= <i>Chamaesyce hirta</i> (L.) Millsp.)	Euphorbiaceae	1,7
16	<i>Herissantia crispa</i> (L.) Brizicky	Malvaceae	1,7
17	<i>Hyptis suaveolens</i> (L.) Poit.	Lamiaceae	1,7
18	<i>Indigofera microcarpa</i> Desv.	Fabaceae	1,7
19	<i>Ludwigia</i> sp.	Onagraceae	1,7
20	<i>Ipomoea bahiensis</i> Willd. Ex Roem and Schult	Convolvulaceae	5,0
21	<i>Merremia aegyptia</i> (L.) Urb.	Convolvulaceae	8,3
22	<i>Merremia cissoides</i> (Lam.) Hallier f.	Convolvulaceae	3,3
23	<i>Panicum maximum</i> Jacq. (= <i>Urochloa maxima</i> (Jacq.) R. D. Webster)	Poaceae	1,7
24	<i>Physalis angulata</i> L.	Solanaceae	1,7
25	<i>Phyllanthus amarus</i> Schumach. and Thonn.	Euphorbiaceae	1,7
26	<i>Richardsonia grandiflora</i> Cham. and Schltldl.	Rubiaceae	1,7
27	<i>Senna</i> sp.	Caesalpinaceae	1,7
28	<i>Sida spinosa</i> L.	Malvaceae	1,7
29	<i>Stachytarpheta</i> sp.	Verbenaceae	1,7
30	<i>Waltheria indica</i> L.	Sterculiaceae	1,7

The mean densities of gliricidia plants between rows in cultivars AG 1051, BM 2061, and BM 2022 at the end of the experiment were 3.6 b; 4.5 ab; and 6.3 a, respectively (where means followed by the same letter do not differ from one another, at 5% probability by Tukey's test). Therefore, the corn cultivars differed in their competitive ability with gliricidia. This fact indicates the complexity of relations between species, when weed control is sought via intercropping. Some of the plants of the intercropped species selected to benefit corn may be eliminated by some corn cultivars. This may also help explain the discrepancies between studies on weed control by intercropping. A higher gliricidia seeding density (20 seeds m<sup>-2</sup>) provided a higher final stand (5.65 plants m<sup>-2</sup>) than the stand obtained at the lowest (10 seeds m<sup>-2</sup>) seeding density

(3.93 plants m<sup>-2</sup>). The CV<sub>plots</sub> and CV<sub>subplots</sub> values for the final gliricidia stand were 40.3 and 40.7%, respectively. There was no effect of cultivars or gliricidia seeding density on mean height of this legume plant (mean 44.6 cm, CV<sub>plots</sub> = 15.8 and CV<sub>subplots</sub> = 24.6).

Cultivar BM 2022 was the best for three (total number of ears and number and weight of marketable husked ears) among the six traits used to evaluate green corn yield (Table 2). In addition, along with cultivar AG 1051, this cultivar had the highest total weight and marketable unhusked ear weight (Table 2). There were no differences between cultivars for the number of marketable green ears, indicating that, from the total number of ears harvested, higher numbers of ears were



discarded in the most productive cultivars, in terms of ear total number.

There were no differences between weed control methods with respect to total number of green ears (Table 3). For the other traits, two hoeings provided higher yields than the other treatments, which did not differ from one another (Table 3). As regards to weight of marketable unhusked ears and number of marketable husked ears, intercropping with gliricidia produced intermediate yields in relation to non-hoeing and two-hoeing treatments.

Cultivar AG 1051 had the highest plant height and ear height values (Table 4). Plant height is considered an important trait in competition. Although it did not influence weed dry matter, the highest plant height obtained in cultivar AG 1051 may have contributed towards the previously reported reduction in gliricidia stand. There were no differences between cultivars as to grain yield,

although they differed with respect to the three main yield components (Table 4). The compensation that occurs among these components is well known. For example, cultivar BM 2022 had the highest numbers of ears per hectare and kernels per ear (in this case, together with cultivar AG 1051), but showed the smallest weight of 100 kernels. Similar compensations occurred with the other cultivars (Table 4).

Not always the best cultivars for green corn production (Table 2) are also the best for grain yield (Table 4). Each product is evaluated differently. Ears unsuitable for sale as green corn (very small, with poor grain set, attacked by pests, etc.) can be perfectly used for mature grain (Silva et al., 2009b).

Weed control method did not influence plant height and corn ear height, but grain yield was higher in hoed plots, smaller in non-hoed plots, and intermediate in plots intercropped with gliricidia (Table 5). These

**Table 2** - Means (of five replicates and four weed control methods) for green ear yield in corn cultivars<sup>1/</sup>

Cultivar	Green ear totals ha <sup>-1</sup>		Marketable unhusked green ears ha <sup>-1</sup>		Marketable husked green ears ha <sup>-1</sup>	
	Number	Weight (kg)	Number	Weight (kg)	Number	Weight (kg)
BM 2022	50,613 a	13,542 a	47,261 a	12,979 a	39,213 a	7,510 a
AG 1051	48,889 ab	13,243 a	44,776 a	12,753 a	29,692 b	6,233 b
BM 3061	47,939 b	11,940 b	44,112 a	11,408 b	34,738 ab	6,100 b
CVplots, %	5.7	9.8	12.7	12.5	17.5	19.2

<sup>1/</sup> In the columns, means followed by the same letter do not differ from one another at 5% probability by Tukey's test.

**Table 3** - Means (of five replicates and three cultivars) for green ear yield in corn cultivars submitted to weed control methods<sup>1/</sup>

Weed control method	Green ear totals ha <sup>-1</sup>		Marketable unhusked green ears ha <sup>-1</sup>		Marketable husked green ears ha <sup>-1</sup>			
	Number	Weight (kg)	Number	Weight		Number		Weight (kg)
				Absolute (kg)	Relative (%)	Absolute (kg)	Relative (%)	
Two hoeings	50,556 a	15,489 a	49,011 a	15,274 a	136	40,633 a	136	8,462 a
Intercropped with gliricidia, sown at 10 seeds m <sup>-2</sup>	48,818 a	12,468 b	44,058 b	11,847 b	105	35,741 ab	120	6,563 b
Intercropped with gliricidia, sown at 20 seeds m <sup>-2</sup>	48,877 a	12,020 b	44,119 b	12,470 ab	111	32,008 b	107	6,030 b
No hoeing	48,335 a	11,656 b	44,344 b	11,261 b	100	29,807 b	100	5,402 b
CVsubplots, %	4.7	11.1	12.7	23.6		19.6		18.9

<sup>1/</sup> In the columns, means followed by the same letter do not differ from one another at 5% probability by Tukey's test.

**Table 4** - Means (of five replicates and four weed control methods) for plant height, ear height, and grain yield and its components in corn cultivars<sup>1/</sup>

Cultivar	Heights (cm)		Grain yield (kg ha <sup>-1</sup> )	Number of ears ha <sup>-1</sup>	Number of kernels ear <sup>-1</sup>	100-kernel weight (g)
	Plant	Ear				
BM 2022	195 b	95 b	6,275 a	50,087 a	414.7 a	32.8 b
AG 1051	207 a	115 a	6,122 a	48,820 ab	415.0 a	35.0 a
BM 3061	185 b	93 b	5,816 a	48,107 b	360.3 b	34.7 a
CVplots, %	6.5	5.5	14.3	3.8	11.0	5.8

<sup>1/</sup> In the columns, means followed by the same letter do not differ from one another at 5% probability by Tukey's test.

**Table 5** - Means (of five replicates and three cultivars) for plant height, ear height, and grain yield and its components in corn cultivars<sup>1/</sup>

Weed control method	Heights (cm)		Grain yield (kg ha <sup>-1</sup> )		Number of ears ha <sup>-1</sup>	Number of kernels ear <sup>-1</sup>		100-kernel weight (g)
	Plant	Ear	Absolute (kg)	Relative (%)		Absolute (kg)	Relative (%)	
Intercropped with gliricidia, sown at 10 seeds m <sup>-2</sup>	200 a	103 a	6,332 ab	119	49,123 a	408 ab	111	34.0 a
Intercropped with gliricidia, sown at 20 seeds m <sup>-2</sup>	194 a	99 a	5,777 ab	108	48,167 a	386 bc	105	34.0 a
No hoeing	196 a	101 a	5,327 b	100	48,301 a	367 c	100	33.2 a
CVsubplots, %	6.8	5.1	19.1		5.3	9.3		8.2

<sup>1/</sup> In the columns, means followed by the same letter do not differ from one another at 5% probability by Tukey's test.

differences in grain yield were due to the differences in the number of kernels per ear, since the weed control methods did not differ from one another with regard to the other two grain yield components (Table 5). Other authors (Silva et al., 2009b) have reported similar results. As weeds compete with crops for water, light, nutrients, and space, smaller corn plants are expected in plots where no weed control is performed. When no differences in plant height and ear height are observed in hoed and non-hoed corn in competition with weeds, corn plants may show some degree of etiolation, at least in their initial growth stages. At these stages corn competition with weeds for light should be higher. Etiolation is the development of shoots, branches, or their parts in the absence of light, which usually causes elongated growth with a yellow or white color resulting from the lack of chlorophyll (Hartmann & Kester, 1990).

For some traits used to assess green corn yield (Table 3) and grain yield (Table 5), intercropping with gliricidia produced intermediate means between those obtained in hoed and non-hoed plots. In addition, the *b* values in the equations  $y_1^2 = 2338020000 + 12356700 x^{0.5}$  ( $R^2 = 0.97$ ) and  $y_2 = 11254.8 + 60.5 x$  ( $R^2 = 0.99$ ), which establish a relationship between gliricidia seeding density (*x*) and the total number of green ears ( $y_1$ ) or gliricidia seeding density (*x*) and the weight of marketable unhusked green ears ( $y_2$ ), were significant at 10 and 5% probability by the *t* test, respectively. These facts indicate that intercropping with gliricidia was, in part, beneficial to corn, since it did not have a complete weed control. Similar beneficial effects have been observed by other authors (Silva et al., 2009b), when corn was intercropped with gliricidia by transplanting seedlings of this legume. The data obtained



in the present study reveal that gliricidia transplanting can be replaced with direct sowing, which is a faster, easier, and more economic system, although it requires a higher number of seeds. These data also demonstrate that increased gliricidia seeding density enhanced the benefits to corn, at least for some traits. As the planting density of the intercropped species increased, reductions in weed density and biomass have also been observed by other authors (Fujiyoshi et al., 2007; Aladesanwa & Adigun, 2008).

The lowest means of almost all evaluated traits were observed in non-hoed corn. This may have occurred due to corn competition with weeds for water, light, and nutrients (Carruthers et al., 1998), but also or mainly because weeds cause reductions in the corn root system and leaf area (Silva et al., 2009c) and may produce allelopathic substances that may be harmful to corn (Rajcan & Swanton, 2001). For similar reasons, gliricidia may have benefited corn, negatively influencing the weeds. At least 15 toxic substances were identified in the above-ground part of gliricidia that could have allelopathic action (Ramamoothy & Paliwal, 1993). Although in the present work intercropping with gliricidia did not significantly reduce weed growth, such a reduction occurred when cotton was intercropped with gliricidia (Silva et al., 2009a).

There were no effects of the cultivars x weed control interaction on the evaluated traits. The cultivars did not influence weed growth, but they produced different gliricidia stands. Cultivar BM 2022 had the best results for the total number of ears and the number and weight of marketable husked ears. Together with cultivar AG 1051, this cultivar had the highest total weight and marketable unhusked ear weight. However, the cultivars did not differ with respect to grain yield. The highest green ear and corn grain yields were obtained with two hoeings; in some traits used to evaluate green ear yield and grain yield, intercropping provided intermediate means as compared to those obtained in hoed and non-hoed plots, indicating that gliricidia was partially beneficial to corn. Increased gliricidia seeding density enhanced the benefits to corn. The lack of hoeing produced the poorest green ear and grain yields.

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