INTERACTION BETWEEN A COVER CROP (*MUCUNA* SP.), A WEED (*ROTTBOELLIA COCHINCHINENSIS*) AND A CROP (MAIZE)[4]

Bernal E. Valverde, Arnoldo Merayo, Carlos E. Rojas and Tom Alvarez
Area de Fitoprotección, CATIE, Turrialba 07170, Costa Rica

Resumen: Se realizó un experimento en Guanacaste, Costa Rica, para estudiar la interacción entre la leguminosa de cobertura, *Mucuna* sp., la maleza conocida como pasto indio (*Rottboellia cochinchinensis*) y el maíz. Se sembró *Mucuna* entre las hileras de maíz a 0, 50 000 y 80 000 plantas/ha. Mediante la aplicación de pendimetalina a razón de 0.12, 0.25, 0.50 y 1.50 kg/ha se obtuvieron cuatro densidades de pasto indio. La eliminación total de la maleza se logró con la dosis más alta de pendimetalina suplementada por deshierba manual. Al final del ciclo de cultivo, en ausencia de *Mucuna*, la biomasa aérea de pasto indio fue de 0, 525, 665, and 1016 g/m^2 según aumentó su densidad. *Mucuna*, irrespectivamente de su densidad, redujo la biomasa del pasto indio entre 75 and 95%. Por el contrario, no se observó ningún efecto del pasto indio sobre la biomasa producida por *Mucuna*. Todos los tratamientos redujeron el rendimiento del maíz en comparación con el testigo (sin interferencia de la maleza y la leguminosa). Consideradas individualmente, la cobertura y la maleza redujeron el rendimiento del maíz hasta en un 40%. La conveniencia de asociar *Mucuna* con maíz para el control de pasto indio debe evaluarse rigurosamente considerando las posibles pérdidas de rendimiento, sus beneficios indirectos y el costo de tratamientos opcionales.

Introduction

Itchgrass (*Rottboellia cochinchinensis*) is one of the most troublesome weeds in Central America. Itchgrass is widespread in Costa Rica, especially in the Pacific and Atlantic regions where it is a major weed in maize, beans, dryland rice, sorghum and sugarcane (Herrera, 1989).

In the seasonally arid area of the Pacific Northwest of Costa Rica, itchgrass causes major crop losses and costs of controling it may limit planting areas for small and medium-size farmers (Rojas *et al.*, 1993b). Under these conditions, the critical period of competition in maize varies between 20 and 60 days after crop planting, depending on the season and itchgrass density, and yield reductions of 45 to 64% have been recorded when left unchecked (Rojas *et al.*, 1993a).

Itchgrass infestation in maize can be reduced by in-crop use of selective herbicides, chemical control during the fallow period and zero tillage (Rojas *et al.*, 1993b). Cover crops also can supress itchgrass when planted in association with maize or during the fallow period. Of several species evaluated, velvetbean (*Mucuna* sp.) was shown to be the best adapted and exhibited the highest ground cover and itchgrass suppression without causing yield losses (De la Cruz *et al.*, 1994).

Research is being conducted to study the competitive effects of both itchgrass and velvetbean on maize yield. In this paper, results from a first experiment on the effect of velvetbean in the presence of increasing densities of itchgrass on maize yields are presented.

Materials and methods

The experiment was established at the University of Costa Rica Regional Centre in Santa Cruz, Guanacaste, Costa Rica, on land which was naturally infested by itchgrass. Maize (cv Diamantes) was planted manually on 23-08-94 at 1.0 by 0.4 m spacing to achieve a density of 50 000 plants/ha. Velvetbean was planted a week later (31-08-94) between maize rows at two spacings (0.40 and 0.25 m) to obtain densities of 50 000 and 80 000 plants/ha. At maize planting, 225 kg/ha of 10-30-10 fertilizer was applied together with 8 kg/ha chlorpyrifos, supplemented with a 136 kg/ha application of ammonium nitrate 21 days after planting (DAP).

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[4] Presented at the Brighton Crop Conference-Weeds, Brighton, United Kingdom, in November 1995.

To obtain four itchgrass densities, a tank mixture of pendimethalin (0.12, 0.25, 0.50 or 1.50 kg/ha) plus 0.40 kg/ha paraquat were applied one DAP by a portable CO_2-operated sprayer equipped with four TeeJet SS8003 flat fan nozzles delivering 250 l/ha. Itchgrass plants that escaped the highest rate of pendimethalin were pulled by hand to achieve the zero density.

Treatments were arranged in a four by three factorial in a complete randomized block design with four replications. Factors were four densities of itchgrass (zero, low, medium and high) and three velvetbean densities (0, 50 000 and 80 000 plants/ha). Experimental plots were 20 m^2 with a sampling unit of four rows of maize for a total of 13.5 m^2. Additionally, four quadrats (0.40 x 0.40 m) were randomly marked, two within the maize row and two between maize rows (where velvetbean had been planted), for determining itchgrass densities. Number of itchgrass plants in each quadrat were counted weekly beginning two weeks after planting (WAP) until the eighth week. A week before maize harvest, a 1.0 m^2 sample was harvested to determine velvetbean and itchgrass fresh weight. Maize was harvested in the sampling unit on 13-12-94 and dried to 12% moisture content.

Results and discussion

At two WAP, itchgrass densities averaged 0, 11, 24, and 28 plants/m^2 within the maize row and 0, 11, 22 and 23 plants/m^2 between maize rows, corresponding to the zero, low, medium and high densities, respectively. The medium and high densities were equivalent throughout sampling dates, except at the last two dates (7 and 8 WAP) between the maize rows where velvetbean suppressed itchgrass (Fig. 1). Regardless of treatments, itchgrass densities increased up to five WAP (Fig. 1), indicating differential germination and emergence, up to a maximum of 70 plants/m^2 within the maize rows (data not shown). Similar observations were made in experiments by Rojas *et al.* (1993), at the same experimental area, where they found increases in itchgrass densities 45 DAP compared to 15 DAP, regardless of in-crop herbicide use.

At the end of the cropping season, above-ground itchgrass biomass (fresh weight) had substantially decreased in plots where velvetbean had been planted (Table 1). Increasing the velvetbean density from 50 000 to 80 000 plants/ha further slightly reduced itchgrass biomass. Velvetbean suppressed itchgrass biomass between 75 and 95%, being more effective at lower itchgrass densities. On the other hand, itchgrass density did not affect velvetbean biomass nor were differences found between the two actual velvetbean densities (Table 1). Thus, it appears that velvetbean could have a higher competitive ability than itchgrass when growing together, which explains the efficacy of this cover crop in the integrated management of this weed.

The presence of velvetbean or itchgrass, regardless of density, reduced maize grain yield up to 39%. There was no significant interaction between velvetbean and itchgrass densities on maize yield. In previous experiments, at the same location and with similar velvetbean densities, velvetbean suppression of itchgrass improved maize yield (De la Cruz *et al.*, 1994). In the present experiment velvetbean was not allowed to invade the maize row but proximity among plants was enough for interference to occur. The most likely resource for which maize and both velvetbean and itchgrass competed was water since rainfall was unusually low during the cropping season. Based on these results, it is important to further characterize the interaction between the three species to better define the role of velvetbean in integrated management of itchgrass in maize, considering yield penalties, non-herbicidal benefits of the cover crop and cost of alternative treatments.

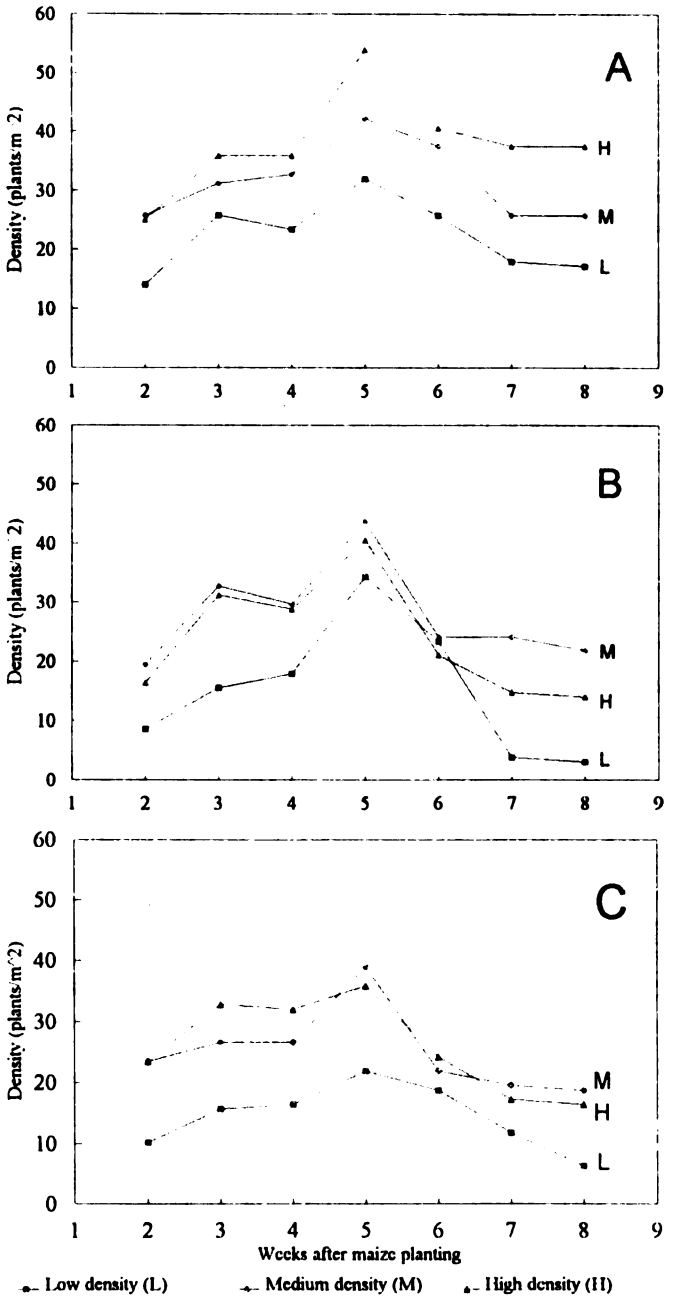

FIGURE 1. Number of itchgrass plants between maize rows at different densities in the absence of velvetbean (A) and with velvetbean at 50 000 plants/ha (B) or 80 000 plants/ha (C).

TABLE 1. Effect of velvetbean and itchgrass densities on velvetbean and itchgrass biomass at the end of the cropping cycle and maize grain yield.

Treatments	Fresh weight (g/m2)		Maize yield
	Itchgrass	Velvetbean	(Kg/ha)
Without velvetbean	(552)[1]	(0)	(3424)
Without itchgrass	0	0	4189
Low itchgrass density	526	0	3167
Medium itchgrass density	665	0	3359
High itchgrass density	1016	0	2981
Velvetbean at 50 000 plants/ha	(111)	(419)	(2809)
Without itchgrass	0	362	3100
Low itchgrass density	26	607	2809
Medium itchgrass density	160	436	2667
High itchgrass density	256	269	2659
Velvetbean at 80 000 plants/ha	(60)	(425)	(2823)
Without itchgrass	0	470	3081
Low itchgrass density	48	280	2570
Medium itchgrass density	54	484	2741
High itchgrass density	139	466	2900
$LSD_{0.01}$ within velvetbean densities	317	-	-
$LSD_{0.01}$ among velvetbean densities	-	155	541

[1] Averages across itchgrass densities in parenthesis.

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References

De la Cruz, R; Rojas C E; Merayo A (1994) Manejo de la caminadora (*Rottboellia cochinchinensis* (Lour.) W.D. Clayton) en el cultivo del maíz y el período de barbecho con leguminosas de cobertura. *Manejo Integrado de Plagas*. **31**, 29-35.

Herrera, F (1989) Situación de *Rottboellia cochinchinensis* en Costa Rica. In: *Seminario-taller sobre Rottboellia cochinchinensis y Cyperus rotundus, Distribución, problemas e impacto económico en Centroamérica y Panamá*. Proyecto MIP-CATIE, Honduras. p. 14.

Rojas, C E; de la Cruz R; Merayo A (1993a) Efecto competitivo de la caminadora (*Rottboellia cochinchinensis* (Lour.) W.D. Clayton) en el cultivo del maíz (*Zea mays* L.). *Manejo Integrado de Plagas*. **27**, 42-45.

Rojas, C E; de la Cruz R; Shannon P J; Merayo A (1993b) Study and management of Itchgrass (*Rottboellia cochinchinensis*) in the Pacific region of Costa Rica. *Brighton Crop Protection Conference - Weeds*, pp. 1183-1188.