

# Pre-emergence weed control in corn in Trinidad\*

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## COMPENDIO

*Se evaluó, en un período de tres años en suelos francos cerca de St. Augustine, Trinidad, la respuesta de malezas y maíz (Zea mays L. cv 'Pioneer') cultivado bajo lluvia a tratamientos de preemergencia o combinados de atrazina con alacloro pynaclor. Todos los tratamientos herbicidas redujeron el crecimiento de malezas durante las primeras 5 semanas. Tratamientos de atrazina o pynaclor solos causaron poco daño, pero ninguno de los tratamientos herbicidas afectaron el número de días hasta la media emisión de barbas, o la población de plantas a la cosecha. Todos dieron rendimientos significativamente más altos, expresados en números de mazorcas y en peso, que el testigo sin tratamiento, pero los tratamientos combinados dieron rendimiento significativamente mejores que los tratamientos con un solo herbicida, los que causaron alguna pérdida de rendimiento comparados con el testigo sin malezas. Ensayos biológicos con muestras de suelo tomadas después de la cosecha de maíz mostraron fitotoxicidad a las 4 semanas con todos los tratamientos con herbicidas, excepto alaclor solo, y a las 8 semanas se detectaron residuos sólo en las parcelas con atrazina sola. La atrazina más alaclor fue el tratamiento más eficaz en el estudio, combinando un excelente control de malezas con buena tolerancia y rendimientos, y ninguna actividad residual a las 8 semanas.*

### Introduction

IN TRINIDAD and Tobago, as elsewhere in the Commonwealth Caribbean, Corn (*Zea mays* L.) for both green cobs and shelled dry grain is mainly grown as a subsistence wet season (June to December) crop on farms of less than 4 ha, but in recent years mechanised larger-scale production has been undertaken (2, 3).

Control of weeds is traditionally by hand on small holdings whereas atrazine, recommended by Kasasian and Seeyave (6), is frequently applied pre-emergence on large scale cultivation. Commonly occurring weeds like *Digitaria* spp., *Echinochloa* spp. and *Panicum* spp. are resistant to this chemical and experience in Jamaica (4), and elsewhere (1, 5, 9) has shown that herbicides like alachlor and pynachlor can be used alternately or in combination with atrazine to provide more effective weed control and shorter soil residual period.

The experiments reported here were designed to further evaluate the effects of single and combination treatments of atrazine and the two previously mentioned herbicides on weed control and yield of corn for green cobs near St Augustine, Trinidad, over a 3-year period.

### Materials and methods

'Pioneer hybrid X306' corn was grown near St. Augustine, Trinidad, during the wet season of 1975-1977 on clay loam soils containing 0.8 - 1.5 per cent organic matter, cation exchange capacity of 6.0 - 7.1 meq/100 g and pH of 6.1 - 6.5. The experimental area was disc ploughed and a broadcast application of approximately 580 - 620 kg/ha of fertilizer (20:10:10) was made prior to final rotavating. Corn was planted by hand in mid-June of each year approximately 5 cm deep in rows spaced 75 cm apart with intra-row spacing of 15 - 20 cm. Rainfall recorded at or near each site was 580, 570, and 578 mm in 1975, 1976 and 1977 respectively. No serious plant diseases were

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observed in any year and insect pests were effectively controlled with weekly applications of carbaryl.

Individual plots measured 30 x 10.0 m and were arranged in a randomized block design with four replicates. The herbicide treatments (Table 1) used were selected from previous screening trials as being the most promising, and consisted of atrazine plus alachlor, atrazine plus prynachlor, atrazine, alachlor and prynachlor. All were applied with a knapsack sprayer in 450 litres/hectare of spray solution immediately after planting.

Five weeks after planting crop injury and weed control were assessed visually using a rating scale of 0-10 with 0 for severe crop injury or complete control of weeds and 10 for full health and vigour of the crop or complete weed cover. Major weed species were *Cynodon dactylon* (L.) Pers., *Cyperus rotundus* L., *Digitaria* spp., *Echinochloa* spp., *Eleusine indica* (L.) Gaertn., *Euphorbia* spp., *Phyllanthus amarus* Schumacher and Thonn. and *Portulaca oleracea* L. Corn plants were counted in 5 m<sup>2</sup> per plot 6 weeks after planting and at harvest; only the former data are presented. Days to milksilking were taken as the number of days from planting to silk emergence of 50 per cent of the plants in each plot. Marketable green cobs from 13.5 m<sup>2</sup> of each plot were harvested by hand at about 85 days after planting. Cobs were counted and weighed.

Analyses of variance were computed on the data for plant population and cob yields, and differences were tested with Duncan's multiple range test at the 5 per cent level of significance (7). Coefficients of variation for all parameters were less than 15 per cent.

In 1975 and 1977 after the corn was harvested, soil samples taken to 6 cm depth were bioassayed using cabbage (*Brassica oleracea* var. *capitata* L., cv. 'Kono Cross') and beans (*Phaseolus vulgaris* L., cv. '27-R') as indicators of residual herbicide activity. These crops were evaluated for residue injury at 4 and 8 weeks after planting.

### Results and discussion

The total rainfall recorded during the cropping period was similar for each year but rainfall distribution in relation to herbicide application varied. In 1975 no rain fell during the week prior to herbicide treatment and only 25.4 mm was received during the subsequent 2-week period. Thus, the herbicides did not perform as well as during 1976 and 1977 when rainfall was more favourable for herbicide activity.

The effects of the treatments on weed control and crop vigour are summarised in Table 1. Throughout the study relatively uniform weed infestations existed with grasses, the dominant species, comprising 58-62 per cent, broad-leaved species 21-30 per cent and sedges 2-8 per cent. The combination of atrazine with alachlor consistently provided the best weed control. This result was expected because of previous reports (1, 4, 9), as well as observations from the screening trials. Excellent control was also given by the mixture of atrazine and prynachlor. Herbicide combinations performed better than the single compound treatments; nevertheless satisfactory weed control, a score of 3.5 or less, in decreasing order was provided by the atrazine, alachlor and prynachlor treatments, particularly in 1976 and 1977. Similar observations have been reported from another clay loam soil (4), except that ineffective weed control was obtained with prynachlor; the slight difference in weed flora in the two studies may be a possible explanation. *C. rotundus* was effectively controlled by the alachlor alone treatment which also gave the best control of most of the grasses. However, weed growth was reduced by all herbicide treatments as compared to the unweeded control plots during the first 5 weeks, the critical period for weed control in corn (8). Subsequent growth reduction was apparently aided by the vigorous growth of the closely planted corn.

Table 1.—Weed and crop scores of corn (cv. Pioneer hybrid X306) at 5 weeks following various treatments for controlling weeds on clay loam soils in Trinidad, 1975-77.

Pre-emergence weed control treatments	Herbicide rate (kg a.i./ha)	Weed scores			Crop scores		
		1975	1976	1977	1975	1976	1977
Clean-weeded control	0	0.0	0.0	0.0	10.0	10.0	10.0
Atrazine + alachlor	1.0 + 2.0	3.0	0.5	1.0	9.0	9.5	9.5
Atrazine + prynachlor	1.0 + 5.0	3.5	2.0	1.5	9.0	9.0	9.0
Atrazine	3.0	4.5	3.0	2.5	8.0	8.5	8.5
Alachlor	3.0	4.5	3.0	3.5	9.5	9.0	9.0
Prynachlor	10.0	6.0	3.5	3.5	8.5	8.5	8.5
Unweeded control	0	9.0	10.0	8.5	7.5	7.0	6.5

Table 2.—Plant population of corn (cv. Pioneer hybrid X306) at 6 weeks following various treatment for weeds on clay loam soils in Trinidad, 1975-77.

Pre-emergence weed control treatments	Herbicide rate (kg a.i./ha)	Plant population (1000s/ha)			
		1975	1976	1977	Average
Clean-weeded control	0	80.7 a*	82.4 a	83.6 a	82.2 a
Atrazine + alachlor	1.0 + 2.0	81.6 a	83.7 a	82.9 a	82.7 a
atrazine + prynachlor	1.0 + 5.0	80.5 a	83.6 a	81.7 a	81.9 a
Atrazine	3.0	80.6 a	83.1 a	83.1 a	82.3 a
Alachlor	3.0	81.4 a	81.2 ab	81.2 a	81.3 a
Prynachlor	10.0	81.0 a	79.4 b	79.6 b	80.0 a
Unweeded control	0	53.2 b	63.1 c	64.5 c	60.3 b

\* Means within a column not followed by the same letter differ significantly at the 5% level

Visual ratings at 5 weeks after planting indicated slight injury to corn with atrazine and prynachlor, both herbicides singly. In addition to similar findings, Hammerton (4) also reported reduced vigour in the same hybrid from alachlor alone, but no such observation was made in this study. This difference in response might be attributed to environmental factors or crop production systems. None of the herbicide treatments affected the mean number of days to mid-silking.

In the previous preliminary screening trials none of the herbicide treatments reduced the plant population, but in 1976 and 1977, reductions were observed at 6 weeks after planting following the prynachlor alone treatment (Table 2). Over the 3-year period all herbicide treated plots at harvest had normal populations

which showed no significant difference, an observation in conformity with that of Hammerton (4). The unweeded crop had the lowest plant population never being less than 25 per cent of that of the clean-weeded control regardless of the time of population determination.

Marketable cob yields expressed as numbers of cobs and weight of cobs are summarised in Table 3. The effects of herbicide treatments on the number of cobs harvested are important commercially because in Trinidad markets green cobs are sold by number and not by weight. Generally, the data for cob yield, both in number and weight, showed similar variation over the 3-year period; the lowest yields of marketable cobs were harvested in 1975 when rainfall apparently reduced the

Table 3.—Marketable green cob yield of corn (cv. Pioneer hybrid X306) following various treatments for controlling weeds on clay loam soils in Trinidad, 1975-77.

Pre-emergence weed control treatments	(kg a.i./ha)	Green cob numbers (1000s/ha)				Green cob weight (kg/ha)			
		1975	1976	1977	Average	1975	1976	1977	Average
Clean-weeded control	0	73.6 a*	80.2 a	80.8 a	78.2 a	21915 a	25187 a	25960 a	24354 a
Atrazine + alachlor	1.0 + 2.0	73.1 ab	79.9 a	80.1 a	77.7 a	21695 a	25214 a	25433 a	24114 a
Atrazine + prynachlor	1.0 + 5.0	72.9 ab	78.1 ab	81.3 a	77.4 a	21480 a	24531 a	22551 b	22854 a
Atrazine	3.0	70.1 ab	71.5 bc	80.9 a	74.2 a	21015 a	21509 b	20503 c	21009 ab
Alachlor	3.0	65.3 bc	71.5 bc	77.2 ab	71.3 a	17535 b	21429 b	20354 c	19773 ab
Prynachlor	10.0	60.5 c	69.7 c	70.2 b	66.8 a	17245 b	17023 c	18432 d	17567 b
Unweeded control	0	36.1 d	49.5 d	48.7 c	44.8 b	7028 c	8833 d	8759 e	8207 c

\* Means within a column not followed by the same letter differ significantly at the 5% level

effectiveness of the herbicide treatments, whereas better yields were recorded in the other 2 years during which rainfall distribution was conducive to good weed control and satisfactory corn production. The 3-year averages showed no significant difference in cob number with herbicide treatments which, like the clean-weeded treatment, yielded significantly more cobs than the unweeded control which was the lowest yielding treatment in each year. However, in the individual years, plots treated with single treatments of the herbicide generally gave significantly fewer cobs than the herbicide combinations which consistently gave cob numbers not significantly different from those of the clean-weeded crop. This control treatment gave the largest number of cobs in all years, except 1977 when the atrazine plus prynachlor treatment gave the most cobs.

The unweeded control gave significantly lower cob weights than all herbicide treatments and the clean-weeded control. With the exception of the atrazine plus alachlor treatment in 1976, the clean-weeded control was the best treatment but the 3-year average was never significantly different from those of all herbicide treatments, except the prynachlor treatment. It seems therefore that the herbicide combinations may be more beneficial than atrazine alone since it was shown earlier that excellent weed control without significant crop injury could be obtained with atrazine as a mixture with either alachlor or prynachlor.

Similar effects were observed in 1975 and 1977 when herbicide residue activity was evaluated. Soil samples from all herbicide treated plots, except alachlor alone, showed damage in both indicator crops at 4 weeks after the corn harvest. At 8 weeks, injury to cabbage, but not beans, was observed with the atrazine alone treatment. Similar results were reported from Jamaica (4) and suggest that only the alachlor treatment would be acceptable where susceptible crops like beans and cabbage follow a green corn crop. Conversely the combined treatments may be safer than atrazine alone when used in the production of a corn crop for dry grain in rotation with susceptible crops.

The application of atrazine plus alachlor was the best overall herbicide treatment giving excellent weed control, satisfactory corn tolerance with acceptable yield and less residue activity than the standard atrazine treatment. A number of more recently available herbicides are currently under study with a view to identifying treatments for adequate weed control combined with treatments affected the number of days to mid silking or higher yield, expressed as cob numbers and weights, short residual activity.

#### Summary

Response of weeds and rainfed corn (*Zea mays* L. cv. 'Pioneer' hybrid X306) to single and combined pre-emergence treatments of atrazine and either alachlor or prynachlor was evaluated over a 3-year period on clay loam soils near St. Augustine, Trinidad. All herbicide treatments reduced weed growth during the first

5 weeks. Single treatments of atrazine and prynachlor caused slight injury, but none of the herbicide treatments affected the number of days to mid silking or plant population at harvest. They all gave significantly higher yields, expressed as cob numbers and weights, than the unweeded control, but the combination treatments generally gave significantly better yields than the single herbicide treatments which caused some loss of yield when compared with the clean-weeded control. Bioassays with soil samples taken after the corn harvest showed phytotoxicity at 4 weeks with all herbicide treatments, except alachlor alone, and at 8 weeks residues were detected only in plots treated with atrazine alone. Atrazine plus alachlor was the most effective treatment in the study combining excellent weed control with good crop tolerance and yields, and no residual activity at 8 weeks.

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