Effects of Two Tillage Systems on Crop Performance and Weed Control[1]

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ABSTRACI

An experiment was conducted at Ile-Ife, Nigeria to determine the influence of two tillage systems (conventional vs. no-tillage) on the performance of cowpea (*Vigna unguiculata* (L) Walp. cv 'Ife Brown) and two subsequent crops of maize (*Zea mays* L, 'Western Yellow'), as well as on the efficacy of different weed control treatments. Crop emergence was not affected by tillage system; however, plant height and stem circumference were significantly better in the no-tillage than in the conventional tillage plots. In addition, cowpea had significantly higher yields in the no-tillage plots while maize yields were not significantly different in both tillage systems. The overall weed control effectiveness was the same under both tillage systems throughout the three seasons. The relative weed growth was, however, higher for the herbicide-based weed control treatments, in the no-tillage plots during the third growing season.

COMPENDIO

Se estableció un experimento en ILE, IFE, Nigeria, para determinar la influencia de dos sistemas de labranza (convencional versus vio-labranza) en el desempeño del cultivo de caupí (*vigna unguiculata* (L) Walp, cv' Ife Brown), y de dos cultivos subsiguientes de maíz, (*Zea mays* L.) variedad "western yelow", así como también en la eficacia de diferentes métodos de control de malezas. La emergencia de las plántulas no fue afectada por el sistema de labranza; sin embargo, la altura de las plantas y la circunferencia del tallo fueron significativamente mejores en el tratamiento de no-labranza que en las parcelas bajo la labranza convencional. Además, los rendimientos del caupí en las parcelas de no-labranza fueron significativamente más altos en tanto que los rendimientos del maíz, no fueron significativamente diferentes en los dos sistemas de labranza estudiados. El control de malezas, en general, fue igualmente efectivo bajo ambos sistemas de labranza, a lo largo de las tres épocas de siembra. El crecimiento efectivo de las malezas, sin embargo, fue mayor para los tratamientos de control de malezas basados en el uso de herbicida, en las parcelas de no-labranza, durante la tercera época de crecimiento del cultivo.

INTRODUCTION

There has been a marked increase in the quantity of food items imported into Nigeria in recent times. While total maize import was 47 000 MT in 1978, it was estimated to be 345 000 MT in 1982 (2, 3). Various attempts are therefore being made by both national and internacional agencies to increase food production. These efforts are commonly geared towards either cultivating more land or a more intensive utilization of existing areas under cultivation, or both. Problems associated with intensive cultivation of the land, especially in tropical rainforest regions using conventional methods, include loss in fertility, deterioration of the soil structure, as well as erosion of the top soil (11, 12). A possible solution to the erosion problem may be the adoption of minimum or zero-tillage farming practices.

Buckley (6) recently reviewed the state of no-tillage farming in the tropics. He observed that while the no-tillage technique has been extensively studied and is being increasingly put into practice in the temperate regions, it has not been exploited to the same degree in the tropics. Yet in areas where zero-tillage has been adopted, yields were as good as or sometimes better than yields obtained under conventional tillage (6, 7). Few studies have been conducted in Nigeria to investigate the effects of tillage systems on crop performance and weed control. The present study was aimed at comparing the effects of conventional and no-tillage systems on the performance of cowpea and maize as well as on the efficacy of different weed control treatments.

MATERIALS AND METHODS

This study was conducted at the University of Ife teaching and research farm on a sandy loam soil during the 1979 and 1980 cropping seasons. The field selected for the study had been in fallow for about one year and was previously cropped to cowpea and maize. The vegetation on the field at the commencement of the study was composed predominantly of grasses (*Brachiaria deflexa* (Schum) C.E. Hubbard ex

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Robyns, *Cynodon dactylon* (L.) Pers. *Digitaria horizontalis* Wild., and *Eleusine indica* (L.) Gaertn, and these formed a good mulch in the no-tillage plots during the first season. The farm is situated in the rainforest belt and has an average annual rainfall of 1500 mm with average minimum and maximum temperatures of 21.69°C and 31.67°C, respectively. The rainfall data for 1979 and 1980 are presented in Table 1.

Table 1. 1979 and 1980 rainfall data (mm at the University of Ife teaching and research farm.

Month	1979	1980
January	0	0
February	0	7
March	154	27
April	169	82
May	261	152
June	141	106
July	254	181
August	403	233
September	138	337
October	176	255
November	38	90
December	0	2

The experiment was designed as a randomized complete block in a split-plot arrangement with two main treatments and six sub-treatments. The main treatments consisted of two tillage systems (no-tillage vs. conventional tillage), while the sub-treatments were made up of six weed control treatments (see Table 4). Individual split-plots were 4 m x 5 m.

Pre-planting plot preparations consisted of ploughing and harrowing in the conventional tillage plots, while the no-tillage plots were sprayed, either with paraquat (1.1' – dimethyl – 4.4' – bypyridinium ion) at 2.0 kg ai/ha or Gramuron, a 3:1 formulated mixture of diuron (3-(3.5-dichlorophenyl)-1, 1-dimethyl urea) and paraquat, at 2.4 kg ai/ha two weeks before planting. Whereas this was enough to kill the existing vegetation in the no-tillage plots in the 1979 late and 1980 early season, a supplementary application of paraquat (1.0kg ai/ha) was made just before planting in the 1979 early season. The post-planting weed control treatments were superimposed on both tillage treatments, except that where Gramuron (equivalent to 1.8 kg ai/ha, diuron) was applied to the no-tillage plots during the 1979 early season, diuron was applied to the equivalent conventionally-tilled plots. All of the sub-treatment herbicide applications were made before crop emergence. In all cases, the weed control treatments were randomly assigned to the sub-plots at the beginning of each cropping season while all treatments were replicated three times. The herbicide applications were made with a CP3 knapsack sprayer using a spray output of 300 l/ha.

Unlike in the case of the tillage treatments, crop emergence, plant height and stem circumsference were not affected by the different weed control treatments (data not shown). However, grain yield responded differently to these weed control treatments (Table 4). The highest cowpea grain yield was obtained with three hand weedings at 2, 4 and 6 WAP; while the lowest yields were obtained from plots that had pre-emergence applications of metolachlor (2-chloro-N-2ethyl-6 methylphenyl)-N-2-(methoxy-1-methylethyl) acetamide) at 2.5 kg ai/ha. Maize grain yield was not significantly affected by weed control treatments in 1979, but it was affected in 1980. The highest yield during the 1980 early season was obtained from the weed-free plots and the lowest yields from the unweeded checks. Yields were generally higher in the 1980 early season than in the 1979 late season.

Weed Control

Paraquat at 2.0 kg/ha, applied two weeks before planting, satisfactorily controlled the existing vegeta-

Table 2. Crop emergence, plant height, and stem circumference of cowpea and maize as affected by tillage system in 1979 and 1980.

Tillage Treatment	Crop emergence count/20 M²			Plant height (cm)			Stem circumference	
	1979		1980	1979		1980	1979	1980
	Cowpea	Maize	Maize	Cowpea	Maize	Maize	Maize	Maize
Conventional Tillage	62	96	17	9.3	27.9	29.5	3.2	4.6
No-Tillage	93	78	55	13.9	47.1	49.7	4.4	5.7
LSD (0.05)	NS	NS	NS*	0.11	13.84	1.73	0.46	0.99

* F – Value significant at 10% level

Table 3. Grain yield (kg/ha) as affected by tillage systems.

Tillage	1979		1980
Treatments	Cowpea	Maize	Maize
Conventional tillage	267	1 271	5 520
No-Tillage	700	2 418	6 128
LSD (0.05)	131 4	NS*	NS

* F – Value significant at 10% level.

tion in the no-tillage plots, except during the 1970 early season when a supplementary application of the herbicide at 1.0 kg ai/ha had to be made just before planting.

The influence of the tillage systems on the effectiveness of the weed control treatments in shown in Table 5. The most prevalent weeds encountered in the unweeded checks of both the no-tillage and conventional tillage plots during the course of this study were *Ageratum conyzoides* L., *Brachiaria deflexa* (Schum) C.E. Hubbard ex Robyns, and *Digitaria horizontalis* Wild. In addition, *Eleusine indica* (L.) Gaertn, and *Mariscus alternifolius* Vahl. were encountered on the conventional tillage plots; while *Spigelia anthelmia* L. and *Talinum triangulare* (Jacq.) Wild. were encountered on the no-tillage plots. All the above weed species, with the exception of *Talinum triangulare*, were satisfactorily controlled in both the no-tillage and conventional tillage plots. Both the average population of weed seedlings and the weed dry weight per unit area were not significantly different under the two tillage systems except during the 1980 early season when weed dry weight was significantly higher in the conventional tillage plots than in the no-tillage plots. While the relative weed growth (weed dry weight at 8 WAP per unit weed seedling at 4 WAP) (8) for the herbicide-based treatments was higher in the conventionally-tilled than in the no-tillage plots in 1979, it was higher in the no-tillage plots in 1980. Relative weed growth for the unweeded checks was higher in the conventionally-tilled plots in both years.

Cowpea, (cv. Ife Brown) was planted on May 4, 1979, while the maize (cv. Western Yellow) was planted on 3 September, 1979 and 15 April, 1980. There was no fertilizer application to the cowpea crop, while each of the maize crops received 40 kg/ha of complete fertilizer (15-15-15) as side-dressing along the maize rows, four weeks after sowing.

Crop Performance

Crop emergence and plant height were determined for both cowpea and maize ten days after planting (DAP) and four weeks after planting (EAP), respectively. Emergence counts were carried out over the whole subplot area, while ten plants per subplot were randomly selected for the measurement of plant height. In the case of maize, the same ten plants were used to determine stem circumference, 10 cm above ground level. Emergence was generally very poor in 1980, hence all missing stands were replanted. Cowpea pods and maize cobs were corrected to 13% moisture content.

Table 4. Effects of weed control treatments on grain yield.

Cowpea		Maize		
Weed control treatment	Yield kg/ha)	Weed control treatment	Yield kg/ha	
	1979		1979	1980
1. 3 handweedings at 2, 4, & 6 WAP	623	1. 2 handweedings at 2 & 4 WAP	1 918	5 837
2. Galex (metolachlor + metobromuron), 2.5 kg ai/ha	520	2. 2 handweedings at 2 & 6 WAP	2 203	6 200
3. Metolachlor, 2 5 kg ai/ha	312	3. Atrazine, 2.5 kg ai/ha	1 504	5 580
4. Diuron, 2.0 kg ai/ha (1.8 kg ai/ha for no-tillage plots)	403	4. Primextra (Atrazine + metolachlor), 2.5 kg ai/ha	1 887	5 644
5. Weedfree control	595	5. Weedfree control	1 887	6 650
6. Weedy control	449	6. Weedy control	1 677	5 033
LSD (0.05)	200	LSD (0.05)	NS*	866 7

* F – Value significant at 10% level.

Weed Control

During the 1979 early season, weed density was enumerated at 4 WAP using two (0.3 m x 0.6 m) quadrats randomly placed in the plots. In the subsequent seasons, a fixed area of 1 m^2 was established in each plot from which weed density enumeration was conducted at 4 WAP, and weeds were harvested at 8 WAP for dry matter determination.

All data were subjected to analysis of variance and treatment means were compared using the least significant difference test.

RESULTS

Throughout the three cropping seasons, the tillage vs. weed control interaction was not significant for any of the parameters. Consequently only the effects of the main treatments will be discussed.

Crop Performance

Throughout the three seasons, there was no significant difference in crop emergence between the no-tillage and conventional tillage plots (Table 2). On the other hand, plant height and stem circumference were consistently greater in the no-tillage than in the conventional tillage plots for both crops. Grain yield was also generally higher in the no-tillage plots than in the conventional tillage plots throughout the three seasons (Table 3). However, it was only for the cowpea crop that these differences were significant.

DISCUSSION

The observed effect of the tillage systems on crop emergence is in line with the findings of previous workers. Kapusta (9), in a three-year study, found that soybean (*Glycine max* L.) population was not affected by tillage except in one year when the conventional and minimum tillage plots had lower plant population due to soil crusting, caused by rainstorms. The greater plant height and stem circumference observed in the no-tillage plots is indicative of better plant growth in the no-tillage than in the coventional tillage plots This is possibly due to a greater moisture and nutrient availability in the no-tillage plots. Lal (11), Akobundu (1), and Blevins, Thomas and Cornelius (5), reported that organic matter content and moisture retention capacity are higher under zero-tillage than under conventional tillage systems. The effects of tillage system on cowpea and maize grain yields are also in line with the findings of previous workers. Olunuga and Ajuwon (12) obtained higher cowpea grain yield under no-tillage systems in

Table 5. Influence of tillage system on weed control effectiveness.

a. Weed population and weed dry weights in cowpea and maize (1979 and 1980).

Tillage treatment	Weed population/M^2 (4 WAP)			Weed dry weight/M^2 (8 WAP)	
	1979		1980	1979	1980
	Cowpea	Maize	Maize	Maize	Maize
Conventional tillage	230	136	18	115.4	59.7
No-tillage	85	208	44	93.9	46.6
LSD (0.05)	NS	NS	NS	NS	12.06

b. Relative weed growth in maize (1979 and 1980).

Tillage treatment	Relative Weed Growth					
	1979			1980		
	Atrazine (2.5 kg ai/ha)	Primextra (2.5 kg ai/ha)	Unweeded check	Atrazine (2.5 kg ia/ha)	Primextra (2.5 kg ai/ha)	Unweeded check
Conventional tillage	8.1	8.2	0.7	0.6	0.0	6.2
No-tillage	2.9	0.6	0.5	4.0	5.0	1.3

the rainforest region, while yields were not affected by tillage in the derived savannah region. The same authors did not obtain any difference in maize yield under various tillage systems. Similarly, Kapusta and Stricker (10) observed that maize yields were affected primarily by level of weed control and less by tillage method.

Planting of the 1979 maize crop was delayed due to incessant rainfall in July and August, although there was very little rainfall in November, when the crop was in its reproductive phase. These factors must have been responsible for the much lower yields obtained in 1979 than in 1980. On the other hand, the replanting of missing stands in 1980 resulted in a more uniform stand distribution between the conventional and no-tillage plots. This must have led to the lower difference in yields obtained between the conventional and no-tillage plots.

On the whole, the level of experimental errors, with respect to grain yield, were high and this might have been responsible for the non-significance of yield differences between the conventional and no-tillage plots. This situation must have been caused in part by the small number of tillage treatments as well as the possible confounding of the tillage effects through the use of the same piece of land during three seasons. This latter was, however, deliberate, as it afforded an opportunity for investigating the possible weed shifts accompanying such a practice.

The overall effectiveness of the weed control treatments was either not affected by the tillage system or was better under the no-tillage plots. Even though the weed population was greater in the no-tillage maize plots, the weed dry weights from these plots were lower compared to the conventional tillage plots (Table 5a). This is in agreement with the observations of Olunuga and Ajuwon (12) who obtained similar significantly lower weed fresh weights from no-tillage plots compared to the conventional tillage plots. Similarly, Ayeni, Duke and Akobundu (4) observed in sole crops of maize and cowpea, as well as in a cowpea maize intercrop that, at six weeks after sowing, weed dry weight under a no-tillage system was 52% of the weight under conventional tillage. As reported earlier, the perennial weed, *Talinum traingulare*, was not adquately controlled in the no-tillage plots starting from the second season. Thus, while the relative weed growth for both the unweeded checks and the herbicide-based treatments was higher in the conventional tillage plots in 1979, it was higher under the no-tillage plots for the herbicide-based treatments in 1980 (Table 5b). The implication of this is that there is likely to be a build-up of this and other perennial weeds in the event of continuous cropping under the no-tillage system. This can be taken care of by using translocating herbicides for the no-tillage plots prior to planting.

The above results further confirm that similar or better crop yields can be attained under a no-tillage culture. There was also no reduction in overall weed control effectiveness, although there was a tendency towards a build-up of perennial weeds in the no-tillage plots, when such plots are used continously and appropriate preplanting herbicides are not used. The possibility of using higher rates of herbicides with little danger of crop injury (13) is an added advantage for the control of such weeds under a no-tillage system.

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Concentração de Imunoglobulina Sérica, Peso Corporal e Diarréia, em Bezerros da raça Holandesa Aleitados com Diferentes Dietas[1]

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ABSTRACT

The effect of different milk feeding systems on diarrhea occurrence (date of first day of scour), duration and severity, was determined in 36 male and female Holstein calves, in relation to serum immunoglobulin concentration and body weight. Calves were given, during at least the first 30 days of life, one of the following treatments: (A) whole milk, colostrum and milk replacer (1:1:2); (B) whole milk; and (C) milk replacer. All calves were fed colostrum up to 72 hours after birth. The blood samples, collected from the jugular vein for immunoglobulin analysis, were obtained at the first and fifth days of life. Body weight was registered at birth, five and 10 days of life and information about diarrhea (occurrence, duration and severity) was registered during the milk-feeding period. Serum immunoglobulin was analysed through zinc sulfate turbidity and radial immunodifusion methods. The results were interpreted by the following statistical analyses: Kruskal-Wallis test; non-parametric test of multiple comparisons, and correlation analysis. The averages of first scour, duration and severity were: 7.53, 3.43 and 2.52 for treatment A; 7.87, 4.87 and 2.25 for treatment B and 5.86, 5.57 and 2.71 for treatment C. Although without statistical significance, calves fed milk replacer had a tendency of earlier and more severe diarrhea. The duration in treatment A did not differ from B, but was significantly shorter than C. These observations could be a consequence of the lack of active immunoglobulins in the treatment C diet, resulting in less protection in the digestive tract. The study of correlations suggested that higher levels of immunoglobulins delayed the occurrence of diarrhea and that the sooner it occurred, the stronger was the tendency to show longer duration, thus affecting weight gain.

RESUMO

Foram determinados, em 36 bezerros da raça Holandesa Preta e Branca de ambos os sexos, os efeitos de diferentes regimes de aleitamento, sobre a ocorrência, duração e intensidade das diarréias, bem como sobre a concentração de imunoglobulinas séricas, no período imediatamente pós-natal. Os bezerros, após receberem colostro nas primeiras 72 horas, foram submetidos, por um período mínimo de 30 dias, aos seguintes tratamentos: A – leite integral, colostro e sucedâneo (1:1:2); B – leite integral e C – sucedâneo. Amostras de sangue, para análise de imunoglobulinas séricas, foram coletadas no 1o. dia (24 horas pós-parto) e 5o. dia de vida. O peso dos bezerros foi registrado na data do nascimento, aos cinco e 10 dias de idade, enquanto as informações sobre diarréias (data da ocorrência, duração e severidade) foram anotadas durante o período de aleitamento. A imunoglobulina sérica foi quantificada pelos métodos ZST e imunodifusão radial. A análise estatística dos dados foi feita através do teste de Kruskal-Wallis, teste não paramétrico de comparações múltiplas e análises de correlação. As médias das idades de ocorrência, duração e severidade das diarréias, foram: 7.53, 3.43 e 2.52 para A; 7.87, 4.87 e 2.25 para B e 5.86, 5.57 e 2.71 para C. Nos animais aleitados com sucedâneo (tratamento C), verificou-se uma tendência de apresentarem diarréias mais cedo e com maior intensidade, porém os resultados não alcançaram níveis significativos. Quanto à duração, o tratamento A não diferiu de B, mas foi significativamente mais curto do que C. Essas observações podem estar relacionadas com o fato do sucedâneo não conter imunoglobulinas ativas, podendo assim ter determinado uma proteção menos eficiente a nível de trato digestivo. A análise das correlações indicou que níveis mais elevados de imunoglobulinas retardaram o aparecimento das diarréias. Este estudo também revelou que, quanto mais cedo ocorreram as diarréias, mais pronunciada foi a tendência em apresentar maior duração, afetando, consequentemente, de modo adverso, o ganho de peso dos bezerros no período crítico de incidência das mesmas.

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