

Full Length Research Paper

Efficacy of primextra for weed control in maize (*Zea mays* L.) and its residual effects on cowpea (*Vigna unguiculata* (L.) Walp.) in a forest – savanna transition zone

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ABSTRACT

Weeds constitute a significant impediment to maize production in Nigeria, hence the need to manage them. The objective of this study was to evaluate Primextra^(R) for weed control in maize and its residual effects on cowpea that followed maize. The experiments were conducted in Ekpoma, Edo north of Nigeria during the 2004 and 2005 cropping seasons. These two trials were laid out as randomized complete block design with four treatments replicated four times. The treatments used were Primextra^(R) at 3.0 kg a. i. ha⁻¹, hoe weeding at 3 weeks after planting (WAP), two-hoe weeding at 3 and 7 WAP and no weeding. Bioassay of the Primextra^(R) treated soil with cowpea as test crop was also carried out to assess the efficacy of Primextra^(R) residues. All the weed control treatments significantly ($p < 0.05$) reduced weed dry weight when compared to the unweeded control in both years. Plots treated with Primextra^(R) and hoe weeded twice gave acceptable and efficient ($\geq 70\%$) weed control. Plots treated with Primextra^(R) significantly produced the highest maize grain yield while the lowest was in the weedy check. Primextra had no significant effects on weed density, weed dry weight, plant height, shoot dry weight, yield and yield components of cowpea and some soil characteristics. Primextra^(R) is therefore, the most effective weed control method in maize without any residual effects on subsequent crop of cowpea in the tropics.

Keywords: Weed control, Primextra^(R), Residual effects, maize, cowpea.

INTRODUCTION

Maize (*Zea mays* L.) is an annual, short day, cross pollinated plant (Khan *et al.*, 2011). It belongs to the family poaceae. It is also one of the main staple food crops in Nigeria and it is increasingly gaining prominent position in crop husbandry because of its short growth period. The average grain yield on farmers' field is still remarkably low ($\leq 1000\text{kg ha}^{-1}$) in Africa (Remison, 1979). Weed infestation is one of the main factors responsible for its low yield

in Nigeria. Uncontrolled weed growth in maize had been reported by Akobundu (1987) to cause between 40 to 100% reduction in maize yield in Nigeria.

Farmers use different weed control measures including chemicals to control weeds in maize. However, the use of chemical weed-killers in Nigeria is not so popular among local farmers, due to ignorance and lack of technical manpower for proper herbicide application (Akinyemiju, 1986; Ikuenobe *et al.*, 2005). Majority of farmers in

Nigeria control weeds by manual hoe weeding, while a few adopt chemical weed control by use of herbicides. Although, herbicides could be used to control weeds, the application of herbicides should be done with caution as they can cause damage to the environment.

Most herbicides when applied at recommended rates do not have any residual effects in the soil. These vary from a few months to some years. For example, simazine, atrazine and diuron may remain active for nearly a year and cause damage to succeeding crops (Remison, 2004).

In most of the humid tropics of Nigeria, farmers rely on natural rainfall pattern to crop generally twice in a year, April to July and August to November. As a result of the short interval between the two cropping seasons, a significant problem arise in deciding which crop will immediately follow maize in rotation within one year where Primextra^(R) has been applied as pre-emergence for weed control. The choice of such a crop depends largely on the knowledge of residual effect of Primextra^(R) in that environment. So far, no work has been reported on Primextra^(R) residue on subsequent crop in the humid tropics of Nigeria. Hence, the aim of this study was to investigate if the Primextra^(R) used for weed control in maize has a residual effect on a subsequent crop

MATERIALS AND METHOD

Experimental site

Two experiments: Efficacy of Primextra^(R) for weed control in maize and Residual activity of Primextra^(R) on field grown cowpea, were conducted in adjacent fields during 2004 and repeated in 2005 wet seasons at the Teaching and Research Farm of Ambrose Alli University, Ekpoma (Latitude 6° 45'N, Longitude 6° 8'E, Altitude 313m above sea level) in the forest – savanna

transition zone of Nigeria. The experimental site was under short fallow for about 2 years, previously cropped to maize. Pre-cropping vegetation in the experimental site was dominated by Siam weed (*Chromolaena odorata*, (L.) R.M. King and Robinson), goat weed (*Ageratum conyzoides* Linn), broom weed (*Sida acuta* Burm F.), guinea grass (*Panicum maximum* Jacq) and *Cyperus* spp. Number of rainfalls during the experiment in 2004 and 2005 seasons were recorded. Soil samples were taken randomly from 0–15cm depth with an auger of diameter 8cm for routine laboratory analysis before planting.

Efficacy of Primextra^(R) for weed control in maize

The site was manually slashed and stumped, before leveling the soil surface with spade. The experimental design was a randomized complete block design. The plot size was 3 m x 4 m with an alley way of 1 m among plots. There were four treatments used for the experiment namely, Primextra^(R) at recommended rate of 3.0 kg a. i./ha (NACWC, 1994), one hoe weeding at 3 weeks after planting (WAP), two hoe weeding at 3 and 7 WAP and no weeding. The four treatments were replicated four times, which give a total of 16 plots occupying an experimental area of 19 m x 15 m.

The maize cultivar (variety ACR 89DMRSERW) used for the experiment was obtained from International Institute of Tropical Agriculture (IITA), Ibadan. Planting of the maize variety were done on 25th and 26th of April respectively for 2004 and 2005 trials. The maize variety was planted at two seeds per hole at a spacing of 75 cm between rows and 25 cm within rows respectively and were thinned to one seedling per stand at 2 WAP, giving a population density of 53,333 plants/ha. Four plots were sprayed with Primextra^(R) at 3.0 kg a. i./ha immediately after planting maize

using hand operated CP₃ knapsack sprayer, calibrated to deliver approximately 250 L/ha at 210kpa with red poliject nozzle (swath width ½ m) (Hardi International A/S, Helgeshoji Alle, DK 2630 Taastrup, Denmark). The Primextra^(R) was mixed with a uniform volume of tap water (288 ml) enough to spray the surface area of each experimental plot.

Three days after the first weeding, urea fertilizer at the rate of 39.6 kg N/ha and 40.48 kg N/ha were applied in 2004 and 2005 respectively to make up the critical level of nitrogen. These were carried out because the level of nitrogen in the soil was inadequate compared to the critical level of 1.5 g/kg (Sobulo and Osiname, 1981, Adepetu *et al.*, 1986). The second weeding was carried out at 7 WAP.

Data Collection and analysis

Weed growth characteristics taken at final harvest (13 WAP) were dry weight and weed control efficiency (WCE). Weed samples were collected from two 1 m² quadrats per plot separated by species, bulked, and oven dried at 80°C for 48hours. Weed control efficiency of the different weed control methods was calculated according to Subramanian *et al.*, (1991) viz:

$$WCE\% = \frac{WDWC - WDWT \times 100}{WDWC} \quad 1$$

Where WDWC = Weed dry weight of unweeded control

WDWT = Weed dry weight in treated plots.

Data on grain yield were taken at 13 WAP from the net plot size of 3 m². The ears were oven dried to a constant weight of 105°C. Maize grain yields were adjusted to the standard moisture content of 12% using a Dickey-John moisture tester (Model 14998, Dickey-John Corporation, Auburn, IL USA). Data collection were analyzed statistically and

mean separated using least significant difference test (P = 0.05).

Residual activity of Primextra^(R) on field grown cowpea

This study was carried out after maize harvest, *i.e.*, during the late season of 2004 and 2005. Twelve (12) out of the 16 plots in the previous season were used to assess the residual effect of Primextra^(R) on cowpea after maize harvest. The treatments were: Primextra^(R) treated soil, two-hoe weeding at 3 and 7 WAP and no weeding (control). The cowpea cultivar (variety Ife brown, "IT84S-2246-4) used for the experiment was obtained from IITA. Before planting cowpea in August in both years, the 12 plots were manually cleared and leveled with spade. Planting of cowpea variety were done on 15th and 17th of August respectively in 2004 and 2005. The cowpea variety was planted at two seeds per hole at a spacing of 60 cm between row and 25 cm within row and thinned to one seedling per stand at 2 WAP giving the population density of 66, 667 plants/ha. The first weeding was done manually at 3 WAP, and the second was 7 WAP in both years.

Data collection and analysis

Weed density were recorded at 6 WAP and at final harvest. Weed samples were collected from 1 m × 1 m quadrants per plot. Weed weight was taken at final harvest. The crop parameters determined were:

Plant height: This was taken at 6 and 12 WAP. This was done by randomly selecting 5 plants from the net plot size of 3 m² and then measuring their vine lengths from the soil level to the tip of the apical bud with a measuring tape. The mean of the plant heights was recorded as height per plant.

Shoot dry weight: This was taken at 6 and at 12 WAP. This was determined by randomly uprooting two plants from the net plot. The shoot samples were dried in

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an oven at 60^o C for 48 hours and weighed for dry weight determination.

Number of pods/plant was estimated as:

$$\frac{\text{Number of harvested pods per net plot}}{\text{number of plants per net plot.}}$$

Seed weight/ plant were estimated as:

$$\frac{\text{Weight of seeds per net plot}}{\text{Number of plants per net plots}}$$

Grain yield: This was determined from net plot size of 3 m², and grain weight in grams converted to kg/ha.

RESULTS

Efficacy of Primextra^(R) for weed control in maize

Rainfall and soil characteristics

The rainfall distribution in both years was bi-modal, with peaks in July and September.

The total rainfall was 1787.6 mm in 2004, distributed over 118 days, and 2176.7 mm in 2005 distributed over 104 days (Table 1). The total rainfall in 2005 cropping season (April to July) was

greater than that in 2004 cropping season (April to July). The physio chemical properties of the soil in the experimental site are presented in Table 2. The soil was sandy, slightly acidic, low in nitrogen and potassium, and contained adequate organic carbon.

Weed growth attributes

All the weed control treatments significantly reduced weed dry weight in both years and combined means compared to the unweeded control, (Table 3). Primextra^(R) treated plots and plot-weeded twice at 3 and 7 WAP gave acceptable weed control efficiency ($\geq 70\%$) in both years and combined means, (Table 3).

Maize grain yield

There were significant differences in maize grain yield among the treatments in both years (Table 4). Primextra treated plot had the highest grain yield while the weedy plot had the lowest. Similar trend was observed in the combined means with Primextra^(R) treated plot producing the highest grain yield (3316.65 kg/ha⁻¹) and the weedy plot (734.50 kg/ha⁻¹).

Table 1. Number of rain days and total rain fall distribution during 2004 and 2005 trials

Months	<u>Number of rain days</u>		<u>Rainfall mm)</u>	
	2004	2005	2004	2005
January	0	1	0.0	60.2
February	1	3	3.1	107.0
March	4	3	33.8	45.2
April	9	6	134.8	108.0
May	13	10	198.9	180.9
June	16	17	371.1	376.8
July	21	21	319.0	439.6
August	16	7	76.9	38.3
September	21	20	432.1	351.6
October	13	12	182.5	320.2
November	4	2	35.4	145.7
December	0	2	0.0	3.2
Total	118	104	1787.6	2176.7
Mean	9.83	8.67	1149.0	187.4

Source: Edo State Agricultural Development Project (EADP), Irrua, Edo State

Table 2: Some physico-chemical properties of the top soil (0 – 15 cm) before cropping maize in the experimental site in 2004 and 2005

Soil Properties	Values		
	2004	2005	Mean
Sand (g/kg)	963.00	963.00	963.00
Silt (g/kg)	17.00	17.00	17.00
Clay (g/kg)	20.00	20.00	20.00
pH (H ₂ O, 1:1)	5.70	5.40	5.55
Organic carbon (g/kg)	15.70	16.00	15.85
Total nitrogen (g/kg)	1.07	1.06	1.07
Available phosphorus (mg/kg)	15.40	15.20	15.30
Exchangeable potassium (cmol/kg)	0.27	0.28	0.28

¹combined data for 2004 and 2005**Table 3. Effect of weed control methods on weed growth characteristics of maize during 2004 and 2005 cropping seasons**

Treatment	Weed dry weight (g/m ²)			Weed control efficiency (%)		
	2004	2005	Mean	2004	2005	Mean ¹
Primextra ^(R) @ 3.0 kg a.i.ha ⁻¹	4.00	4.48	4.24	96.89	96.73	96.81
Weeded x 1 (3 WAP)	43.20	43.50	43.35	66.41	66.37	66.39
Weeded x 2 (3 + 7 WAP)	6.97	7.40	7.19	94.58	94.28	94.43
No weeding	128.62	129.38	129.00	-	-	-
LSD (P = 0.05)	*	*	*	*	*	*

¹Combine analysis for 2004 and 2005 data * = Significant**Table 4. Effects of weed control methods on maize grain yield during 2004 and 2005 cropping seasons**

Treatments	Maize grain yield (kg ha ⁻¹)		
	2004	2005	Mean ¹
Primextra ^(R) @ 3.0 kg a.i.ha ⁻¹	3444.79	3188.50	3316.65
Weeded x 1 (3 WAP)	2023.33	2005.00	2014.17
Weeded x 2 (3 + 7 WAP)	2705.00	2675.00	2690.00
No weeding	756.50	712.50	734.50
LSD (P = 0.05)	*	*	*

¹Combine analysis for 2004 and 2005 data, * = Significant**Residual activity of Primextra^(R) on field grown cowpea****Residual effects of Primextra^(R) on weed growth attributes**

The residual effects of Primextra on weed density is shown in Table 5. There was no significant different between Primextra treated plots and the unweeded control at 6 WAP and at final harvests. The two treatments i.e. Primextra treated plots and unweeded control differ

significantly from plots that were hoe weeded twice in both years.

In the combined means a population of 63.1 weeds/m² was recorded in the Primextra^(R) treated plot at 6 WAP and unweeded control 63.4 no/m² while the lowest population of 12.4 weeds/m² was recorded in plots that were weeded twice. At final harvest, the combined means of weed density showed that Primextra^(R) treated plots

Table 5. Residual effect of Primextra® on weed growth characteristics of cowpea in the late seasons of 2004 and 2005

Treatment	Weed density (no/m ²)			Final harvest			Weed dry weight (g/m ²)		
	6 WAP ¹			Final harvest			Final harvest		
	2004	2005	Mean ²	2004	2005	Mean	2004	2005	Mean
Primextra ^(R) @ 3.0 kg a.i.ha ⁻¹	63.8	62.3	63.1	193.8	184.3	189.1	133.8	128.3	131.1
Weeded x 2 (3 + 7 WAP)	13.0	11.8	12.4	26.3	18.8	22.6	12.8	11.0	11.9
No weeding	64.0	62.8	63.4	195.8	184.0	189.9	134.5	129.3	131.9
LSD (P = 0.05)	*	*	*	*	*	*	*	*	*

1 = Weeks after planting, 2 = Combine analysis for 2004 and 2005 data, * = Significant

and unweeded control had similar weed density of 184.3 and 184.0 no/m² respectively while the least was in plot hoe weeded twice (22.6 no/m²). Primextra treated plots and unweeded control plot had similar weed dry weight in both years; but they differ significantly from plots that were hoe weeded twice. In combined means, the same trend was observed on weed dry weight. (Table 5).

Residual effects of Primextra on plant height of cowpea

Table 6 shows the residual effects of Primextra^(R) on plant height of cowpea at 6 and 12 WAP. There were no significant difference between plot

treated with Primextra^(R) and the unweeded control but they differ from plots that were hoe weeded twice in both year. In combined means, the same trend was observed with Primextra^(R) treated plot and unweeded control plots producing the shortest plant height of 74.2 cm while the plot that was hoe weeded twice produced the tallest plant with a height of 99.7 cm at 6 WAP. At 12 WAP plot treated with Primextra and unweeded control had a similar plant height of 100.9 cm and 100.8 cm respectively while the plot hoe weeded twice produced the tallest plant with height of 120.8 cm.

Table 6. Residual effect of Primextra^(R) on plant height of cowpea at 6 WAP and 12 WAP in the late seasons 2004 and 2005

Treatment	Plant height (cm)					
	6 WAP ¹			12 WAP		
	2004	2005	Mean ²	2004	2005	Mean
Primextra ^(R) @ 3.0 kg a.i.ha ⁻¹	73.9	74.5	74.2	100.4	101.4	100.9
Weeded x 2 (3 + 7 WAP)	99.4	99.9	99.7	119.6	121.9	120.8
No weeding	73.6	74.6	74.2	100.3	101.3	100.8
LSD (P = 0.05)	*	*	*	*	*	*

1 = Weeks after planting, 2 = combine analysis for 2004 and 2005 data, * = Significant

Residual effects of Primextra^(R) on shoot dry weight of cowpea

Table 7 shows the residual effects of Primextra on shoot dry weight of cowpea at 6 and 12WAP. There was no significant difference between plot treated with Primextra^(R) and the unweeded control in both years. The

combined means at 6 WAP shows that Primextra treated plots and unweeded control had similar shoot dry weight of 0.80 and 0.79 g/plant respectively. They however, differ from plot hoe weeded twice which had the highest dry weight of 1.61 g/plant. Similar trend was observed in the combined mean at 12

WAP with plot hoe weeded twice producing the highest shoot dry weight and the lowest in Primextra® treated plot and un-weeded control plots.

Table 7. Residual effect of Primextra® on shoot dry weight of cowpea in the late seasons of 2004 and 2005

Treatment	Shoot dry weight (g/plant)					
	6WAP ¹			12WAP		
	2004	2005	Mean ²	2004	2005	Mean
Primextra ^(R) @ 3.0 kg a.i.ha ⁻¹	0.78	0.81	0.80	14.45	15.23	14.84
Weeded x 2 (3 + 7 WAP)	1.58	1.63	1.61	26.61	26.65	26.63
No weeding	0.79	0.79	0.79	14.53	15.63	15.08
LSD (P = 0.05)	*	*	*	*	*	*

¹ = Weeks after planting, ² = Combine analysis for 2004 and 2005 data, * = Significant

Residual effect of Primextra^(R) on yield and yield components of cowpea

There were no significant difference on residual effect of Primextra on cowpea between plot treated with Primextra and unweeded control on number of pods per plant, but they differ from plots that were hoe weeded twice in both years (Table 8). Similar trend was observed in the combined means with plot hoe weeded twice producing the highest number of pods (10.39) and plot treated with Primextra^(R) and unweeded control had the lowest number of 6.25 (Table 8). The

effect of Primextra^(R) on seed weight per plant did not differ significantly from the unweeded control plots, since they had similar seed weight/plant (Table 8). However, both treatments differ significantly from plot hoe weeded twice which had the highest seed weight/plant. Similar trend was observed in the combined means with a plot hoe weeded twice having the highest seed weight 12.65 g/plant while Primextra^(R) treated plots and unweeded control had 6.74 g/plant as the lowest (Table 8).

Table 8. Residual effects of Primextra^(R) on yield and components of cowpea in the late season of 2004 and 2005

Treatment	Number of Pods/Plant			Seed weight/ Plant			Grain yield (kg/ha)		
	2004	2005	Mean ¹	2004	2005	Mean	2004	2005	Mean
Primextra ^(R) @ 3.0 kg a.i.ha ⁻¹	5.81	6.29	6.05	6.25	7.23	6.74	671.3	843.8	757.55
Weeded x 2 (3 + 7 WAP)	10.18	10.59	10.39	12.20	13.09	12.65	1412.5	1634.7	523.70
No weeding	5.95	6.29	6.11	6.25	7.23	6.74	670.9	843.5	757.22
LSD (P = 0.05)	*	*	*	*	*	*	*	*	*

¹ = Combine analysis for 2004 and 2005 data, * = Significant

The residual effect of Primextra^(R) on cowpea grain yield is shown in Table 8. In both years, there were no significant difference between Primextra^(R) treated plots and unweeded control but these plots differ significantly from plot hoe weeded twice. The highest grain yield (1523.7 kg/ha) was obtained in plot hoe-weeded twice while the lowest were

recorded in Primextra^(R) treated plots and unweeded control plots with grain yield of 757.6 kg/ha and 757.2 kg/ha respectively.

Residual effects of Primextra^(R) on some soil characteristics before planting cowpea There were no significant difference (P > 0.05) on some soil physical characteristics (sand, silt and

clay particles) among Primextra^(R) treated soil, plot hoe weeded twice and no weeding plots in 2004 and 2005. The textural class of the soil was sandy. The residual effects of Primextra^(R) on some

soil chemical characteristics before cropping are presented in Table 9.

There was no significant difference in soil pH among the treatments in both years and combined means.

Table 9. Residual effects of Primextra[®] on some soil chemical characteristics before cropping of cowpea in the late seasons of 2004 and 2005

Treatment	pH (H ₂ O, 1:1)			Organic carbon (g/kg)		
	2004	2005	Mean ¹	2004	2005	Mean
Primextra ^(R) @ 3.0 kg a.i.ha ⁻¹	5.10	4.80	4.95	10.00	9.75	9.88
Weeded x 2 (3 + 7 WAP)	5.30	5.20	5.25	12.00	12.10	12.38
No weeding	5.20	4.90	5.05	9.00	9.88	9.74
LSD (P = 0.05)	NS	NS	NS	*	*	*

¹ - Combine analyses for 2004 and 2005 data, * = Significant, NS = Not Significant

In Primextra^(R) treated soil, pH ranged from 4.80 to 5.10 with a mean of 4.95; hoe weeded plots pH ranged from 5.20 to 5.30 with a mean of 5.25 while in no weeding plot, it ranged from 4.90 to 5.20 with a mean of 5.05. There were no significant difference ($p > 0.05$) between Primextra^(R) treated plots and no weeding control plot in organic carbon content but they differ significantly ($p < 0.05$) from plots that were hoe-weeded twice in both years (Table 10). In Primextra treated soil, organic carbon ranged from 9.75 g/kg to 10.00 g/kg with a mean of 9.88 g/kg; plot hoe weeded twice ranged from 12.00 g/kg to 12.10 g/kg with a mean of 12.38 g/kg while no weeding plot ranged from 9.00 to 9.88 g/kg with a mean of 9.74 g/kg.

DISCUSSION

Effect of Primextra^(R) on weed and maize yield

The treatments in both years reduced weed dry weight when compared to the unweeded control. However, the weed control effect differed according to the treatment. The highest weed dry weight recorded in weedy plots could be attributed to heavy weed infestation which emanated as a result of zero application of treatment. The lowest

weed dry weight recorded in Primextra^(R) – treated plots resulted in its highest weed control efficiency. The lowest weed dry weight recorded in Primextra^(R) treated plot could be attributed to the ability of the herbicide to maintain acceptable weed control efficiency beyond the critical period of weed interference in maize and partly due to reduced root competition. The Primextra^(R) used in the study was able to control weeds beyond the critical period. Olunuga (1978) noted that the critical period of weed competition in maize is between 30 and 40 days after emergence.

The low grain yield observed in the weedy plots could be attributed to severe weed competition. Apparently, weeds compete with maize plant especially for light and nutrients judging from the reduced grain yield of 72.03% and 73.38% recorded in 2004 and 2005 respectively, when compared to two hoe weeding. Hoe weeding once at 3 WAP was obviously not adequate for effective weed control in maize since it was not comparable to two hoe-weedings in promoting good yield. The higher grain yield in Primextra^(R) treated plots is expected because of effective weed control by the herbicide. Although hoe-weeding twice gives effective weed

control which translates into good yields, unavailability of labour makes this control option more expensive under farmer's condition (Chikoye *et al.*, 2002).

Residual effect of Primextra^(R) on cowpea

The non-significant difference observed in weed growth attributes between Primextra^(R) treated plots and no-weeding control plots indicates absence of Primextra^(R) residues from the soil. Toxicity rating was not included because there were practically no traces of cowpea injury and normal growth was apparently observed in cowpea plants. The non-significant difference between Primextra^(R) treated plots and the unweeded control plots could also be attributed to dissipation of Primextra^(R) from the soil.

The residual activity of Primextra^(R) did not vary between the two cropping seasons and the difference was insignificant. This is not surprising as there was no much difference between the total rainfall observed during cowpea growth (August to November). If the soil is too moist, herbicides may be leached beyond the root zone of the weeds resulting in poor weed control. Lack of a residual effect of Primextra^(R) used in this study could be attributed to leaching of herbicide from the soil through excess rainfall. This result is in agreement with that of Olunuga (1976) who evaluated some herbicides (alachlor, atrazine, cyannazine, dicamba, metolachlor and 2-4Daminz) in maize production and found that these herbicides had no residual effects on a following crop of maize. He attributed their findings to leaching effect caused by excess rainfall.

Some soil physical characteristics that influence herbicides efficacy are sand, silt and clay particles. Sandy soil is less likely to retain herbicide because of its coarse nature. The soil textural class used in this study was sandy. This facilitates easy leaching of Primextra^(R).

Some of the soil chemical characteristics that had influence on herbicide residues are soil pH and organic carbon.

The initial soil pH value of 5.55 obtained before cropping maize in 2004 and 2005 cropping season decreased to 4.95 in Primextra^(R) treated soil, 5.25 in plot hoe-weeded twice and 5.05 in weedy plots. The slight decrease could partly be attributed to leaching effect of nutrients and partly to nutrients removal by both maize and weeds. The soil pH value of 4.95 in both years recorded in Primextra^(R)-treated soil was below the established pH value of 6.0 recommended by Akobundu (1987) for triazine herbicides retention in tropical soils. The chemical degradation of Primextra^(R) at this low pH of 4.95 could be responsible for rapid Primextra^(R) loss from soil without having any residue effect on cowpea. Similar observations were reported by Utulu *et al.* (1986) on effect of soil pH on atrazine persistence. They reported that pH values of 4.2 to 4.8 left no atrazine residues in the soil, and implicated the prevalent high temperature and rainfall in tropical regions to be responsible for leaching of the triazine from the soil.

The initial value of 15.85 g/kg of organic carbon obtained in both years before cropping maize decreased to 9.88 g/kg in Primextra^(R) treated soil, 12.38 g/kg in plots hoe-weeded twice and 9.74 g/kg in no weeding plots. The decrease observed in the treatments could be attributed to faster rate of decomposition of organic matter from the top soil due to high temperature and rain fall. However, there was significantly less decrease in organic carbon in plots hoe weeded twice, due to additional decomposition of weeds that were left unpacked from the plots after weeding which release more nutrients to the soil. The organic carbon of 9.88 g/kg obtained in soil treated with Primextra^(R) in both years of study was below the critical value of 15 g/kg recommended by (Akobundu, 1987;

Williams, 1998) for triazine herbicides retention in tropical soil. The low organic carbon facilitates the rapid dissipation of Primextra^(R) from the soil through leaching without having any residual effect on cowpea.

In conclusion, this study, suggests that Primextra^(R) can effectively control weed in maize without any residual effects on a subsequent cowpea crop, and it is therefore recommended for cereal-legume rotational cropping system in the tropics.

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