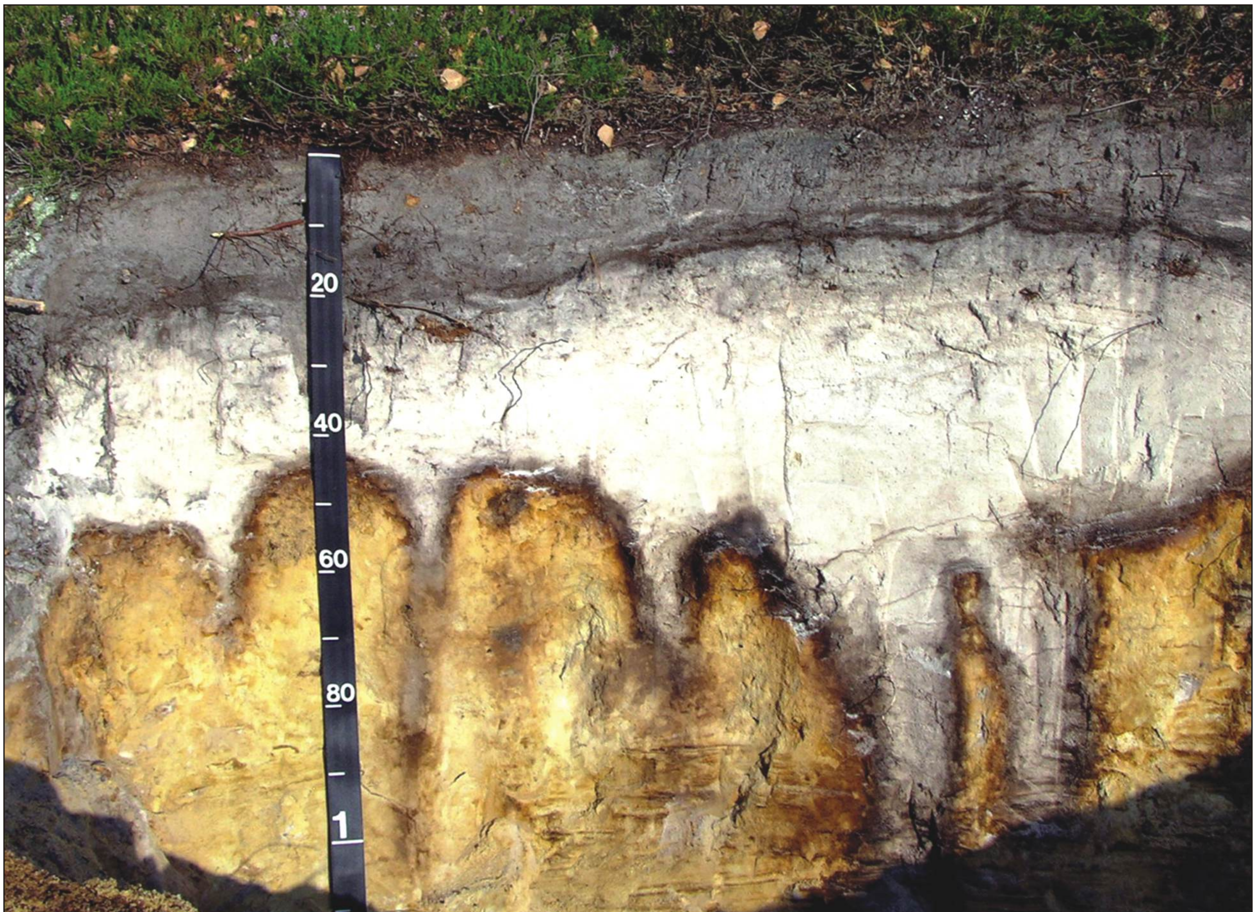

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The Effect of Tillage and Herbicides (Rimsulfuron and Codal Gold) on Weed Regeneration

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Abstract: The effect of three tillage methods (No-till, NT; Plough, P and Plough and harrow, (P+H) and the efficacy of Rimsulfuron (N-(4,6-dimethoxyl-2-pyrimidinyl) (amino carbonyl)-3-(ethysulfonyl)-2-pyridinesulfonamide) applied at 30 g ai ha^{-1}, Codal gold (a formulated mixture of metolachor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-)2-methoxl-1-methyethyl) acetamide) and prometryn (N,N'-bis(1-methylethyl)-6-(methylthio)-1,3,5-triazine-2,4-diamine) applied at 1.23 kg ha^{-1} on weed regeneration in maize (*Zea mays* L.) was studied at the University of Benin, Benin City, Faculty of Agriculture farm. The experiment was a split-plot arrangement in a completely randomized block, with tillage methods as the main treatment and weed control methods (Rimsulfuron, RIM; Codal Gold, CG; No weeding NW; HW) as sub treatment. Tillage methods significantly influenced weed biomass (1556, 980.12 and 1024.57 kg ha^{-1} for NT, P and P+H respectively, ($p<0.05$), but there were no significant differences in weed biomass between P and P+H. Weed control methods also significantly affected weed biomass, 1153.12, 1048.49, 1010.04 and 1535.91 kg ha^{-1} for CG, HW, Rim and NW, respectively ($p<0.05$). Tillage and weed control methods significantly influenced maize plant height and dry matter. Tillage methods significantly affected maize grain yield with values of 801.37, 1131.55 and 1272.37 kg ha^{-1} for NT, P and P+H, respectively. Codal Gold significantly depressed grain yield irrespective of the tillage system.

Key words: Tillage, rimsulfuron, prometryn, metolachlor, maize

INTRODUCTION

Tillage is done to optimize soil temperature and moisture control, minimize weed competition and stimulate root re-growth. The common tillage systems include conventional reduced and No till. Weed seeds are usually retained in reduced tillage than in conventional tillage systems (Forcella and Lindstrom, 1988; Felix and Owen, 2001). This higher amount of weeds may be accounted for firstly by the accumulation of crop residue on the soil surface, indicating more protection from predators and adverse conditions, secondly less movement of seeds along the profile, fewer dormancy breaking mechanisms and lower exposure of seeds to potential hazards (Feldman *et al*., 1994). Distribution of weed seeds within the plough layer have been shown to decrease linearly and logarithmatically with depth for conventional and no-till systems respectively (Yenish *et al*., 1992). Crop residues on the soil surface reduce weed seedling establishment in no-till systems, but tillage eliminates this effect (Anderson, 2004).

Land preparation practices vary widely among farmers in Nigeria. In some cases farmers do not undertake any form of land preparation beyond slash and burn of the resulting residue. In some cases, farmers leave the stubble mulch resulting from clearing of bush with minimal burning. Farmers in

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Nigeria have sometimes reported inadequate weed control from use of herbicides (Ikuenobe *et al*., 2005). It is not exactly known if the lack of adherence to label instructions could be responsible for this. Since tillage has been shown to influence the efficacy of herbicides in weed control (Ikuenobe *et al*., 1994), it is necessary to evaluate the performance of herbicides under different land preparation practices as tillage and other agronomic practices operations differ among farmers in Nigeria.

The objective of this study was to evaluate the effect of different tillage systems and the efficacy of Rimsulfuron and Codal Gold (metolachor + prometryn) herbicide formulations on weed control, using maize (*Zea mays* L.) as the test crop.

MATERIALS AND METHODS

A field experiment was laid out in split plot arrangement in compete randomized block design. The main plots were the land preparation consisting of three tillage treatments, No till (NT), Plough (P), land was ploughed using disc plough and Plough and Harrow, (P+H), land was ploughed with disc plough and harrowed a day after plough to obtain a fine seed bed. The main plot was 14×19 m with each tillage treatment separated by 1 m. The sub-plot was the weed control method:

- Rimsulfuron (RIM) (N-4,6-dimethoxy-2-pyrimidinyl) amino) carbonxl)-3-(ethysulfonyl)-2-pyridine sulfonamide) applied at 30 g a.i. ha^{-1}
- Codal Gold (CG) (a formulated mixture of 240 g L^{-1} Prometryn (N,N'-bis(1-methylethyl)-6-(methylthio)-1, 3, 5-triazine-2,4-diamine)+82.5 g L^{-1} metolachlor (2-chloro-N-(2-ethyl-6-methylphenyl)-N-) (2-methoxl-1-methyethyl) acetamide) applied at 1.23 kg a.i. ha^{-1}
- Hand weeding (HW), hoe was used for weeding
- No weeding (NW).

The main plot size was 14×19 m while the sub plots were 4×4 m. Pre-cropping vegetation was dominated by guinea grass (*Panicum maximum* Jacq.) sensitive plant (*Mimosa pudica* Linn.) giant sensitive plant (*Mimosa invisa* Mart), wandering Jew (*Commelina erecta* L.), Digit grass (*Digitaria horizontalis* Wild.) Yellow nutsedge (*Cyperus esculentus* Linn.), purple nutsedge (*Cyperus rotundus* Linn.), Cat's tailgrass (*Sporobolus pyramidalis* P. Beauv.), Dutch millet (*Paspalum scrobiculatum* Linn.) and to a less extent *Calopogonium mucunoides* Desv. The experimental site was under short fallow for 2 years, previously cropped to maize (*Zea mays* L.).

Paraquat (1,1-dimethyl-4,4'-bi pyridinium ion) was applied 4 weeks after ploughing and harrowing on the entire experimental plot to kill existing weeds on 4th August, 2004. Maize (variety CR89 DMR-ESRW) was sown at 75×25 cm spacing, one week after application of paraquat. Herbicide treatments were applied in a spray volume of 240 L ha^{-1} using a CP 15 knapsack, post emergence 7 days after planting of maize. The hand weeding was done on the same day of post emergence herbicide application. Fertilizer (urea 46% N) was applied at the rate of 120 kg N ha^{-1} at 3 Weeks After Planting (WAP).

Three permanent quadrats (1×1 m) were established in each sub-treatment plot. Weed identification and biomass was obtained from three quadrats at 4, 8 and 12 Weeks After Treatments (WAT) were applied. Plant height of 6 plants per qudrants were measured at 50% tasselling. At tasselling 10 plants of maize in the middle row of each subplot were collected for dry matter determination. Samples were weighed after oven drying at 65°C to a constant weight. Maize grain and cob weight were not determined because livestock grazed part of the field when the plants were due for harvest.

Soil particle size analysis was done using the hydrometer method (Bouyoucous, 1951). Soil pH was determined in 1:1 soil:water suspension using pH meter. Soil organic matter was determined using Walkley-Black method as modified by Black (1965). Exchangeable cation was extracted with neutral 1N ammonium acetate determined with the EDTA titration, Na and K were measured with digital flame Analyzer. Exchangeable acidity was extracted with 1N potassium chloride and titrated with sodium hydroxide. Effective Cation Exchange Capacity (ECEC) was determined by the summation of exchangeable cations plus exchangeable acidity.

All data were subjected to analysis of variance and treatment means separated by Duncan Multiple Range Test using the Statistical Analysis System (SAS, 1995).

RESULTS AND DISCUSSION

The physico-chemical properties of the soil of the site are shown in Table 1. The soil is loamy sand, low base saturation, acidic and low ECEC.

Weeds observed in the plots in order of relative abundance were mainly *Panicum maximum* Jacq., *Paspalum scobiculatum* L., *Sporobolus pyramadalis* P. Beauv, *Digitaria horizontalis* Wild., *Commelina benghalensis* L., *Cyperus rotundus* L., *Mitracarpus villosus* (Sw.) DC. and *Mimosa invisa* Mart. The *Mimosa invisa* population increased at the later stages of the experiment. The grasses dominated the weed composition especially in the RIM plots.

The no weeding (NW) plots recorded the highest weed biomass, but were not significantly different from those of RIM, CG and HW. Weed biomass increased with time, irrespective of tillage treatments. Weed collection at 12 WAT recorded the highest weed biomass (Table 2). There were no significant differences in weed biomass between P and P+H treatments 4, 8 and 12 WAT; however the NT had significantly higher weed biomass than the P and P+H treatments.

The weed biomass of NW was significantly higher than that of HW plots but not different from those of RIM and CG at 4 WAT. At 8 WAT, there were no significant differences between the weed biomass in the NW and the HW and CG treatments. No significant differences were observed between the herbicide treatments (RIM and CG) and HW at any time during the study. Tillage and weed control methods interaction was not significant throughout the period of treatment. The weed biomass of the tilled plots (P and P+H), were significantly ($p<0.05$) less than those of NT plots (Table 3) all through the duration of observation.

Table 1: Physico-chemical properties of soil of the experimental site

pH	Org.C (%)	AVP (mg kg^{-1})	Total N (%)	Ca	Mg	Na	K	Exch. Acidity	ECEC	Sand	Silt	Clay
				----------------Cmol kg^{-1}----------------						--------(%)--------		
5.3	0.77	4.56	0.13	1.25	0.42	0.005	00.009	1.45	3.26	85	2	13

Table 2: Effect of tillage and herbicide treatments on weekly weed regrowth

WAT		NT	P	P+H	Mean
4	CG	513.65	225.48	377.88	372.33^{ab}
	HW	333.38	118.73	197.93	216.68^{b}
	RIM	575.98	364.43	234.50	391.64^{ab}
	NW	843.95	216.95	306.60	455.83^{a}
	Mean	566.74^{a}	231.4^{b}	279.23^{b}	
8	CG	1562.70	867.90	1338.60	1256.40^{ab}
	HW	2035.75	995.18	1953.08	1361.34^{ab}
	RIM	1169.10	841.55	988.45	999.70^{b}
	NW	2185.13	1271.63	1754.73	1737.16^{a}
	Mean	1738.17^{a}	994.07^{b}	1283.72^{b}	
12	CG	2155.45	1735.13	1601.35	1830.64^{b}
	HW	2078.98	1263.40	1359.98	1567.45^{b}
	RIM	2129.75	1654.93	1131.73	1638.80^{b}
	NW	3088.00	2206.18	1950.00	2414.73^{a}
	Mean	2363.05^{a}	1714.91^{b}	1510.77^{b}	

Weekly means with similar letter(s) in same column are not significantly different. Weekly means with similar letter(s) in same row are not significantly different

Table 3: Effect of tillage and weed control treatments on weed biomass (kg ha^{-1})

	Tillage treatment			
Weed control	NT	P	P+H	Mean
CG	1410.59	942.83	1105.94	1153.12^b
HW	1482.70	792.43	870.33	1048.49^b
RIM	1291.61	953.63	784.89	1010.04^b
NW	2039.03	1231.58	1337.11	1535.91^a
Mean	1556.00^a	980.12^b	1024.57^b	

Means on the same column having similar letter(s) are not significantly different. Means on the same row having similar letter(s) are not significantly different (p>0.05)

Table 4: Effect of tillage and weed control methods on maize dry plant height (cm)

	Tillage treatment			
Weed control	NT	P	P+H	Mean
CG	52.57	46.21	51.52	50.10^b
HW	68.18	63.71	61.54	64.48^a
RIM	65.04	64.54	79.24	69.61^a
NW	56.70	61.22	79.25	65.72^a
Mean	60.62^{ab}	58.92^b	67.89^a	

Means on the same column having similar letter(s) are not significantly different. Means on the same row having similar letter(s) are not significantly different (p>0.05)

Table 5: Effect of tillage and weed control treatments on maize dry matter (kg ha^{-1})

	Tillage treatment			
Weed control	NT	P	P+H	Mean
CG	214.53	802.12	904.45	640.37^b
HW	1176.72	1721.25	765.00	1220.99^b
RIM	682.66	1045.24	1900.63	1010.04^b
NW	1131.57	957.58	1519.38	1535.91^a
Mean	801.37^b	1131.55^a	1272.37^a	

Means on the same column having similar letters are not significantly different. Means on the same row having similar letters are not significantly different (p>0.05)

The method of land preparation significantly influenced maize height and dry matter (Table 4). Maize heights were higher in the P+H and P than in the NT ($p<0.05$). Maize dry matter was significantly reduced by Codal Gold. The values of maize dry matter for HW, RIM and NW were not significantly different, except from that of CG. The maize height for P+H was higher than that of P but not significantly different, however both were significantly higher than the NT plots ($p>0.05$) (Table 5).

Rimsulfuron reduced the presence of broad leaf weeds but did not effectively control grasses, which was consistent with the findings of Blackshaw *et al*. (1995) and Guttieri and Eberlein (1997) indicating that Rimsulfuron may only be effective in controlling broadleaved weeds but ineffective in controlling grasses in maize under the tillage conditions evaluated in this trial. Land preparation method influenced regeneration of weeds. Weeds were generally less controlled under no till condition. The lack of significant differences in the weed biomass regenerating between P and P+H suggest that further effort beyond ploughing may not be required to reduce weed population or improve on the efficacy of the herbicides evaluated in this trial.

The influence of the tillage method on maize height may be attributed to the level of weed suppression achieved under the different tillage methods. Since weeds were better suppressed under the P and P+H plots, the weed interference on maize growth was less than under the NT plots where weeds were less suppressed.

Maize height and dry matter in the Codal Gold treatment were significantly lower ($p<0.05$) than in the Rimsulfuron plots. Maize suffered foliar injury arising from application of Codal Gold. Codal

Gold is labelled for legumes and cotton. Thus it may not be a safe herbicide for use in maize. As maize is often intercropped with legumes in Nigeria, it would not be a safe herbicide for maize under such cropping circumstance. However further study would be needed to evaluate it for use in crop rotations where, maize is a relayed crop.

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