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POTENCY OF FIVE PRE-EMERGENCE HERBICIDES FOR WEED CONTROL IN COCOYAM (Colocasia esculenta (L) SCHOTT) PRODUCTION IN UMUDIKE, ABIA STATE

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ABSTRACT
This study was conducted at the National Root Crops Research Institute, Umudike, Abia State in 2015 and 2016 to investigate the weed control efficacy of five pre-emergence herbicides in cocoyam (NCe012) production. The trial was laid out in a Randomized Complete Block Design (RCBD) with three replications. The treatments consist of Diuron at 3 and 4L/ha, Goal Tender 4F at 0.5 and 0.75kg/ha, Liberator forte at 1.0 and 1.5L/ha, Codal Gold at 3 and 4.5L/ha, Primextra Gold at 3 and 4.5L/ha, three hoe weeding at 4,8 and 12 weeks after planting (WAP) and a weedy check plot. In both years, the plots treated with Goal Tender 4F at 0.75 kg/ha gave the lowest weed dry matter of 6.9 and 7.9 g/m^{2}at 6WAP, 32.5 and 28.3 g/m^2 at 9WAP, while the unweeded check plot had the highest weed dry matter of 20.0 and 24.4g/m^{2}at 6WAP, 65.7 and 75.0 g/m^2 at 9WAP in 2015 and 2016 respectively compared with other treatments. In both years, Goal Tender 4F at 0.75kg/ha was very effective in controlling weed growth at all sampling periods, although the efficacy of the pre-emergence herbicide decreased as the weeks increased after planting (WAP). However its efficacy was still better than other herbicides treatments. Liberator forte at the rate of1.5L/ha was the least effective pre-emergence herbicide in controlling weeds. Application of Goal Tender 4F at 0.5 and 0.75 kg/ha gave significantly lower crop injury at all sampling periods in both years. For all the period of data collection, it was observed that the unweeded check plot gave the highest weed density in both years, while the plots treated with Goal Tender 4F at 0.75 kg/ha resulted in significantly lower weed density at all sampling periods in both years. For the number of corms and cormels, the results showed that the unweeded check plot gave the least number of corms and cormels. There was a significant difference between the herbicide treatments. Highest corm mean weight of 2.38 t/ha was obtained in plots treated with premextra gold at 4.5 L/ha, while the unweeded check had the lowest mean corm weight of 0.63 t/ha. The results also showed that, Gold Tender 4F at 0.75 kg/ha gave the highest cormel mean weight of 3.95 t/ha, while the least mean cormel weight of 0.38 t/ha were obtained from unweeded check plot. With good weed control, lower crop injury, higher cormel number and weight than other treatments, Goal Tender 4F at 0.75 kg/ha is therefore recommended for weed control in cocoyam in south Eastern Nigeria.

Keywords: Goals tender 4f, Diruon, Codal gold, liberator forte, Weed dry matter, Efficacy, and Crop injury

Introduction

Colocasia esculenta (Taro)and *Xanthosoma sagittitifolium* (Tannia) are the two food cocoyam crops of economic importance (Green and Oguzor, 2009). They belong to the Araceae family. Cocoyam is probably one of the oldest crops on earth and its domestication is likely to have occurred more than 10,000 years ago. Although some authors (Yen and Wheeler, 1968; Mathews, 1990) noted that cocoyam originated in Indo-Malayan region, between Maynmar and Bangladesh, there is insufficient evidence to confirm this supposition. Nigeria remains the largest producer of *Colocosia* in the world, with an estimated production of 5.49 million metric tons (FAO, 1990), followed by Ghana and China. It ranks third after cassava and yam, in terms of total production, land area under crop and importance. Taro (*C. esculenta*) is an important traditional staple crop in rural African countries, but its contribution to food security is limited by a lack of research on its agronomy and commercialization (Mare, 2009). It is a starchy widely cultivated crop and consumed in south eastern agricultural zone of Nigeria for decades (Ndon *et al*., 2003). Previously, cocoyam had been regarded as "poor man's food or woman's crop and such has lagged behind the preferred staple root/tuber crops such as yam and cassava in research attention (Ezeh and Mbanaso, 1987; Ikwelle *et al*., 2003).

Currently *X. sagittifolium* is seriously threatened with extinction in South Eastern Nigeria as a result of its high susceptibility to complete rot diseases. Weeds, pest and diseases are the most limiting factors in cocoyam production; resulting in significant yield losses in the field and after harvest. There is buildup of disease in the farm site due to lack of crop rotation and unavailability of land. However, weeds and diseases restrict cocoyam production more than pests because the family Araceae is vulnerable to weeds and diseases (FAO, 1990). Weeds account for an estimated 14% loss of yield on worldwide basis, and are the most common and destructive to crop plants (Jackson *et al*., 2003). Weeds are plants growing where man does not want it to be (Onwueme and Singh, 1999). Weeds have been observed to drastically reduce the yield of cocoyam. It is a major determinant of farm size and productivity of peasant farmers (Akobundu, 1978). He reported that weeds could cause yield losses ranging from 50 to 80%, in cocoyam, crop losses by weeds cover can be aggravated by delay in weeding or inability to weed throughout the entire crop growth period. However, studies of threshold levels of weed have shown that complete weed elimination is not essential for high yields (Sangakkara, 1999). Probably because the crop also compete strongly with weeds. Weed compete with crops for nutrients, water and light (Gulden *et al*., 2009). All plants require the same basic nutrients, but plants differ in the way they respond to nutrient availability (Blackshaw *et al*., 2001).

The level of soil fertility determines the relative competitiveness between the crop and the weeds (Blackshaw *et al*., 2001). At higher levels, or if an imbalance favors high levels of N, weeds like wild oats are generally more competitive than crops. Investigating the relationship between weeds and plants nutrients can help arable crop farmers manage weed by avoiding critical period of weed competition with crops and adoption of various cultural management practices. Weeds reduce crop yields and quality. They also decrease the value and productivity of land; reduce harvesting and processing efficiency, increases cost and labour for control measures and constitute the biggest constraint in improving crop production in Africa and yield (Ekeleme and Ekwenta, 2004). Considering the extent of damage and loss caused by weeds to crops, it is imperative to control them in order to increase the quality and quantity of farm produce. A number of strategies have been used in the control of weed but the most spectacular is the use of herbicide. There is need therefore to identify the appropriate herbicides for weed control in cocoyam and determine the appropriate rates of selected pre-emergence herbicides for weed control in cocoyam.

Materials and Methods

The experiement was conducted at NRCRI Umudike. A genotope of colocasia esculenta L. schoot (Nce 012) was obtained from National Root Crops Research Institute Umudike. The experiment was laid out as a Randomized Complete Block Design (RCBD) in three replicates. The plot measured 4m x 5m consisting of 4 rows with plant spacing of 100cm x 50cm. Two days after planting, the pre-emergence herbicides were applied using knapsack sprayer. The treatments include the following;

Treatments	Active ingredients (a.i)	Rates (kg/ha
Diuron at 3 L/ha	Diuron	1.50
Diuron at 4 L/ha	Diuron	2.0
Goal Tender 4F at 0.5 L/ha	Oxyflurfen	0.24
Goal Tender 4F at 0.75 L/ha	Oxyflurfen	0.60
Liberator Forte at 1.0 L/ha	Flufenacet + diflufenican flurtamone	0.12 + 0.12 + 0.12
Liberator Forte at 1.5 L/ha	Flufenacet + diflufenican flurtamone	0.18 + 0.18 + 0.18
Codal Gold at 3 L/ha	Prometryn + S – metolachlor	0.75 + 0.49
Codal Gold at 4.5 L/ha	Prometryn + S – metolachlo	1.13 + 0.73
Primextra Gold at 3 L/ha	S – metolachlo + atrazine	0.87 + 1.11
Primextra Gold at 4.5 L/h	S – metolachlo + atrazine	1.31 + 1.67
Three hoe weeding	-	4.8, 12 WAP
U weeding	-	-

WAP- Weeks after planting

All the data collected were subjected to analysis of variance (ANOVA) using the Genstate Discovery Edition 12 (Genstate, 2009) and mean separation done using least significant difference.

Results and Discussion

Table 1 shows the visual rating of crop injury. From the result, it was observed that visual rating of crop injury at 6, 8 and 10 WAP had significant difference ($P<0.05$) between the years. Also across the two years, plants in plots treated with Goal Tender 4F at 0.5 L/ha showed the least (23.7%) visible crop injury. Table two shows the result for weed density assessment. In both

years, it was observed that Goal Tender 4F at 0.75 L/ha had comparable weed density with hoe weeding at 8WAP. A significant difference was observed among the treatments also. Weed control efficacy rating is presented in Table 3. Result obtained shows also that Goal Tender 4F at 0.75L/ha had the highest weed control efficacy at all sampling time up 12 WAP without any post-emergence weed control. Plot treated with Goal Tender 4F at 0.5L/ha had excellent to good weed control up to 6 WAP and latter declined to 75% weed control in both years.For the number of corms and cormels per hectare, plots treated with Diuron and Goal Tender 4F at 0.75L/ha produced the highest number of corms in both years while for cormels, while plot treated with Goal Tender 4F at both rates also produced the highest number of cormels in both years and was significantly differences at ($P<0.05$) than other treatments. The production of cocoyam is grossly affected by weed infestation in southern part of Nigeria (Sangakkara, 1997). Oluwafemi (2013) reported that in Ekiti State, the challenging factor in cocoyam production is weed infestation; he further stated that during the early stages of between 4-12 weeks, Cocoyam is more affected by weeds.

In another similar study, Chikoye (2000) confirmed that the total information on economic impact of weeds on cocoyam production is still vague, probably because methods for estimating yield losses often differ and this makes it difficult for easy comparison in different regions of the country. For weed density, the highest weed density was observed at 14WAP in 2015and 2016 . In recent study, findings of Oluwafemi (2013), was similar to that of this present study indicating that highest weed density was observed in weedy check plots. It has also been observed that when higher canopy closure occurs weeds are kept reasonably in check (Onwueme, 1998). Weed affects the number of corns and cormels. This could be as a result of weed infestation on weedy plot. Oerke et al, (1994) noted that losses caused by weed infestation in cocoyam production could be extensive.

Conclusion

The five pre-emergency herbicides used in this study could be used for replacement of other methods of weed control. Though all the herbicides significantly reduced weed dry matter, weed density, and improved weed control efficacy, Goal tender 4F at 0.5L/ha and 0.75L/ha where the most effective in controlling weeds especially on mimosa invisa and could be recommended to the poor resource farmers for weed control in cocoyam.

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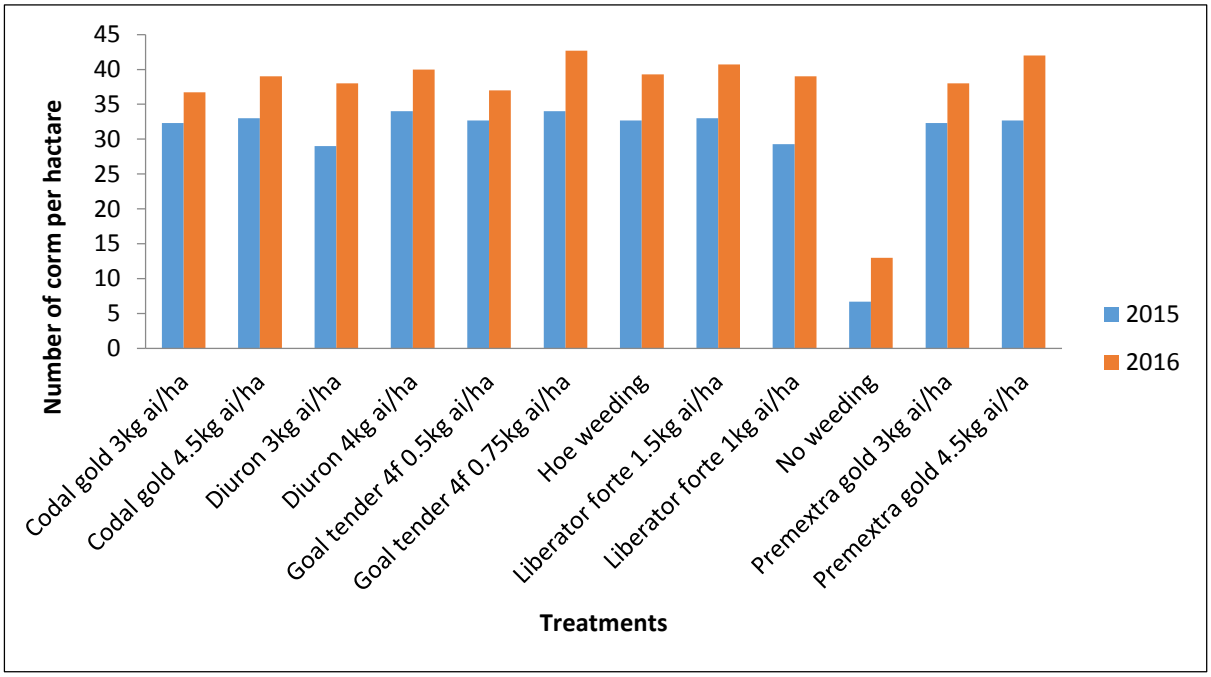

Figure 1: Effects of weed control treatments on number of corms per hectare

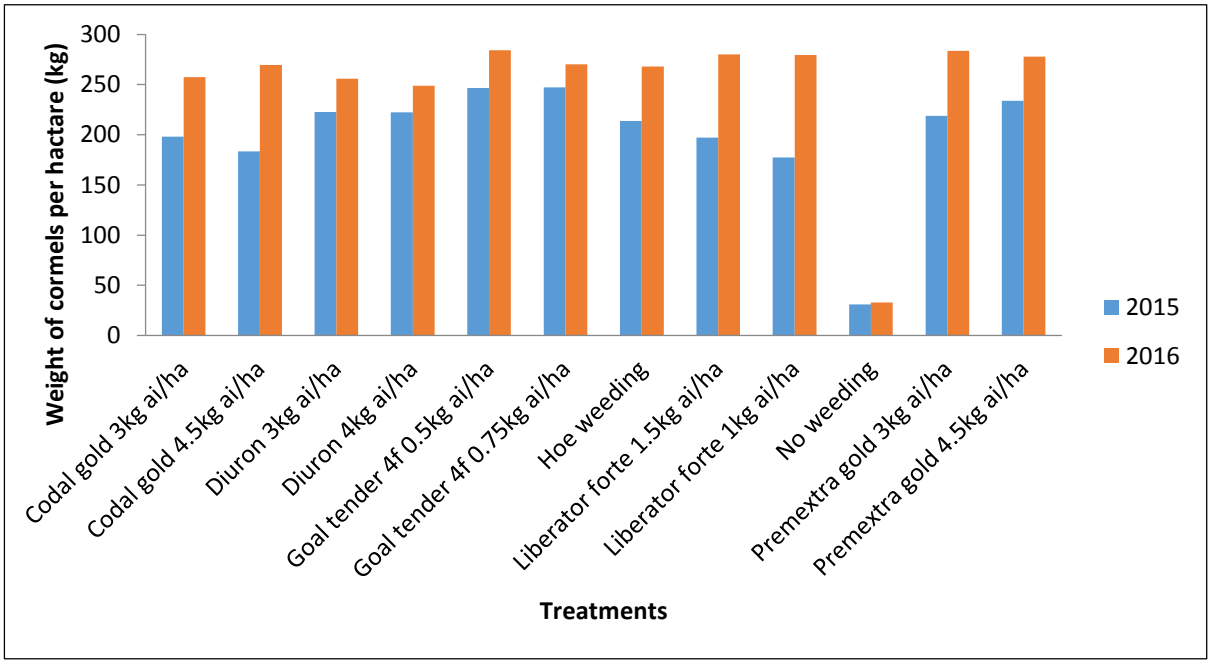

Figure 2: Effects of weed control treatments on number of cormels per hactare

Table 1: Percentage injury rating of cocoyam under different weed control treatments in 2015 and 2016

	Percentage injury rating (%) and weeks after planting (weeks)														
	2 WAP			4 WAP			6 WAP			8 WAP			12WAP		
Treatments	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**
Codal Gold at 3 L/ha	28.7	31.3	30.0	31.3	33.3	32.3	36.7	40.0	38.3	33.3	34.7	34.0	30.7	33.3	32.0
Codal Gold at 4.5 L/ha	32.0	30.0	31.0	30.0	30.0	30.0	40.0	40.0	40.0	31.7	34.7	33.2	30.0	33.7	31.8
Diuron at 3 L/ha	26.7	30.7	28.7	30.0	34.0	32.0	30.0	30.0	30.0	31.7	31.3	31.5	30.7	30.7	30.5
Diuron at 4 L/ha	27.3	23.3	25.3	30.0	30.0	30.0	30.0	30.0	30.0	30.0	31.3	30.7	28.7	30.3	29.5
Goal Tender 4F at 0.5 L/ha	23.3	24.0	23.7	32.3	34.0	30.2	30.0	30.0	30.0	31.3	31.3	31.3	27.3	30.3	28.8
Goal Tender 4F at 0.75 L/ha	27.3	26.7	27.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.7	30.3	30.0	30.0	30.0
Hoe weeding	30.0	30.0	30.0	30.0	30.0	30.0	30.0	44.0	42.0	30.0	35.0	32.5	30.7	33.7	32.2
Liberator Forte at 1.0 L/ha	28.3	30.0	29.2	30.0	33.3	31.7	40.0	40.0	40.0	31.3	34.7	33.0	29.3	33.7	31.5
Liberator Forte at 1.5 L/ha	30.0	28.0	29.0	32.3	36.7	34.5	40.0	40.0	40.0	32.3	34.7	33.5	30.7	33.7	32.2
No weeding	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Primextra Gold at 3 L/ha	30.0	27.3	28.7	30.7	30.0	30.3	36.7	40.0	38.3	33.3	34.7	34.0	29.3	33.7	31.5
Primextra Gold at 4.5 L/h	28.7	29.3	29.0	30.7	33.3	32.0	36.7	40.0	38.3	33.3	34.7	34.0	32.3	33.7	33.0
LSD $_{(0.05)}$	6.02	6.50		2.22	86.13	4.66	1.69		3.52	1.55			Ns	2.06	
Coefficient of variation (CV %)	8.6	8.5		1.7	5.8	0	0.7		1.4	1.2	1		7.3	2.9	

Table 2: Effect of herbicides and weeding methods on weed density of cocoyam after 6, 8, 10, 12 and 14 WAP in 2015 and 2016

	Weed density and WAP (weeks)														
	6 WAP			8 WAP			10 WAP			12 WAP			14WAP		
Treatments	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**
Codal Gold at 3 L/ha	19.0	24.7	21.8	40.3	45.0	42.7	64.0	56.0	60.0	80.0	72.7	76.3	90.3	83.3	86.8
Codal Gold at 4.5 L/ha	19.3	20.7	20.0	32.0	40.3	36.2	53.0	54.7	53.8	68.7	67.0	67.8	87.0	76.0	81.5
Diuron at 3 L/ha	34.0	23.7	28.7	35.7	49.3	42.5	61.0	62.0	61.5	76.7	77.3	77.0	84.3	100.0	92.2
Diuron at 4 L/ha	20.0	21.7	20.8	33.3	42.7	38.0	55.7	63.7	59.7	68.7	74.7	71.7	77.3	109.3	93.3
Goal Tender 4F at 0.5 L/ha	16.7	20.7	18.7	25.3	35.3	30.3	46.0	59.7	52.8	58.0	78.7	68.3	65.7	93.3	79.5
Goal Tender 4F at 0.75 L/ha	13.0	17.3	15.2	22.3	30.3	26.3	37.0	52.0	44.5	54.0	72.0	63.0	64.3	88.7	76.5
Hoe weeding	15.7	8.3	12.0	0.0	17.3	8.7	9.3	26.0	17.7	22.0	70.0	46.0	24.0	76.3	50.2
Liberator Forte at 1.0 L/ha	25.0	20.7	22.8	42.0	38.0	40.0	61.7	60.7	61.2	85.7	69.0	77.3	92.0	82.7	87.3
Liberator Forte at 1.5 L/ha	22.7	23.3	23.0	55.7	42.0	48.8	74.0	68.7	71.2	95.0	80.0	87.5	107.3	97.7	102.5
No weeding	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Primextra Gold at 3 L/ha	19.3	24.7	22.0	36.3	46.0	41.2	59.0	68.7	63.8	66.00	71.3	68.7	81.0	88.0	84.5
Primextra Gold at 4.5 L/h	19.7	21.0	20.3	37.7	39.3	38.5	55.3	59.3	57.3	63.7	83.3	73.5	70.3	87.7	79.0
LSD $_{(0.05)}$	ns	3.0		6.6	6.5		1032.0	8.5		6.8	5.3		1097.0	13.7	
Coefficient of variation (CV %)	16.7	3.3		5.2	5.8			4.3		2.3	2.4		2.2	3.9	

Table 3: Weed control efficacy of herbicides and weeding methods after 2, 4, 6, 8 and 12 WAP in 2015 and 2016

	Efficacy (%) and WAP (weeks)														
	6 WAP			8 WAP			10 WAP			12 WAP			14WAP		
Treatments	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**	**2015**	**2016**	**Mean**
Codal Gold at 3 L/ha	78.7	78.3	78.5	73.3	65.0	69.2	71.7	65.0	68.3	61.7	60.0	60.8	50.0	50.0	50.0
Codal Gold at 4.5 L/ha	82.0	81.7	81.8	80.7	76.7	78.7	78.0	76.7	77.3	65.0	65.0	65.0	60.0	60.0	60.0
Diuron at 3 L/ha	80.0	73.3	76.7	73.3	70.0	71.7	71.7	70.0	70.8	68.3	66.7	66.7	60.0	61.7	60.8
Diuron at 4 L/ha	81.7	81.7	81.7	80.0	78.3	79.2	77.0	75.0	76.0	71.7	70.0	70.0	61.7	60.0	60.8
Goal Tender 4F at 0.5 L/ha	90.0	90.0	90.0	90.0	90.0	90.0	86.0	85.0	85.5	70.0	75.0	72.5	65.0	65.0	65.0
Goal Tender 4F at 0.75 L/ha	96.0	95.0	95.5	93.3	93.0	93.2	90.0	90.0	90.0	80.0	80.0	80.0	70.0	70.0	70.0
Hoe weeding	85.0	83.3	84.2	81.7	80.7	81.2	80.0	80.0	80.0	70.0	70.0	70.0	61.7	60.0	60.8
Liberator Forte at 1.0 L/ha	70.0	80.0	75.0	61.7	73.3	67.5	51.7	68.3	60.0	50.0	51.7	50.8	51.7	53.3	52.5
Liberator Forte at 1.5 L/ha	65.0	71.7	68.3	60.0	68.3	64.2	50.0	58.3	54.2	50.0	81.7	50.8	50.0	50.0	50.0
No weeding	20.0	20.0	20.0	10.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.3	0.0
Primextra Gold at 3 L/ha	75.0	76.7	78.5	73.3	70.0	71.7	72.0	71.0	71.0	66.7	65.0	65.8	55.7	61.7	54.5
Primextra Gold at 4.5 L/h	81.7	81.7	81.8	79.3	80.0	79.7	76.7	75.8	75.8	70.0	70.0	70.0	63.3	2.9	62.5
LSD $_{(0.05)}$	2.8	4.3		5.6	3.1		5.1			ns	2.4		4.3	0.8	
Coefficient of variation (CV %)	0.9	1.7		0.5	0.5		1			7.3	0.7		1		