EVALUATION OF SULFONYL–UREA HERBICIDES FOR THE CONTROL OF ITCHGRASS (*ROTTBOELIA COCHINCHINENSIS CLAYTON*) ON MAIZE IN NORTHERN NIGERIA

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Abstract

Two trials were conducted during 2010 and 2011 wet seasons on the farm of Institute for Agricultural Research, Ahmadu Bello University Samaru Zaria, to evaluate to sulfonylurea herbicides, cinosulfuron and prosulfuron, on maize to address the problem of low yield due to infestation of itch grass (Rottboelia cochinchinensis).The two herbicides were evaluated at four rates each (0.4, 0.6, 0.8 and 1.0 kg a.i./ha) and compared against a hoe–weeded control and a weedy check in a Randomized Complete Design with three replications. Among the various rates of the herbicides evaluated, 0.60 and 0.80 kg a.i per ha of both cinosulfuron and prosulfuron gave better control of itch grass, crop growth and grain yield of maize that was comparable to the hoe–weeded control. It can be concluded that these two herbicide rates can be adopted by farmers as an alternative to manual hoe–weeding of itch grass in northern Nigeria.

Keywords: Evaluation, sulfonylurea, cinosulfuron, prosulfuron, maize and itch grass

INTRODUCTION

Maize (*Zea mays L*) is the most completely domesticated of all field crops and the second most important cereal crop in Nigeria after Sorghum (Fakorede *et al.*, 1993). However, maize is gradually replacing sorghum and becoming the most important cultivated cereal crop now especially in northern Nigeria. Maize production in Nigeria is fast becoming an important feature in both subsistence and large scale agriculture. As at 2010, the world's maize production was 829 million tonnes with 8.1 million tonnes produced in Nigeria, which was just 1.0 % of the total world production (FAO, 2010). Due to poor yields among large and small scale farmers in Nigeria, there has been a growing concern on raising its productivity and profitability (Adamu, 1991). This general decline in yield has been attributed to high weed infestations which results to low yield due to weed interference and competition with the crop. This is because an average yield reduction due to uncontrolled weed growth in maize is between 40 – 80 % losses in the potential yield (Lagoke *et al.*, 1999). Among the weed species the most prevalent in the Nigerian Savannah now is itch grass (*Rottboelia cochinchinensis*). A survey conducted on more than 80 % of the cultivated fields in the northern Guinea Savannah of Nigeria indicated that 40 – 60 % of the weed type that ravages agricultural lands in this ecology was Itch grass (Kuchinda *et al.*, 2006). This high infestation of Itch grass not only causes a drastic reduction in the yield of the crop but its high infestation and ability to cover large area of arable farms within few years of infestation, has caused many farms to be uncultivatable. Moreover its itching effect that ultimately causes a skin disease called inflammatory dermatitis, which causes labour scarcity at the time of need, due to labourers' failure to work in the infested fields has been causing large arable lands to be abandoned completely by farmers especially in the savannah ecological zones of Nigeria (Anonymous, 2009). Thus, making manual hoe–weeding which is the prevalent method of weed control in Nigeria, impossible and impracticable in almost all the itch grass infested fields. Therefore, a better control method of this weed which is threatening food production, security and even health of farmers in Nigeria must be invented in order to improve the productivity of maize as well as to reclaim all agricultural land that were abandoned due to the infestation of itch grass weed. It is in this view that chemical control method of itch grass, which requires less labour, is also less tedious, without drudgery and is also associated with less risk to human health, which may serve as an alternative to manual hoe weeding of the weed, was proposed. This work was therefore carried out with the following objectives:

Evaluation of two Sulfonylurea herbicides for the control of itch grass (*Rottboelia cochinchinensis*) in maize as well as to determine the effects of the two herbicides on the general performance of the crop.

MATERIALS AND METHODS

The trials were conducted during the wet seasons of 2010 and 2011 on the research farm of the Institute of Agricultural Research Samaru (11°11'N; 07°37'E) Zaria, in the northern Guinea Savannah ecology of Nigeria. The most common and dominant weed type on the experimental site was Itch grass (*Rottboelia cochinchinensis*), with few other species of broad leaf weeds and grasses. The treatments consisted of herbicides evaluated at four rates each of Cinosulfuron and Prosulfuron (0.40, 0.60, 0.80 and 1.00 kg a.i/ha), a hoe–weeded control and a weedy

check, making a total of ten treatments. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The experimental field was ploughed and harrowed twice at forth night in each season and was ridged at 75 cm spacing. The land was then marked out into appropriate number of plots, according to the plot sizes of 4.5 by 6.0 m^2 and net plot sizes of 3.0 by 6.0 m^2.

The maize variety SAMMAZ 11 seeds were used as planting material obtained from Institute for Agricultural Research, Samaru Seed Production Unit in each year. The seeds were dressed with Apron star at the rate of 10 g of the seed dressing chemical to 2 kg of the maize seeds, prior to planting, in order to protect the seeds from soil borne pests and diseases. The maize was sown on 16th June and 10th June in 2010 and 2011, respectively at an intra–row spacing of 25 cm and later thinned to one plant per stand at 2 weeks after sowing. All the various rates of the herbicides were applied at pre–emergence (one day after sowing the maize seeds) using a CP15 Knapsack sprayer, calibrated to deliver 240 L/ha of spray solution using a green deflector nozzle. The hoe–weeded control was weeded using hand hoe at 3, 6 and 9 weeks after sowing (WAS) the maize. Fertilizers were applied by band placement to the crops at the rate of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O per hectare. The nitrogen was applied in two split doses at 3 and 6 WAS, while phosphorous and potassium were applied at planting. The maize was harvested on the 20th November and 12th November, 2010 and 2011, respectively. The harvesting was done using a hand hoe by cutting the stems near the ground level. The cobs were threshed and winnowed in the air and clean grains were obtained.

The data collected were on:

Crop stand count: This was taken at 3 WAS and at harvest by counting the number of stand of maize plants in each net plot and recording the number.

Crop vigour score: This was assessed visually at 9 WAS using a scale of 1 to 9 **where 1** was scored to plots with completely dead plants and **9** for the most vigorous plants.

Crop Injury Score: This was also visually assed using a scale of 1 to 9 where 1 represented least injured plants and 9 the most injured plants.

Rottboelia Weed dry weight: This was taken by drying the Rottboelia weed samples collected from $1M^2$ quadrat in an oven to a constant weight and then weighed on a Mettler balance.

Cob Weight of Maize: The cob weight of maize was taken after harvesting the maize from the net plot and converted on per hectare basis.

Grain Yield: the grain yield of maize was taken after threshing and winnowing of the maize grains in the air and by weighing on Mettler balance and the weights were converted to per hectare basis. All the data collected were subjected to analysis of variance (ANOVA) and the treatment means were separated using Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The results in Table 1 showed that, the application of sulfonylurea herbicides significantly influenced the crop stand count of maize in both the years of the experiment. Application of all rates (0.04 to 1.00 kg a.i/ha) of both cinosulfuron and prosulfuron resulted in significantly higher crop stand count of maize than the weedy check treatment at 3 WAS in both 2010 and 2011 while the application of 0.60 kg a.i/ha of cinosulfuron and 0.40 to 0.60 kg a.i/ha of Prosulfuron gave significantly higher crop stand count than prosulfuron at 1.00 kg a.i/ha and the weedy check in 2011.

Similarly at harvest, application of 0.60 and 0.80 kg a.i/ha of cinosulfuron resulted in significantly higher crop stand count of maize than 0.60 to 1.00 kg a.i/ha of Prosulfuron in 2010 and 2011 as well as in the mean (Table 1). This is an indication that lower rates, 0.40 and 0.60 kg a.i/ha of cinosulfuron where more tolerated by the crop than their corresponding rates and higher rates of prosulfuron. The results also confirmed the earlier report of Achildron *et al.* (1990) that, application of Prosulfuron at higher rates up to 0.40 kg a.i/ha resulted in lower crop stands and vigour of rice. It was also obvious from the results that the weedy check treatment had significantly lower crop stand count of maize than all the herbicide treatments evaluated and the hoe weeded control at harvest in both the years and the mean (Table 1). This was probably due to severe weed competition and interference with the crop in the weed infested plots, which retards the growth of the crop and resulted in the loss of some of the stands due to the plants inability to withstand competition with the weeds.

The application of sulfonylurea herbicides also significantly affected both the crop vigour score and crop injury score of maize at 9WAS in 2010 and 2011 (Table 2). Application of all herbicide rates (0.40 to 1.00 kg a.i/ha) resulted in significantly higher crop vigour score of maize than the weedy check in both the years and the mean. Among the herbicides evaluated application of 0.60 to 0.80 kg a.i/ha of cinosulfuron resulted in significantly higher crop vigour score than the weedy check but were comparable to all other herbicide treatments. Similarly, application of all rates (0.40 to 1.00 kg a.i/ha) of cinosulfuron and prosulfuron resulted in

clear indication that, the maize crop was able to overcome the initial phytotoxicity induced by the herbicide on the crop at a later stage of the crop growth. The results also is in line with the earlier report if Ishaya (1997) that, after application of cinosulfuron and prosulfuron at the rates of 10 – 40 g

a.i/ha on rice, chlorosis and necrosis symptoms were initially noticed on the rice plants but disappeared at a later stage of the crop growth.

The application of herbicides also significantly influenced the Rottboelia weed infestation in maize in both the years of trials (Table 3). Application of 0.60 and 1.00 kg a.i/ha of cinosulfuron resulted in significantly lower Rottboelia weed cover score than all other herbicide treatments but was comparable to 0.80 kg a.i/ha of Cinosulfuron in both the years and the mean. Similarly application of 0.60 to 0.80 kg a.i/ha of Cinosulfuron and all rates (0.40 to 1.00 kg a.i/ha) of Prosulfuron, resulted in significantly lower Rottboelia weed dry weight than the weedy check but was statistically at par with Cinosulfuron at 1.00 kg a.i/ha in 2011. The weed suppression by all the herbicide treatments applied when compared with the weedy check, was a clear indication that the sulfonylurea herbicides were able to control weeds especially Itch grass (*Rottboelia cochinchinensis*) during the trials. This result corroborates the earlier findings by Quadranti *et al*. (1990) who reported that, Sulfonylurea herbicides (cinosulfuron and nicosulfuron) when applied at 10 to 40 g a.i/ha

grass due to the application of 0.6 to 0.8 kg a.i/ha of Cinosulfuron indicated that, these two rates suppressed weeds better in maize crop. The result is also in line with the earlier report of Anonymous (1992) that application of Cinosulfuron at 10 – 40 g a.i/ha controlled weeds like *Cynodon dactylon*, *Cyperus rotundus*, *Commelina benghalensis* and *Rottboelia* sp.

Table 1: Effect of Sulfonylurea Herbicides on the Stand Count of Maize at Samaru in 2010 and 2011 Wet Seasons

Treatment	Rate in kg a.i/ha	Crop stand count at 3WAS[1]			Stand count at harvest		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	90.0a[2]	89.3ab	89.7a	82.0b	77.4d	99.7a
Cinosulfuron	0.60	82.0bc	94.7a	88.4a	81.0b	93.2a	87.1b
Cinosulfuron	0.80	88.0ab	91.6ab	89.8a	88.0a	90.3ab	89.2b
Cinosulfuron	1.00	87.7ab	93.6ab	90.7a	87.7a	70.6e	79.2c
Prosulfuron	0.40	86.3ab	93.3a	89.8a	86.3ab	92.3ab	89.3b
Prosulfuron	0.60	88.3ab	91.7a	87.0ab	72.3c	73.0e	72.7d
Prosulfuron	0.80	86.7ab	91.3ab	86.8ab	70.0c	71.0e	70.5d
Prosulfuron	1.00	86.3ab	85.3bc	85.8ab	68.7c	71.3e	70.0d
Hoe weeded control at 3, 6 and 9WAS	—	80.7bc	89.7ab	85.2ab	80.7b	88.0bc	84.4b
Weedy check	—	77.3c	78.3bc	82.8b	46.6d	50.0f	48.3e
SE ±		2.34	1.93	2.14	1.83	1.68	1.76

1 = Weeks after sowing;
2 = Means in a column of any set of treatments followed by unlike letters are significantly different at P≤0.05 using Duncan Multiple Range Test (DMRT

Table 2: Effect of Sulfonylurea Herbicides on Crop Vigour and Injury Score of Maize at 9WAS at Samaru in 2010 and 2011 Wet Seasons

Treatment	Rate in kg a.i/ha	Crop vigour score[1]			Crop injury score[2]		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	7.33ab[4]	6.67ab	7.00a	2.00bc	3.00b	2.50bc
Cinosulfuron	0.60	9.00a	8.00a	8.50a	1.00c	1.33c	1.17d
Cinosulfuron	0.80	9.00a	8.00a	8.50a	2.00bc	3.00b	2.50bc
Cinosulfuron	1.00	8.00ab	6.67ab	7.34a	2.00bc	3.67b	2.84bc
Prosulfuron	0.40	9.00a	6.00ab	8.00a	2.33b	1.00c	1.67cd
Prosulfuron	0.60	8.00ab	8.00a	8.00a	2.33b	3.00b	2.67bc
Prosulfuron	0.80	8.33ab	7.00ab	7.67a	3.00b	3.00b	3.00a
Prosulfuron	1.00	7.33ab	6.67ab	7.00a	3.00b	1.00c	2.00bc
Hoe weeded control at 3, 6 and 9WAS[3]	—	9.00a	8.00a	8.50a	1.00c	1.00c	1.00d
Weedy check	—	3.33c	4.00c	3.67b	6.00a	5.67a	5.84a
SE ±		0.828	0.564	0.696	0.457	0.391	0.424

1 = Crop injury using a scale of 1–9 where, 1represented most injured plants and 9 = least injured plants. 2 = Crop injury using a scale 1–9 where, 1represented completely death plants and 9 = least injured plants. 3 = weeks after sowing. 4 = Means in a column of any set of treatments followed by unlike letters are significantly different at $P \leq 0.05$ using (Duncan Multiple Range Test) DMRT.

Table 3: Effect of Sulfonylurea Herbicides on Rottboelia Weed Cover Score and Dry Weight of Maize at Samaru in 2010 and 2011 Wet Seasons

Treatment	Rate in kg a.i/ha	Rottboelia weed cover score[1]			Rottboelia weed dry weight		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	4.00a[3]	2.00c	3.00b	187.9	132.3b	160.1ab
Cinosulfuron	0.60	1.00e	1.003	1.00e	169.3	106.8b	138.1ab
Cinosulfuron	0.80	1.33de	1.67cd	1.50de	160.3	120.5b	140.4ab
Cinosulfuron	1.00	1.00e	1.00e	1.00e	83.4	205.2ab	94.3ab
Prosulfuron	0.40	1.00e	2.67b	1.84cd	104.0	125.0b	114.5ab
Prosulfuron	0.60	2.67b	1.67cd	2.17c	168.0	126.5b	147.3ab
Prosulfuron	0.80	1.67cd	2.00c	1.84cd	107.3	114.6ab	110.9ab
Prosulfuron	1.00	2.00c	1.67cd	1.84cd	104.3	113.0ab	108.7ab
Hoe weeded control at 3, 6 and 9WAS[2]	—	1.67cd	1.67cd	1.67cd	53.3	48.3c	50.8b
Weedy check	—	6.33a	6.67a	6.50a	188.3	268.4a	228.4a

SE ±	0.211	0.201	0.206	54.677^{NS}	38.540	46.609

1=Rottboelia weed cover score using a scale of 1–9 where, 1represented no Rottboelia weed and 9 completely Rottboelia infested

Table 4: Effect of Sulfonylurea Herbicides on Cob Weight and Grain Yield of Maize at Samaru in 2010 and 2011 Wet Seasons

Treatment	Rate in kg a.i/ha	Cob weight (kg/ha)			Grain yield (kg/ha)		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	14562abc[2]	14363a	14462a	2097.9b	3840ab	1240.9d
Cinosulfuron	0.60	16500a	14700a	15600a	2452.0ab	4630a	3541.0a
Cinosulfuron	0.80	14442abc	15233a	14838a	2478.4ab	3698ab	3088.2abc
Cinosulfuron	1.00	13040bc	13980a	13510a	2416.1abc	2517ab	2466.6abc
Prosulfuron	0.40	15603ab	14633a	15118a	2289.1bc	1722b	2005.6cd
Prosulfuron	0.60	14415abc	15206a	14810a	2000.3de	2285ab	2142.7bcd
Prosulfuron	0.80	13004bc	15101a	14052a	2173.6cd	3553ab	2863.3abc
Prosulfuron	1.00	11622bc	14804a	13214a	1884.5e	4023a	2953.8abc
Hoe weeded control at 3, 6 and 9WAS[2]	—	16662a	15805a	16234a	2260.3bc	4193ab	3226.7ab
Weedy check	—	1068d	2307b	1687b	364.5f	722c	543.3e
SE ±		1112.014	2085.809	1598.915	74.460	729.112	401.8

1 = weeks after sowing; 2 = Means in a column of any set of treatments followed by unlike letters are significantly different at $P \leq 0.05$ using DMRT

The results in Table 4 show that both the cob weight and grain yield of maize were significantly affected by the application of both cinosulfuron and prosulfuron. Application of all rates (0.40 – 1.00 kg a.i/ha) of both cinosulfuron and prosulfuron resulted in significantly higher cob weight than the weedy check both in 2010 and 2011 as well as in the mean. In 2010 however, the application of 0.60 kg a.i/ha of cinosulfuron resulted in higher cob weight of maize than cinosulfuron at 1.00 kg a.i/ha and prosulfuron at 0.80 kg a.i/ha and 1.00 kg a.i/ha but was comparable to all other herbicide treatments evaluated in the trials in 2010 (Table 4). This consistent higher value for all the parameters due to application of 0.60 kg a.i/ha of both cinosulfuron and prosulfuron was a clear indication that it was the result of better performance of the herbicide rate on the growth of the crop when compared with the other rates. It was also obvious from the results that application of 0.60 kg a.i/ha resulted in significantly higher grain yield of maize than 0.40 kg a.i/ha of Prosulfuron but was comparable to other herbicide treatments in 2011 and the mean. It was clearly shown earlier that 0.60 kg a.i/ha of the two herbicides had better suppressed weeds including *Rottboelia* sp. and therefore inhibited weed interference with the crop and thus, resulted in higher grain yield of maize than other rates. This result also agrees with that of Adeosun (1999) who reported that, application of 40 to 60 g a.i/ha of cinosulfuron in rice gave significantly higher paddy rice yield than lower rates of 10 to 30 g a.i/ha. The weedy check treatment however resulted in significantly lower cob weight and grain yield of maize than all the herbicide treatments evaluated (Table 4). This was a clear manifestation of yield depression due to weed interference with the crop plants. This result is also in line with earlier report of Zoschke *et al.* (1989) that, Cinosulfuron plus BAS–514 when applied to control weeds in different rice production systems suppressed weeds and gave better yield of rice compared with the weedy control plot.

CONCLUSION

From the results of the experiment it can be concluded that application of 0.60 and 0.80 kg a.i/ha of both cinosulfuron and prosulfuron which gave better crop growth, suppression of *Rottboelia cochinchinensis* and grain yield of maize can be adopted by maize farmers as an alternative to manual hoe weeding for the control of Itch grass (*Rottboelia* sp) in northern Nigeria.

REFERENCES

Achildron, M., Rufener, J. & Zoschke, A. (1990). C G A 142’464 (Prosulfuron) a new herbicide for weed control in different rice production systems. In proceeding, Asian Pacific Weed Science Society Conference, Indonesia, 1: 117 – 128.

Adamu, I. (1991). Growth and Yield of Maize and Rice as Affected by Crop mixture and N–levels. Unpublished M.Sc Thesis. Department of Agronomy, Ahmadu Bello University, Zaria, p. 73 – 81.

Adeosun, J. O., Lagoke, S. T. O. & Shebayan, J. A. Y. (1999). Evaluation of Herbicides for Weed Control in Upland Rice (*Oryza sativa L*) in Samaru, Nigeria. Report of Cropping Scheme Meeting on Cereals Research, I.A.R. /ABU Samaru, pp. 90 – 91.

Anonymous (1992). International Label Text on Setoff (Cinosulfuron) of the Ciba Geigy (Swiss Nigerian Chemical Company) Lagos, Nigeria, pp. 1 – 9.

Fakorede, M. A. B., Alofe, C. O. & Kim, S. K. (1993). Maize: Improvement, Production and Utilization in Nigeria, pp. 199 – 203.

FAO, (2010) Production Statistics Food and Agricultural Organiation of the United Nations. Year Book, Rome, Italy, pp. 36 – 37.

Ishaya, D. B. (1997). Evaluation of Sulfonyl–Urea Herbicides for Weed Control in Rice and Maize at Samaru. An M.Sc Thesis. Department of Agronomy, Ahmadu Bello University, Zaria.

Kuchinda, N. C., Ishaya, D. B., Adekpe, D. I. & Shinggu, C. P. (2004). A Survey of Different Weed Status at Samaru, Northern Guinea Savannah of Nigeria. A Paper Presented at the 36th Annual Conference of Weed Science Society of Nigeria held between 2nd to 4th November, 2004 at Usman Danfodio University, Sokoto, pp. 1 – 11.

Lagoke, S. T. O., Adeosun, J. O., Elemo, K. A., Chude, V. O. & Shebayan, J. A. Y. (1999). Herbicide Evaluation for the Control of Weeds in Maize at Samaru. In Report on Cereals Research Cropping Scheme Meeting held at I.A.R/A.B.U. Samaru Zaria. November, 1999, pp. 90 – 91.

Quadranti, M., Rufener, J. & Zosche, A. (1990). C G A 142 464 (setoff) new herbicide for weed control in different rice production systems. Asian Pacific Weed Science Society Conference, 1:117–128.