

Research paper

**EVALUATION OF SULFONYL- UREA HERBICIDES FOR THE CONTROL OF
ITCH GRASS (*Rottboelia cochinchinensis* clayton) ON GRAIN SORGHUM
(*Sorghum bicolour* L.) IN NIGERIA.**

ABSTRACT

Two trials were conducted during 2010 and 2011 wet seasons on the farm of the Institute for Agricultural Research, Ahmadu Bello University, Samaru in Northern Nigeria, to evaluate two sulfonyl-urea herbicides, Cinosulfuron and Prosulfuron on grain sorghum to address the problem of low yield due to infestation of Itchgrass (*Rottboelia cochinchinensis*). Among the various rates of the herbicides evaluated, 0.60kg a.i/ha of cinosulfuron and 0.60 – 0.80kg a.i/ha of prosulfuron gave better itchgrass control, weed suppression, growth and yield of sorghum that were comparable to the hoe weeded control. It can be concluded that, the 0.60kg a.i/ha dose of both herbicides which was the most economically efficient, can be adopted as an alternative to manual hoe-weeding of itchgrass in Nigeria.

Keywords: Weed, Herbicides, control, maize, sulfonyl-urea
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INTRODUCTION

Sorghum (*Sorghum bicolour* L.) is native to Africa, where they have been cultivated since ancient time. It ranks fifth in importance among the world cereals after wheat, rice, maize and barley (FAO, 2009). It is however the second most important cereal crop after maize in Nigeria which occupy about 45% total land devoted to cereals production (Shebayan, 2002). It is the staple food for millions of people in the continent of Africa and Asia (Ranava, 1992) because it is well adapted to growth in hot and semi-arid regions.

38 In Nigeria, the prevalence of weed infestation is the greatest limiting factor of
 39 sorghum production. This is because an average yield reduction due to uncontrolled
 40 weed growth in sorghum is between 60 to 80% loss in the potential yield (Lagoke *et. al.*,
 41 1990). Among the weed species now, the most prevalence is itchgrass (*Rottboelia* sp.)
 42 especially in the savanna ecology. A survey on the occurrence of weed species on all the
 43 farming fields at Samaru in the northern Guinea savanna indicated that 40 – 60% of the
 44 types of weed species that ravage agricultural lands in northern Guinea savanna was
 45 itchgrass (*Rottboelia cochinchirensis*) (Kuchinda *et. al.*, 2004). This high infestation of
 46 itchgrass in almost all the farmer's field has caused vast areas of land to be completely
 47 abandoned by farmers. This is because both farmers and labourers do refuse entry into
 48 fields infested by this weed species to work because of its itching effect that ultimately
 49 causes a skin disease known as Inflammatory Dermatitis and thereby reducing land area
 50 put under agricultural crop cultivation (Kuchinda *et. al.*, 2004). Since the control of this
 51 weed using manual hoe-weeding which is the most prevalent method of weed control in
 52 Nigeria is impracticable due to itching and skin disease effect. Therefore a better control
 53 method of this weed which is threatening food production and health of farmers in
 54 Nigeria, must be invented in order to improve the productivity of sorghum as well as to
 55 reclaim all abandoned lands due to this weed to be able to cultivate the reclaimed lands.
 56 Chemical weed control of itchgrass which requires less labour, it is also less tedious,
 57 without any drudgery and less risk to human health, may serve as the best alternative of
 58 controlling this weed. It is in view of that, that the experiment was designed with the
 59 objective of evaluating some sulfonyl-urea herbicides for the control of itchgrass
 60 (*Rottboelia cochinchinensis*) on grain sorghum.

MATERIALS AND METHODS

Two field trials were conducted during the rainy seasons of 2010 and 2011 to evaluate some sulfonyl-urea herbicides for the control of itchgrass (*Rottboelia cochinchinensis* Clayton) in sorghum field at Samaru (11°11' N; 07° 38' E) in the northern Guinea savanna ecology of Nigeria.

The soil at the site of the experiment was sandy loam with pH of 5.8, organic carbon 66%, total Nitrogen of 0.19 and CEC of 4.9⁰C mole per kg.

The dominant weed species that were prevalent at the site of the trial were *Rottboelia* sp. *Cynodon dactylon* and *Cyperus esculentus* but *Rottboelia cochinchirensis* was the most dominant among all other species. The experiment consisted of nine different doses of sulfonyl-urea herbicides and pendimethalin which consisted of cinosulfuron (Setoff) and prosulfuron (CGA 152'005) each at 0.40, 0.60, 0.80 and 1.00kg a.i/ha all compared against pendimethalin which is the standard herbicide known for controlling itchgrass in the Nigerian savanna at 2.5kg a.i/ha and a hoe-weeded control at 3, 6 and 9 WAS as well as a weedy control. There were a total of eleven treatments in the experiment, all were laid out in a Randomized Complete Block Design (RCBD) replicated three times. The gross and net plot sizes were 24.0m² and 22.5m², respectively. Sorghum seeds (variety SAMSORG 14) were sown on ridges 75cm at an intra-row spacing of 25cm. Five seeds were sown per hole and later thinned to one plant per stand at 10 day after sowing (DAS). The herbicides were applied using a conventional CP 15 knapsack sprayer at a pressure of 2.1kg/cm² and discharge rate of 240L/ha. The herbicides were applied at pre-emergence at one day after sowing (DAS) the crop.

Fertilizer as 30kg N, 13kg P and 25kg K were applied same day as sorghum was sown. A second dose of 30kg N/ha was applied at 6 WAS.

Weeding was done to the hoe-weeded control plot using manual hoe at 3, 6 and 9 WAS, which is the farmer's practice in the northern Guinea savanna ecological zone of Nigeria.

The crop was harvested by cutting the stem at ground level with a hand hoe and the panicles were later cut off the stems and threshed on the floor. The grains were winnowed to remove chaff and cleaned grains were then obtained.

The data collected were:-

Crop stand count: This was taken by counting the number of crop stands in the net plot at 3 WAS and at harvest.

Crop vigour score: This was assessed visually using a scale of 1 to 9 where, 1 represented completely death plants and 9 represented the most vigorous plants at 6 and 9 WAS. The features used were size of stem, greenness of the leaves and size of the leaves.

Rottboelia sp. cover score:- This was also assessed only for itchgrass visually, using a scale of 1 to 9 where, 1 represented plots without Rottboelia sp. and 9 represented plots completely covered with the weed species.

Cumulative Rottboelia Dry Weight:- This was taken from the itchgrass weed samples at random in 1 x 1m quadrat from each plot. The weed samples were oven dried to a constant weight at 70°C before weighing.

Cumulative General Weed Dry Weight:- This was also taken from all weed samples present on the field at random in 1 x 1m quadrat from each plot. The general weed samples were dried in an oven to a constant weight at 70°C before weighing.

Grain Yield:- This of sorghum was taken by measuring the sorghum grains obtained from each net plot on a mettler balance after threshing and winnowing in the air. All data collected were subjected to analysis of variance and the treatment means were separated using Duncan Multiple Range Test.

RESULTS

The results in Table 1 show that, the application of Cinosulfuron and Prosulfuron significantly influenced the crop stand count of sorghum at 2 weeks after sowing (WAS) and at harvest. The application of 0.60 to 1.00kg a.i/ha of cinosulfuron and also pendimethalin at 2.5kg a.i/ha resulted in significantly higher crop stand count of sorghum than the lowest dose (0.40kg a.i/ha) of cinosulfuron and the weedy control at 2 WAS, but were comparable to all the doses of prosulfuron in both the years.

Similarly, the application of higher doses of (0.80-1.00kg a.i/ha) of cinosulfuron and 0.60kg a.i/ha of prosulfuron resulted in significantly higher crop stand count than 0.40kg a.i/ha of cinosulfuron and prosulfuron at 0.80-1.00kg a.i/ha at harvest in 2011 and the mean. The weedy control gave significantly lower crop stand count of sorghum compared with all other herbicide treatments evaluated at the same sampling period and years (Table 1).

The application of both cinosulfuron and prosulfuron was significant on the crop vigour score of sorghum (Table 2).

At 6 WAS, the application of 0.40 and 0.60kg a.i/ha resulted in significantly higher crop vigour score of sorghum than prosulfuron at 0.40 and the weedy control in 2010. Also the same doses (0.40 and 0.60kg a.i/ha) of both cinosulfuron and prosulfuron gave significantly higher crop vigour score of sorghum than the weedy control in 2011

and the mean data, both were statistically at par with all other herbicide treatments evaluated.

Similarly at 9 WAS, the application of the same doses of 0.40 and 0.60kg a.i/ha of cinosulfuron resulted in significantly higher crop vigour score than 1.00kg a.i/ha of prosulfuron and the weedy control, but were statistically the same with all other herbicide treatments and the hoe-weeded control at 3, 6 and 9 WAS in both 2010 and the mean data (Table 2).

Table 3 show that, the influence of the application of both cinosulfuron and prosulfuron was significant on the cover score of *Rottboelia sp.* in both the years.

At 6 WAS, application of all doses of both cinosulfuron and prosulfuron with the exception of only 0.40kg a.i/ha of cinosulfuron, resulted in significantly lower weed cover score of *Rottboelia sp.* than the weedy control in 2010 and the mean data. The hoe-weeded control at 3, 6 and 9 WAS also gave significantly lower *Rottboelia sp.* cover score than the weedy control.

At 9 WAS, similar results were obtained during which the application of all doses of both cinosulfuron and prosulfuron with the exception of only 0.40kg a.i/ha resulted in significantly higher *Rottboelia sp.* cover score than the weedy control in 2010 and the mean data. In 2011 however, application of 0.40kg a.i/ha of both cinosulfuron and prosulfuron gave statistically higher *Rottboelia sp.* cover score than all other herbicide treatments but were statistically at par with 0.60kg a.i/ha of prosulfuron and the weedy control (Table 3).

The effect of application of cinosulfuron and prosulfuron was significant on the *Rottboelia sp.* cumulative weed dry weight of sorghum (Table 4). At 6 WAS, application

of all doses (0.40 – 1.00kg a.i/ha) of both cinosulfuron and prosulfuron and the hoe-weeded control treatment, resulted in significantly lower *Rottboelia* sp. cumulative weed dry weight than the weedy control in both years and the mean. Application of higher doses of the herbicides (0.60 to 1.00kg a.i/ha) gave significantly lower *Rottboelia* sp. cumulative weed dry weight than the lower dose (0.40kg a.i/ha) of both herbicides.

At 9 WAS however, the application of 0.60kg a.i/ha of cinosulfuron and all rates of prosulfuron resulted in significantly lower cumulative *Rottboelia* sp. weed dry weight in 2010 while, in 2011 the same cinosulfuron at 0.60kg a.i/ha and the hoe-weeded control gave significantly lower *Rottboelia* sp. cumulative weed dry weight than the weedy control (Table, 4).

Table 5 show that the influence of the application of both cinosulfuron and prosulfuron was significant on the general weed cumulative weed dry weight of sorghum in both 2010 and 2011.

The application of 1.00kg a.i/ha of cinosulfuron in both years as well as 0.60 – 0.80kg a.i/ha of prosulfuron in 2010 resulted in significantly lower general weed cumulative dry weight compared with the weedy control.

All other herbicide treatments evaluated gave statistically similar general weed cumulative dry weight of sorghum with the weedy control (Table 5).

The application of the sulfonyl-urea herbicides, cinosulfuron and prosulfuron significantly influenced the grain yield of sorghum in both the years (Table 6).

Application of 0.60kg a.i/ha of both cinosulfuron and prosulfuron resulted in significantly higher grain yield of sorghum than 0.40kg a.i/ha of cinosulfuron and prosulfuron at 0.80 to 1.00kg a.i/ha as well as the weedy check but was comparable to all

other herbicide treatments and the hoe weeded control in both 2010 and the mean. The weedy check however, gave significantly lower grain yield of sorghum than all the herbicide treatments evaluated and the hoe weeded control at 3, 6 and 9 WAS (Table 6).

DISCUSSION

Effect of Sulfonyl-urea Herbicides on Growth of Sorghum.

From the results, it was obvious that application of 0.60 to 1.00kg a.i/ha and of cinosulfuron and pendimethalin at 2.5kg a.i/ha had resulted in higher crop stand count of the crop while, 0.04 to 0.60kg a.i/ha of both herbicides gave higher crop vigour score than the highest doses (0.80 – 1.0kg a.i/ha) of the herbicides. This is clear indication that the sorghum crop was able to overcome the initial phytotoxicity induced by the herbicides on the crop at a later stage of the crop growth. The results also confirmed the earlier report of Ishaya (1997) that, after application of cinosulfuron and prosulfuron at the doses between 10 – 40g a.i/ha on rice, Chlorosis and necrosis symptoms were initially noticed on the plants but were overcome at a later stage of the crop growth.

Effect of Sulfonyl-urea Herbicides on Weed Infestation

The results also show clearly that, application of all herbicides reduced the infestation of *Rottboelia* sp. than the weedy check while 0.60kg a.i/ha of cinosulfuron and 0.60 – 0.80kg a.i/ha of prosulfuron also reduced the general weed dry weight compared with the weedy control. The weed suppression by all the herbicide treatments applied when compared with the weedy control was a clear indication that the sulfonyl-urea herbicides were able to control weeds including *Rottboelia cochinchinensis* during the

197 trials. This results corroborates the earlier findings by Valverde *et. al.*, (2010) who
 198 reported that, sulfonyl-urea herbicides (cinosulfuron and Nicosulfuron) applied at 0.40kg
 199 a.i/ha controlled itchgrass (*Rottboelia* sp.) and *Sorghum halpense* in maize field. The
 200 better suppression of general weeds dry weight in the trials due to application of 0.60kg
 201 a.i/ha of Cinosulfuron and 0.60 – 0.80kg a.i/ha of prosulfuron indicated that, these two
 202 doses suppressed the weeds better in sorghum field. The results is in line with the earlier
 203 report of Anonymous (1992) that, application of cinosulfuron at 10 to 40kg a.i/ha
 204 controlled weeds like *Cynodon dactylon*, *Cyperus rotundus* *Sida acuta*, *Commaline*
 205 *benghalensis* and *Rottboelia* spp.

206 **Effects of sulfonyl-urea Herbicides on grain yield**

207 The results also show that application of 0.60kg a.i/ha of both herbicides gave
 208 higher grain yield of sorghum than 0.40kg a.i/ha of cinosulfuron and 0.80 – 1.00kg a.i/ha.
 209 This is probably due to the fact that, the lowest dose (0.40kg a.i/ha) of the herbicides was
 210 not sufficient dose in controlling weeds while th higher rates 0.80 – 1.00kg a.i/ha)
 211 induced serious initial phytotoxicity on the crop which the plants couldn't recover at the
 212 later stage of their growth. It was clearly shown that 0,60kg of the herbicides has
 213 however better suppressed weeds including *Rottboelia* sp. and therefore inhibited weed
 214 interference with the crop and thus also resulted in higher grain yield of the sorghum than
 215 the lowest dose of 0.40kg a.i/ha. The results also is in line with the earlier report of
 216 Adeosun (1999) that, application of higher rates (0.40 – 0.60kg a.i/ha of cinosulfuron) in
 217 rice gave significantly higher paddy rice yield than the lower rates (0.10 to 0.30kg a.i/ha).
 218 The weedy control however, resulted in significantly lower grain yield of sorghum than
 219 the herbicide treatments evaluated. This was a clear indication of yield depression due to

weed interference with the crop plants in the weedy control plot. This is also in line with the earlier report of Achildron *et. al.*, (1990) that, prosulfuron when applied to control weed in different rice production system, suppressed weeds and gave better yield of rice compared with the weedy control plot.

CONCLUSION

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

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Table 1: Effect of Sulfonyl-Urea Herbicides on the Crop Stand Count of Sorghum in 2010 and 2011 Wet Seasons at Samaru.

Treatments	Rate in kg a.i/ha	Crop Stand Count of Sorghum					
		At 2 WAS ¹			At Harvest		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	74.0b ²	84.0b	79.0b	75.0b	84.0c	79.5bc
Cinosulfuron	0.60	81.7a	91.7a	86.7a	79.0ab	78.0d	78.5bc
Cinosulfuron	0.80	81.7a	90.3a	86.0a	79.0ab	90.3ab	84.7ab
Cinosulfuron	1.00	79.3a	89.7a	84.5ab	79.0ab	88.7ab	83.9ab
Prosulfuron	0.40	78.3ab	87.0ab	82.7ab	78.3ab	87.0abc	82.5ab
Prosulfuron	0.60	76.3ab	86.0ab	81.2ab	76.3ab	85.0bc	82.7ab
Prosulfuron	0.80	76.7ab	86.0ab	81.3ab	76.7ab	85.5bc	80.9bc
Prosulfuron	1.00	74.3ab	84.0ab	79.2b	70.3b	84.0c	77.2c
Pendimethalin	2.5	79.3a	91.0a	85.2ab	78.3ab	91.0a	84.5ab
Hoe-weeded control at	3, 6 and 9 WAS	81.7a	91.0a	86.4a	80.7.a	90.0ab	85.4a
Weed Control		70.7b	70.3b	70.5c	61.7b	58.3e	60.0d
S.E. ±		2.455	2.313	2.384	1.989	2.001	1.995

1 WAS = Weeks after sowing

2 Mean in a column of any set of treatments followed by unlike letter(s) are significantly different at $P \leq 0.05$ Using DMRT.

Table 2: Effect of Sulfonyl-Urea Herbicides on the Crop vigour score of Sorghum in 2010 and 2011 Wet Seasons at Samaru.

Treatments	Rate in kg a.i./ha	² Crop Vigour Score of Sorghum					
		At 6 WAS ¹			At 9 WAS		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	6.33a	7.33a ³	6.83a	8.00a	8.33ab	8.17a
Cinosulfuron	0.60	6.33a	8.00a	7.17a	8.00a	9.00a	8.50a
Cinosulfuron	0.80	5.67ab	7.00ab	6.34ab	7.67ab	8.67ab	8.17a
Cinosulfuron	1.00	5.67ab	7.00ab	6.34ab	6.33ab	8.00ab	7.17ab
Prosulfuron	0.40	5.00b	8.00a	6.50ab	6.00ab	8.33ab	7.17ab
Prosulfuron	0.60	7.00a	7.33a	7.17a	7.33ab	8.33ab	7.83ab
Prosulfuron	0.80	5.67ab	7.00ab	6.34ab	7.00ab	8.00ab	7.50ab
Prosulfuron	1.00	5.00ab	4.33b	5.67ab	6.00b	6.00abc	5.00b
Pendimethalin	2.5	7.00a	7.00ab	7.00a	8.00a	7.33ab	7.67ab
Hoe-weeded control at Weed Control	3, 6 and 9 WAS	7.0-0a	7.00ab	7.00a	8.00a	8.00ab	8.00a
S.E. ±		0.503	0.927	0.715	0.735	1.108	0.922

1. WAS = Weeks after sowing
2. crop vigour score using a scale of 1 to 9 where 1 = death plants and 9 = most vigorous plants.
3. Mean in a column of any set of treatments followed by unlike letter(s) are significantly different at $P \leq 0.05$ using DMRT.

Table 3: Effect of Sulfonyl-Urea Herbicides on the Rottboelia Sp. Cover Score of Sorghum in 2010 and 2011 Wet Seasons at Samaru.

Treatments	Rate in kg a.i/ha	¹ Rottboelia Sp. Cover Score					
		At 6 WAS ²			At 9 WAS		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	4.60a	1.67ab ³	2.64b	6.00ab	4.50ab	5.25ab
Cinosulfuron	0.60	1.33ef	1.00b	1.17d	4.00cd	2.33c	3.17c
Cinosulfuron	0.80	1.60d-f	1.00b	1.30d	4.67bc	2.60c	3.64c
Cinosulfuron	1.00	1.67de	1.00b	1.34d	4.00cd	2.67c	3.34c
Prosulfuron	0.40	2.67b	1.33ab	2.00bc	5.33b	3.67ab	4.50b
Prosulfuron	0.60	2.33bc	1.33ab	1.83cd	2.67d	3.33b	3.00c
Prosulfuron	0.80	1.33ef	1.00b	1.17d	3.00cd	2.33c	2.67cd
Prosulfuron	1.00	1.33ef	1.00b	1.17d	3.00cd	2.33c	2.67cd
Pendimethalin	2.5	1.00f	1.00b	2.00bc	2.00f	2.00c	2.00d
Hoe-weeded control at Weed Control	3, 6 and 9 WAS	2.00cd 4.33a	1.00b 2.67a	1.50cd 3.50a	1.00g 6.33a	3.00bc 5.33a	2.00d 5.83a
S.E. ±		0.312	0.152	0.232	0.351	0.312	0.332

1. Rottboelia Sp. cover score using a scale of 1 to 9 where 1 = no Rottboelia Sp. and 9 = completely covered by Rottboelia Sp.
2. WAS = week after sowing
3. Mean in a column of any set of treatments followed by unlike letter(s) are significantly different at $P \leq 0.05$ using DMRT.

Table 4: Effect of Sulfonyl-Urea Herbicides on the Rottboelia Cumulative Weed Dry Weight (g/m²) of Sorghum in 2010 and 2011 Wet Seasons at Samaru.

Treatments	Rate in kg a.i/ha	Rottboelia Cumulative Weed Dry Weight (g/m²)					
		At 6 WAS			At 9 WAS		
		2010	2011	Mean	2010	2011	Mean
Cinosulfuron	0.40	94.0b ²	81.0b	87.5b	149.3ab	122.3a	135.8ab
Cinosulfuron	0.60	67.0d	70.0c	53.5d	118.3b	104.7b	112.5ab
Cinosulfuron	0.80	72.0cd	77.0b	74.5b	126.8ab	114.7ab	120.8ab
Cinosulfuron	1.00	61.0d	72.0b	66.5c	120.0b	112.0ab	116.0ab
Prosulfuron	0.40	94.0bc	88.0b	90.0b	148.0ab	118.7ab	133.4ab
Prosulfuron	0.60	69.0d	71.0b	70.0bc	120.0b	114.7ab	117.4ab
Prosulfuron	0.80	61.0d	70.0b	65.5c	109.7b	113.3ab	111.5ab
Prosulfuron	1.00	61.0d	71.0b	66.0c	102.3b	112.0ab	107.2ab
Pendimethalin	2.5	35.0e	40.0c	37.5d	63.3b	93.3b	78.3b
Hoe-weeded control at Weed Control	3, 6 and 9 WAS	36.0e	45.0c	40.5d	72.7b	93.3b	83.0b
S.E. ±		151.0a	149.0a	150.0a	255.1a	122.7as	188.9a
		7.354	8.112	7.733	44.060	13.779	28.919

1. WAS = week after sowing
2. Mean in a column of any set of treatments followed by unlike letter(s) are significantly different at $P \leq 0.05$ using DMRT.

Table 5: Effect of Sulfonyl-Urea Herbicides on the Cumulative General Weed Dry Weight (g/m^2) of sorghum at 9 WAS in 2010 and 2011 Wet Seasons at Samaru.

Treatments	Rate in Kg a.i./ha	Cumulative General Weed Dry Weight (g/m^2)		
		2010	2011	Mean
Cinosulfuron	0.40	700.6ab ²	519.3ab	609.7ab
Cinosulfuron	0.60	566.7ab	401.0ab	483.5ab
Cinosulfuron	0.80	700.0ab	370.3ab	535.2ab
Cinosulfuron	1.00	366.7b	284.7ab	325.7b
Prosulfuron	0.40	566.7ab	464.0ab	515.4ab
Prosulfuron	0.60	366.7b	393.3ab	380.0ab
Prosulfuron	0.80	733.7b	504.0ab	618.7ab
Prosulfuron	1.00	533.3ab	429.3ab	481.3ab
Pendimethalin	2.5	566.0ab	233.3b	399.7ab
Hoe-weeded control at Weedy Control	3, 6 and 9 WAS ¹	533.0ab 866.7a	230.0b 546.3a	381.5ab 706.5a
S.E. $\pm$		133.938	85.817	109.878

1. WAS = week after sowing
2. Mean in a column of any set of treatments followed by unlike letter(s) are significantly different at $P \leq 0.05$ using DMRT.

Table 6: Effect of Sulfonyl-Urea Herbicides on Grain Yield of sorghum at 9 WAS in 2010 and 2011 Wet Seasons at Samaru.

Treatments	Rate in Kg a.i./ha	Grain Yield of Sorghum (kg/ha)		
		2010	2011	Mean
Cinosulfuron	0.40	2691bc	2437cd	2564b
Cinosulfuron	0.60	3991a	3603ab	3797a
Cinosulfuron	0.80	3146abc	2989bc	3068ab
Cinosulfuron	1.00	3333an	3212ab	3273ab
Prosulfuron	0.40	2636bc	2347cd	2492b
Prosulfuron	0.60	3809a	2365cd	3087ab
Prosulfuron	0.80	2135c	3423ab	2779b
Prosulfuron	1.00	2495c	3087abc	2791b
Pendimethalin	2.5	3717a	3498ab	3608a
Hoe-weeded control at Weedy Control	3, 6 and 9 WAS	3836a 1103d	3792a 937e	3814a 1020c
S.E. $\pm$		284.130	259.030	271.500

. Mean in a column of any set of treatments followed by unlike letter(s) are significantly different at $P \leq 0.05$ using DMRT.