EVALUATION OF PRE- AND POST-EMERGENCE HERBICIDE FOR WEED MANAGEMENT ON YIELD OF EARLY MAIZE VARIETIES IN NORTHERN GUINEA SAVANNAH OF NIGERIA

AdamuA.I.,[1] Mani, H.A.[2], Shebayan, J.A.Y.[2], Abubakar, I.U.[2], Aisha, S.[2] and Musa L.[2]

[1]*Department of Agronomy, Federal University of Kashere, Gombe state*

[2]*Department of Agronomy, Ahmadu Bello University, Zaria*

Email address: damuka83@gmail.com

ABSTRACT

Two field trials were conducted, during 2016 and 2017 wet seasons at the Institute for Agricultural Research (IAR) farm, Samaru (11° 11′ N, 07° 38′ E and 686m above sea level)Ahmadu Bello University, Zaria, in the northern Guinea savannah ecological Zone of Nigeria respectively, to assess the performance of three extra-early maize varieties (SAMMAZ-29, SAMMAZ-32 and SAMMAZ-33). Consisting of 12 weed control treatment combinations and they are as follows: 1.Nicosulfuron(0.075) at 2WAS only, 2. Nicosulfuron (0.075) at 2WAS followed by(fb) hoe weeding at 5WAS, 3. Nicosulfuron (0.075kga.i/ha) at 2WAS fb Nicosulfuron (0.075kga.i/ha) at 5WAS, 4. Nicosulfuron (0.15kga.i/ha) at 2WAS only, 5. Nicosulfuron (0.15kga.i/ha) at 2WAS fb hoe weeding at 5WAS, 6. Nicosulfuron (0.15kga.i/ha) at 2WAS fb Nicosulfuron (0.075kga.i/ha) at 5WAS, 7. Atrazine + Pendimethalin(2.0+2.0kg a.i/ha) only, 8. Atrazine + Pendimethalin (2.0+2.0 kg a.i/ha) fb hoe weeding at 5WAS, 9. Atrazine + Pendimethalin (2.0+2.0 kg a.i/ha) fb Nicosulfuron (0.075kga.i/ha) at 5WAS, 10. Atrazine (2.0 kg a.i/ha) fb Nicosulfuron (0.075kga.i/ha) at 5WAS, 11.Hoe weeding at3 and 6 weeks after sowing(WAS) and 12. Weedy check. The treatments were laid out in a split plot design, weed control in the main plots and varieties in the sub-plot and replicated three times. The parameters measured includes; cob length, cob diameter, number of grains per row, number of kernel rows per cob, 100-grain weight and grain yield (kg/ha). Application of Nicosulfuron(0. 15kga.i/ha) at 2WAS followed by Nicosulfuron(0. 075kga.i/ha) at 5WAS gave significantly higher cob length, cob diameter, number of grains per cob, number of grain-rows per cob, 100-seed weight and grain yield ha^{-1} than other weed control treatment combinations. In conclusion, it could be suggested thatNicosulfuron(0. 15kga.i/ha) at 2WAS followed by Nicosulfuron (0. 075kga.i/ha) at 5WAS (W6) could be used by farmersin the Northern Guinea savannah ecological zone of Nigeria.

Keywords: Yield attributes, Extra-early maize varieties, Herbicides

INTRODUCTION

Maize (*Zea mays* L.), also called corn, is believed to have originated in central Mexico 7000 years ago from a wild grass family. Maize contains approximately 72% starch, 10% protein, and 4% fat, supplying an energy density of 365 Kcal/100 g and it is grown throughout the world (FAO, 2019).The United States, China, and Brazil are the top three maize-producing countries in the world, producing approximately 563 of the 717 million metric tons/year. Maize can be processed into varieties of foods and industrial products such as starch, sweeteners, oil, beverages, glue, industrial alcohol, and fuel ethanol. In the last 10 years, the use of maize for fuel production significantly increased, accounting for approximately 40% of the maize production in the United States (FAO, 2019). As the ethanol industry absorbs a larger share of the maize crop, higher prices for maize will intensify demand competition and could affect maize prices for animal and human consumption. Low production costs, along with the high consumption of maize flour and cornmeal, especially where micronutrient deficiencies are common public health problems, make this food a staple and an ideal food vehicle for fortification (Ann*et al*., 2014)

It was introduced to West Africa by the Portuguese in the 10th century. Maize (*Zea mays* L.) was relatively a minor food crop in Africa by 1900 (Manyong*et al.,* 2003), but over the years, its widespread uses in the human diet and animal feeds popularized it in Africa, especially in Nigeria. Maize is the most widely adapted and the most important cereal crop in the worldwith current production of 1125.01 million metric tons followed by rice and wheat with 782.3 and 680.2 million metric tons respectively in 2019, however, United States of America is the largest producer accounting for 32.56% of the world's total production followed by China and Brazil that accounted for 22.87% and 8.98% respectively (USDA, 2019). Africa produced 5.15% of the world's total production from 191.91 million hectares. Nigeria is the second largest producer of maize in Africa after South Africa with 11,000 million metric tons which represented 0.97% of the world's total production in 2018 (USDA, 2019).

There was an increase in cultivated land area and production output for maize in many states in Nigeria in 2019, Kaduna had the highest increase in cultivated land and production for maize in 2019 with the total production of 1000 metric tons with 400 land area (Hectares), followed by Niger state with 800 metric tons with cultivated land area of 250 hectares and the least state is Bayelsa with 100 metric tons with land area of 50 hectares (NAERLS, FMARD, 2019). Maize requires annual rainfall of 600–1000mm; sandy loam and silt loam soils containing adequate organic matter and tolerates soil pH from 5.5 to 8.0 but the optimum range is 5.5 – 7.0 (Wolkoski, 2001).

For good growth, maize requires a lot of sunshine and warmth. Ideal temperature for its growth ranges between21-27C. The general fertilizer requirement of maize is NPK 120-60-60kgN/ha, spacing of 25cm by 75cm and weed control regime of 3 weeks after sowing WAS and 6WAS in the northern Guinea savanna of Nigeria (Wolkoski, 2001). Manual hoe-weeding is the most predominant method of weed control in crop production among peasant farmers in Nigeria, however, it is tedious, slow and ineffective and drudgery under farm, sometimes the labor may not be readily available at the time of need and therefore costly (Lagoke, 1991). Consequently, the average yield (1.9tons/ha) of maize in Nigeria is generally very low as compared to the potential yield of maize varieties of 3.0 to 6.5t/ha, (Anon., 2015).

Weeding takes between 21-32% of the total time devoted to maize production in Nigeria (Lucas, 2007). To address these draw-backs in manual weed management, different herbicides have been recommended for maize and maize based crop mixtures. However, biotic and abiotic factors within the eco-system have hindered the attainment of season-long weed control, resulting in the need for supplementary weed management (Akobundu*et al.,* 1994).

Hoe-weeding has been used to control weeds as supplement to the pre-emergence herbicides; however, such effort has proved equally controls, but, tedious and ineffective. In order to attain effective supplementary weed management farmers have resorted to the use of directed spray of paraquat; this in turn has resulted in herbicide drift with serious scorching of maize leaves that may affect yields (AGRO., 2011). It is in the light of these inadequacies of supplementary weed management through manual weeding or post-emergence paraquat application, that the use of nicosulfuron, a post-mergence systemic herbicide selective to maize, is being considered both as a primary treatment and as a supplement to itself and to a pre-emergence herbicide treatment. With new maize varieties, bred to address biotic and abiotic constraints such as parasitic weeds, low soil nitrogen and drought, there is the need to watch out for any differential responses of the varieties to these herbicides (Olsen and Sanders, 1988). The research was carried out to

i. Determine the response of maize varieties to pre- and post-emergence herbicides and
ii. Determine the herbicide treatment(s) for efficient and season-long weed control in maize.

METHODOLOGY:Two field trials were conducted, during 2016 and2017 wet seasons at the Research Farms of the Institute for Agricultural Research, Ahmadu Bello University, Samaru, Zaria, (1111' N; 738' E, and 686m above the sea level) in the northern Guinea savannah of Nigeria. The treatments consisted of 12 weed control treatment combinations: (Nicosulfuron at 0.075kg a.i/ha and 0.15kg a.i/ha), each was applied alone at 2WAS, followed by hoe weeding at 5WAS and followed by nicosulfuron at 0.075 kg a.i/ha at 5WAS, atrazine plus pendimethalin at 2.0 + 2.0 kg a.i/ha alone as pre-emergence and followed by hoe weeding at 5WAS, and followed by nicosulfuron at recommended rate (0.075 kg a.i/ha) at 5WAS, atrazine alone at 2.0kg a.i/ha followed by nicosulfuron at 0.075kg a.i/ha at 5WAS, a hoe-weeded control (weeded at 3 and 6WAS) and a weedy check using three extra-early maturing maize varieties (SAMMAZ-29, SAMMAZ-32 and SAMMAZ-33). The treatments were laid out in a split plot design, the weed control treatments in the main plot, while varieties were in the subplot, and replicated three times. The gross plots consisted of 6 ridges each 0.75m wide and 4.0 m long (18m^2), while net plot size consisted of 4 inner ridges each 4.0 m long and 3.0 m wide (12m^2). Five soil samples were taken randomly from the depth of 0-30cm across experimental fields prior to land preparation; a composites soil sample was taken to the laboratory for analysis to ascertain the physical and chemical properties of the soil using standard analytical procedures (IITA, 1975).

SAMMAZ-29 (2000 TZEE-W-STR): It is early maturing and takes 57 days to mid-silking and 80-85 days to physiological maturity under uninfested (with *Striga hermonthica)* conditions. The height is 170cm. It is white-seeded and has a potential yield of 4.0tha^{-1}. It is tolerant to *Striga hermonthica*, maize streak virus and is drought tolerant (IAR, 2009).

SAMMAZ-32 (99TZEE-Y-STR): It is extra-early maturing variety (50 days to mid-silking and 80-85 days to physiological maturity). It has a height of 170cm, yellow-seeded kernels and a potential yield of 4.0t ha^{-1}. It's tolerant to *Striga hermonthica* and Maize Streak Virus (IAR, 2009)

SAMMAZ-33(95TZEE-Y-STR): It is extra-early maturing and takes 57 days to mid-silking and 80-85 days to physiological maturity under uninfested (with *Striga hermonthica)* conditions. The height is 155cm. It is yellow-seeded and has a potential yield of 4.0tha^{-1}. It is susceptible to *Striga hermonthica*, but tolerant to maize streak virus and is drought tolerant (IAR, 2001).

All the required agronomic practices such as land preparation, sowing, fertilizer application, pest and disease control, herbicide application and harvesting were duly observed.The following parameters were taken:Cob length, Cob diameter,Number of kernel-rows/cob, Number of grains per row, 100-grain weight and grain yield per hectare. General linear model procedure (GLM) of the statistical analysis system (SAS) package (SAS,1990) was used for statistical analysis of all the data collected and differences between the treatment means were compared using Duncan Multiple Range test as described by Duncan(1955). Simple correlation and path coefficient analysis among the parameters were worked out using the procedure described by Dewey and Lu (1959) and little and Hills (1978) to assess the type and magnitude of relationships among the variable

RESULTS

Table 1: shows effects of soil analysis on the performance of extra-early maize varieties at

samara during 2016 and 2017 wet seasons

Soil physical and chemical properties analysis of the experimental sites are presented in Table 1. The textural class of soils at Samaru location showed loamy during 2016 and 2017 rainy seasons. Soil chemical composition showed soil PH to be slightly acidic, moderate organic carbon and available phosphorus, while Nitrogen level was very low, Exchangeable cation indicated low Mg, K and Na and a moderate CEC.

Table 1: shows Physico-chemical properties of soils from the experimental fields from 0-30cm depth at Samaru 2016 and 2017 wet seasons.

Seasons	2016	2017
Soil characteristics		
Particle size distribution (gkg^{-1})		
Sand	426	500
Silt	450	420
Clay	124	80
Textural class	Loam	Loam
Chemical composition		
PH in H_2O (1:2.5)	6.25	6.34
6.47		
PH in 0.0m $Cacl_2$ (1:2.5)	5.52	5.65
Organic carbon (g/kg)	13.4	14.56
Nitrogen(g/kg)	1.0	1.19
Available phosphorous ($Mgkg^{-1}$	9.65	12.69
Exchangeable bases (Cmols/kg)		
Ca	2.80	2.84
1.1		
Mg	0.61	0.69
K	0.15	0.17
Na	0.19	0.21
CEC	3.98	4.13

Source: IAR Field Z 11

Effects of weed control treatments on cob length of maize varieties at Samaru during 2016 and 2017 wet seasons.

Table 2, shows that varietal difference caused significant difference on maize varieties at Samaru 2017 wet season only. In 2017 SAMMAZ-29 had the highest cob length which was statistically similar to SAMMAZ-32, while SAMMZ-33 produced the lowest. Weed control treatments caused significance difference on cob length of maize varietiesexcept at Samaru 2017. In 2016, application of Nicosulfuron (0. 075kha.i/ha) at 2WAS followed by Nicosulfuron at same rate (W3) produced the highest cob length which was statistically at par (p≤0.05) with W1, W2, W4, W5, W6 and W8. However, W12 produced the least cob length. Similarly,in the mean, weedy check produced the least, but similar result with cob length; however, weedy check produced the least cob length At Samaru 2016 and 2017 wet seasons, varietal differences had no significant effect on cob diameter of maize except the means of the two seasons, where SAMMAZ-29had the highest cob diameter which was statistically (p≤0.05) at par with SAMMAZ–33, while SAMMAZ-32 produced the lowest cob diameter. Weed control treatments significantly influenced cob diameter of maize at Samaru in both seasons. In 2016, Nicosulfuron(0. 075kga.i/ha) at 2WAS followed by Nicosulfuron at same rate (W3)produced the highest cob diameter than the rest of the treatments combination, but was statistically at par with W1, W5 W6 W8-10, however, weedy check produced the least cob diameter. Similar trend was observed in 2017, where, W3 produced the highest cob diameter, however, W1 and W12 produced the least cob diameter; similarly with the mean where W3 had the highest cob diameter, but was statistically at par with W5, W6 and W10, however, weedy check produced the least cob diameter.

Table 2: Cob length (cm) and cob diameter (mm) of extra-early maize (*Zea mays* L.) Varieties as influenced by weed control treatments at Samaru during 2016 and 2017 wet Seasons

Treatments		Cob length(cm)			Cob diameter(mm)		
		2016	2017	mean	2016	2017	mean
Variety(V)							
SAMMAZ-29		12.47	11.67a	12.214a	12.77	3.82	8.434a
SAMMAZ -32		12.87	11.07ab	11.733a	13.02	3.65	8.032b
SAMMAZ -33		12.50	10.82b	11.758a	12.59	3.65	8.276ab
SE±		0.249	0.246	0.2493	0.212	0.105	0.2493
Weed control (W)	kga.i/						
Nicosulfuron at 2WAS only (W1)	0.075	12.57ab	11.04	11.860a	12.76a-d	3.48b	8.120b-d
Nicosulfuron at 2WAS fb HW at 5WAS (W2)	0.075	12.53ab	11.77	12.158a	12.44b-d	3.77ab	8.111b-d
Nicosulfuron at 2WAS fb Nicosulfuron at same rate(W3)	0.075	14.13a	10.73	12.436a	14.06a	4.21a	9.138a
Nicosulfuron at 2WAS only (W4)	(0.15	12.58ab	10.97	11.749a	11.94d	3.53ab	7.741cd
Nicosulfuron at 2WAS fb HW at 5WAS (W5)	(0.15	13.38ab	10.42	11.906a	13.27a-d	3.67ab	8.476a-c
Nicosulfuron(0.15kg a.i/ha) at 2WAS fb Nicos.(0.075kg a.i/ha) at recommended rate at 5WAS (W6)	(0.15	12.80ab	11.66	12.233a	13.46a-c	3.81ab	8.639ab
Atrazine.+Pendimethalin at only (W7)	2.0+2.0	12.45b	11.22	11.836a	12.45b-d	3.54ab	7.996b-d
Atrazine.+Pendimethalin at fb HW at 5WAS (W8)	2.0+2.0	12.78ab	11.74	12.260a	12.72a-d	3.71ab	8.220b-d
Atrazine.+Pendimethalin at fb Nicosulfuron(0.075kg a.i/ha) at 5WAS (W9)	2.0+2.0 fb 0.075	12.09bc	11.81	11.953a	12.74a-d	3.72ab	8.232b-d
Atrazine fb at 5WAS(W10)	2.0 fb 0.075	13.31bc	11.59	12.453a	13.48ab	3.86ab	8.673ab
Hoe weeding at (3 and 6WAS) (W11)		12.09bc	11.04	11.568a	12.16b-d	3.83ab	7.998b-d
Weedy check (W12)		10.63c	10.18	10.407b	12.05cd	3.19b	7.625d
SE±		0.498	0.493	0.4987	0.425	0.210	0.4987
Interaction							
W x V		NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within the same column and treatment group are not statistically different at 5% level of probability using Duncan Multiple Range Test (DMRT) **fb=followed by**

Effects of weed control treatments on the number of grains per row of extra-early maize varieties at Samaru during 2016 and 2017 wet seasons.

Varietal difference did not cause significant difference on number of grains per row throughout the seasons and the mean. Weed control treatments significantly affected the number of grains per row in both years and the mean. Nicosulfuron (0. 15kga.i/ha) at 2WAS followed by Nicosulfuron (0. 075kga.i/ha) at recommended rate (W6) produced the highest number of grains per row in both years and the mean. However, in 2016, W6 was statistically ($p \leq 0.05$) at par with all other weed control treatment combinations except with W4, W8 and W11. But weedy check produced the least number of grains per row. In 2017 similar trend was also observed where W6 produced the highest number of grains per row, but, was statistically at par with all other weed control treatments except with W3 and W10 which produced the least number of grains per row.

Likewise with the mean W6 had the highest number of grains per row, but was statistically at par with all other treatments, however, weedy check produced the least number of grains per row. While the effects of the treatments on the number of rows of grains per cob of early maize varieties at Samaru during 2016 and 2017 wet seasons. There were no significant ($p \leq 0.05$) differences among the varieties throughout the seasons except during 2016 wet season, where SAMMAZ-33 produced the highest number of rows of grain per cob than the rest of the varieties. Weed control treatments caused significant ($p \leq 0.05$) difference on number of rows of grains per cob in both years and the mean. Hoe weeding produced the highest number of rows per cob which was statistically similar to weedy check in 2016 wet season, while the rest of the treatments had similar result. However, in 2017 Atrazine+Pendimethalin followed by Nicosulfuron at 5WAS produced the highest number of rows of grains per cob than the the rest of the treatments, but was statistically at par with the rest of the treatments. Hoe weeding produced the highest number of rows of grains per cob when averaged over the two locations, while all other weed control treatments means were statistically similar.

Table 3: Number of grains/row and Number grain-rows/cob of extra-early maize (*zea mays* L.) Varieties as influenced by weed control treatment at Samaru during 2016 and 2017 wet seasons

	Number of grains/row			**Number of grain-rows/cob**		
Treatment	2016	2017	Mean	2016	2017	Mean
Variety (V)						
SAMMAZ-29	29.92	25.69	27.61	13.76b	13.47	13.35
SAMMAZ-32	28.17	24.55	15.36	13.76b	13.00	13.01
Sammaz-33	28.34	24.97	26.66	19.14a	12.77	13.59
SE±	0.775	0.696	0.735	4.507	0.232	0.753
Weed control (W)						
Nicosulfuron at 2WAS only (W1)	31.66ab	26.33a-c	28.99a-c	13.56b	12.33b	12.94b
Nicosulfuron at 2WAS fb HW at 5WAS (W2)	28.96ab	26.66a-c	27.81a-c	14.11b	13.44ab	13.78b
Nicosulfuron at 2WAS fb Nicosulfuron at same rate (W3)	29.11a-c	23.77bc	26.44a-c	13.67b	13.11b	13.39b
Nicosulfuron at 2WAS only (W4)	26.09c	24.77a-c	25.43a-c	14.04b	13.66ab	13.85b
Nicosulfuron at 2WAS fb HW at 5WAS (W5)	29.10a-c	23.77a-c	26.44a-c	13.41b	12.66ab	13.04b
Nicosulfuron at 2WAS fb Nicosulfuron at same rate (W6)	32.85a	28.88a	27.51b	12.89b	12.77ab	12.83b
Atrazine + Pendimethalin at only (W7)	25.63c	25.a-c	27.55a-c	12.37b	12.88ab	12.63b
Atrazine + Pendimethalin at fb HW at SWAS (W8)	27.48bc	27.55ab	27.52ab	13.55b	12.88ab	13.22b
Atrazine + Pendimethalin at fb Nicosulfuron at SWAS (W9)	29.96a-c	24.55a-c	28.70ab	13.74b	14.11a	13.93b
Atrazine at (fb Nicosulfuron at 5WAS (W10)	31.88ab	23.00bc	27.44ab	14.33b	13.11ab	13.72b
Hoe weeding at (3 and 6WAS) (W11)	27.63bc	24.33a-c	25.98a-c	19.48a	13.11ab	15.30a
Weekly check (W12)	25.37c	24.78a-c	27.08c	13.48a	12.88ab	13.19b
SE±	1.551	1.393	1.472	53.015	0.464	1.225
Interaction						
W x V	NS	NS	NS	NS	NS	NS

Table 4: shows effects of weed control treatment on 100-seed weight at Samaru 2016 and 2017 wet season. Varietal difference caused significant different on 100–seed weight of maize in 2016, seasons and the mean except at Samaru 2017 and the mean. SAMMAZ-29 produced the highest 100-seed weight, but was at par with SAMMAZ-33. In 2016 Samaru SAMMAZ-33 had statistically similar 100-seed weight with SAMMAZ-29. Weed control treatments caused significant difference on 100-seed weight of maize varieties in both years and the mean.W3, W9 and W10 produced the

heavier 100-seed weight, but were statistically at par with treatments except with weedy checks which had the least 100-seed weight. however, in Samaru 2017, Nicosulfuron (0.15kg a.i/ha) at 2WAS followed by Nicosulfuron at the same rate (W6) and Hoe weeding produced the highest 100-seed weight that the rest of the treatment combination, however, weedy check produced the lowest 100-seed weight, similarly Nicosulfuron (0.15kg a.i/ha) at 2WAS followed by Nicosulfuron(0.075kga.i/ha) (W6) produced the highest 100-seed weight which was statistically similar to the all other weed control treatment combinations, but weedy check produced the least 100-seed weight. However, in the mean W5 produced the highest 100-seed weight, but was statistically similar with the rest of the treatments, but, weedy check produced the least 100-seed weight. While the effects of the treatments on grain yield/ha of maize atSamaru 2016 and 2017 wet seasons. Varietal difference caused significant different on yield/ha of maize, SAMMAZ-29 produced the highest grains per hectare in both locations and years except at 2017 wet season. However, SAMMAZ-33 had the least yield/ha, however SAMMAZ-32 produced the least yield/ha in the means of both years. Weed control treatments caused significant effect on yield/ha in both seasons and the mean.W6 produced the highest yield/ha of maize at Samaru 2016 and 2017 and the mean, however, weedy check produced the least grain yield/ha, but in the mean, Nicosulfuron (0.15kg a.i/ha) at 2WAS followed by Nicosulfuron (0.075kga.i/ha) (W6) and Hoe weeding at 3 and 6WAS produced the highest yield/ha, but were statistically at par with the rest of the treatment combinations except with Atrazine+Pendimethalin (2.0+2.0kga.i/ha) only(W7) and weedy check.

Table 4: 100-seed weight (g) and grain yield/ha (kg) of extra-early maize (*Zea mays* L.) Varieties as influenced by weed control treatments at Samaru during 2016 and 2017 wet Seasons

		100-seed weight(g)			Yield/ha(kg)		
Variety(V)		2016	2017	mean	2016	2017	Mean
SAMMAZ-29		17.12 a	25.46	19.898	1296.31 a	1618.01	641.71a
SAMMAZ -32		15.76 b	23.85	19.213	1197.72 ab	1507.64	336.70c
SAMMAZ -33		16.61 ab	23.79	18.872	1069.89 b	1538.34	491.60b
SE±		0.363	0.976	0.7785	68.174	64.464	51.9921
Weed control (W)	kga.i/						
Nicosulfuron at 2WAS only (W1)	0.075	15.63 ab	23.46 b	19.44ab	971.3cd	580.9g	397.3b-d
Nicosulfuron at 2WAS fb HW at 5WAS (W2)	0.075	16.11ab	20.75 b	19.71ab	935.4cd	1353.0 cd	443.5a-c
Nicosulfuron at 2WAS fb Nicosulfuron at same rate(W3)	0.075	17.93 a	22.30 b	20.35ab	767.8ef	919.4ef	449.6a-c
Nicosulfuron at 2WAS only (W4)	(0.15	16.08 ab	21.44 b	19.42ab	921.1c-e	1673.4c	498.0a-c
Nicosulfuron at 2WAS fb HW at 5WAS (W5)	(0.15	17.11ab	25.20 b	20.94a	888.0b-e	2542.6b	487.1a-c
Nicosulfuron(0.15kg a.i/ha) at 2WAS fb Nicos.(0.075kg a.i/ha) at recommended rate at 5WAS (W6)	(0.15	16.65 ab	41.22 a	19.23ab	2860.0a	3597.4a	641.2a
Atrazine.+Pendimethalin at only (W7)	2.0+2.0	17.11ab	21.64 b	19.38ab	500.4ef	682.7fg	379.6cd
Atrazine.+Pendimethalin at fb HW at 5WAS (W8)	2.0+2.0	15.84 ab	23.58 b	19.31ab	1084.9cd	1677.4c	561.9a-c
Atrazine+Pendimethalin at fb Nicosulfuron(0.075kg a.i/ha) at 5WAS (W9)	2.0+2.0 fb 0.075	17.57 a	19.42 b	18.44ab	1256.7c	1472.9cd	633.7ab
Atrazine fb at 5WAS(W10)	2.0 fb 0.075	17.26 a	24.87 b	20.66ab	1144.0cd	1155.1de	559.4a-c
Hoe weeding at (3 and 6WAS) (W11)		15.61 ab	39.22 a	18.22ab	2466.9b	2673.1b	642.3a
Weedy check (W12)		14.74 b	9.33c	17.14b	459.1f	328.0g	182.5d
SE±		0.729	1.953	1.5571	136.348	128.929	103.9842
Interaction							
W x V		NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within the same column and treatment group are not statistically different at 5% level of probability using Duncan Multiple Range Test (DMRT)

Discussion

The application of Nicosultion (0.075kg ai/ha and 0.15kga.i/ha), Atrazine + Pendimethalin (2.0 + 2.0kgai/ha) each applied alone and followed by hoe weeding at (5WAS) or followed by Nicosultion (0.075kgai/ha) at 5WAS had significantly reduced weed cover score and weed dry weight. This observation could be attributed to the fact that the herbicides and supplementary hoe weeding inhibit the photosynthetic of the susceptible weed plant species and effective control of annual grasses that escaped herbicide treatments. This was in line with findings of (Anon., 1994) who reported that pre-emergence application of herbicides (primextra-gold) at 2.0kgai/ha followed by hoe weeding at 3 and 6WAS effectively controlled *Rottboeliacochinchimensis* in maize. Magani (1990) reported that pre-emergence application of herbicides (atrazine) at 2.0kga.i/ha followed by hoe weeding at 6WAS controlled broad leaf and annual grasses in maize.

Similarly, Ishaya (1997) reported that application of Sulfanyl urea herbicides resulted in reduction of weed infestation in maize and rice. Also, some weed speeches like *Rottboeliacochinchimensis* that caused serious, yield reduction in maize can only be easily controlled by pre-emergence application of *sulfonl urea* herbicides and supplementary hoe weeding (Anon., 1994). The weedy check had that highest weed cover score and weed dry weight since no weed control measure was applied throughout the crop life cycle.

The application of nicosulfuron at double recommendation followed by nicosulfuron at recommended rate each at 0.15kg a.i/ha and 0.075kg a.i/ha respectively.Hoe weeding at 3 and 6WAS had increased crop cob length, cob diameter, number of grains per cob, number of grain-rows per cob, 100-seed weight and yield/ha, These observed increase in growth parameters by weed control treatments and supplementary hoe weeding could be attributed to effective weed control of the treatments which had reduced the level of competition for growth resources such as light, nutrients and water by maize crops. This observation also could be due to good weed control that allowed the crop to develop more and larger leaf area and leaf area index which resulted to high light interception thereby accumulated high dry matter per plant per unit area. This findings is supported byMagani (1990) who reported that application of pre-emergence herbicides at 1.29kga.i/ha and supplementary hoe weeding at 6WAS resulted in high crop vigor score, crop growth rate, and relative growth rate as well as plant height of maize. Also (Anon., 1994) reported that pre-emergence application of herbicides at 3.0kga.i/ha supplementary hoe weeding at 6WAS resulted in high crop cob length, cob diameter, number of grains per cob, number of grain-rows per cob, 100-seed weight and grain yield/ha of maize. Ishaya (1997) reported that, application of cinosulfuron at 0.04kga.i/ha and prosulfuron at 0.08kga.i/ha resulted in high crop vigor score, crop growth rate, relative growth rate and plant height. The weedy check resulted in the reduction of these growth parameters throughout the experimental periods. This may be probably due to severe weed interference posed as a result of serious competition between maize plant and uncontrolled weeds which led to drastic reduction in growth of the crop. (Ishaya, 1997) have reported reduction in growth parameters due to uncontrolled weeds in the weedy check.

The better performance of all herbicide and hoe weeding treatments combination as compared to the weedy check could be attributed to adequate weed suppression which allowed greater efficiency in the use of available growth resources such as light, water and nutrients.

This is in line with the findings of Pampoola (1990), who reported that, yield increase of the crop was free from the weeds during its critical periods of weed interference which was reported to be about 40 days after emergence in maize. Anon. (1988) reported that pre-emergence application of herbicides at 4.0 kga.i/ha followed by hoe weeding at 6WAS gave high yield of maize and rice. Also reported that pre-emergence application of herbicide at 2.5 kga.i/ha followed by hoe weeding at 6WAS and 9WAS resulted in significant increase of maize grain yield compared to hoe weeded control. Magani (1990) reported that pre-emergence application of herbicides followed by hoe weeding at 6WAS resulted in high grain yield of maize. Ishaya (2004) also reported that, the application of cino-sulfuron at 0.04 kg a.i/ha and prosulfuron at 0.08 kga.i/ha resulted in high grain yield of maize and rice which was comparable to hoe weeded control. This is similar withthe findings ofAttangs (1997) who reported that application of sulfonylurea herbicides at 0.03 kga.i/ha gave high yield of maize and rice, better growth and effective weed control.

CONCLUSION

For good growth and yield of extra-early maize at Samaru, planting SAMMAZ-29 using nicosulfuron(0.15kg a.i/ha) at 2WAS followed by nicosulfuron(0.075kg a.i/ha) at 5WAS and hoe weeding at 3 and 6WAS could be recommended for better performance in maize.

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