

Research Article

Effect of Weed Control Methods and Variety on Yield Performance of Maize (*Zea mays* L.) in the Sudan Savanna of Nigeria

Bichi B. I[#], Yawale M. A[#] and Shehu A. D[#]

[#]Department of Agriculture, Audu Bako College of Agriculture Dambatta, Kano, Nigeria

Accepted 22 Oct 2015, Available online 30 Oct 2015, Vol.5, No.5 (Oct 2015)

Abstract

Field experiments were conducted during 2011 rainy season at Bayero University Kano, Teaching and Research Dry land Farm and Bichi in Bichi Local Government Area, Farmer's Dry land Farm of Kano State to determine the effect of variety and weed control methods on yield performance of maize (*Zea mays* L.). The treatments consisted of eight weed control treatments [Atrazine (1.25 and 1.75 kg a. i ha⁻¹), post emergence 2, 4-D (0.5 and 1.0 kg a. i ha⁻¹) with or without supplementary hoe weeding, weed free check, weedy check and two improved varieties (2008 SynEE – WDTSTR, EV99DT – WSTR) which were planted 25cm between stands with double row planting on 75cm ridges. The treatments were factorially combined and laid out in a randomized complete block design (RCBD) and replicated three times. Important weed species observed in the experimental plots were *Cynodon dactylon*, *Digitaria marginata*, *Dinebra retroflexa*, *Cyperus rotundus*, *Ageratum conyzoides*, *Alternanthera sessilis*, *Amaranthus viridis*, *Euphorbia* spp., *Commelina benghalensis*, *Cynotis cyclata*, and *Digera arvensis*. Among the herbicide treatments, pre-emergence application of atrazine (1.75kg a. i ha⁻¹) + 2, 4-D (1.0 kg a. i ha⁻¹) at 5 WAS recorded higher weed control efficiency (WCE %) and lower weed index (WI %) followed by pre-emergence application of atrazine (1.25kg a. i ha⁻¹) + 2, 4-D (1.0 kg a. i ha⁻¹) at 5 WAS in both locations. Weed free check recorded the highest value of WCE % and lowest WI % followed by pre-emergence application of atrazine (1.75kg a. i ha⁻¹) + 2, 4 - D (1.0 kg a. i ha⁻¹) at 5 WAS where as weedy check significantly recorded lowest values of WCE % with highest WI % in both locations. Based on the result obtained, it could be deduced that pre-emergence application of atrazine (1.75kg a. i ha⁻¹) + 2, 4-D (1.0 kg a. i ha⁻¹) at 5 WAS resulted to the production higher grain yields with EV99DT-W STR variety in both locations among other herbicide treatments.

Keywords: Weeds, pre-emergence, Atrazine, Double Row Planting, Yield.

Introduction

Maize is one of the most important cereal crop in the world agricultural economy both as a food and fodder crop (Dixit and Gautam, 1996). Maize grains are used for human consumption, feed for poultry and livestock, extraction of edible oil and also for starch and glucose industry and has very high yield potential (Anonymous, 2005). In 2014, 872.07 million metric tons of maize was produced worldwide on 177.4 million hectares of land, 69.64 million metric tons from Africa on 33.71million hectares of land and Nigeria produced 9.41 million metric tons on 5.20 million hectares of land (FAO, 25 Feb. 2014). In 2009, 811 million metric tons of maize was produced worldwide on 147 million hectares of land. USA is the world largest producer, accounting for 43% of the world total maize production followed by China, Brazil, India and Mexico (Onwueme and Sinha, 1997). Africa produced about 6% of the world total maize production with

Nigeria being the tropical African largest producer. Nigeria is the tenth largest producer of maize in the world, producing about 7.8 million metric tons in 2007 on 394,400 hectares which is about 0.7% of the world total production (FAO, 2012).

Tall maize cultivars were not found effective in suppressing weeds as compared to some shorter modern cultivars (Cosser *et al.*, 1997). Maize has potential to contribute to solving food insecurity problems in Nigeria, because it requires low capital investment, has low growing risk, early maturity, a longer window of harvest and storage ability once adequately fully dried (IITA, 1998).

The objectives of this study were

- To determine the effectiveness of various herbicide and or herbicide combinations on maize yield performance and weed infestation.
- To assess the response of the two maize variety on weed control methods

*Corresponding author: Bichi B. I

Materials and Methods

Experimental Site

Field trials were conducted during 2011 rainy season in two locations namely; Bayero University, Kano Teaching and Research Dry land Farm (11° 58' N, 8° 26' E and 460m above sea level) and Bichi in Bichi Local Government Area, Farmer's Dry land Farm of Kano State (11.50° N and 8.50° E) both in the Sudan savanna ecological zone of Nigeria. The annual rainfall of BUK and Bichi were (418.7mm, 375.5mm) and mean daily temperature were (28.3°C and 26.9°C). The soil of BUK site was sandy loam of the pH 6.5, Organic matter content 7.9 g kg⁻¹ and total nitrogen 0.56 while Bichi site had sandy loam of pH 6.0, Organic matter content 6.1 g kg⁻¹ and total nitrogen was 0.49.

Experimental Treatments and Design

The field trials consisted of the following treatments

Varieties of maize: [2008Syn EE-WDT STR (V₁) and EV99DT-W STR (V₂)].

T₁- Pre-emergence application of atrazine (1.25kg a. i ha⁻¹) + (SHW) at 5 (WAS),

T₂- Pre-emergence application of atrazine (1.75kg a. i ha⁻¹) + SHW at 5 WAS,

T₃-Pre-emergence application of atrazine (1.25kg a. i ha⁻¹) + 2, 4-D (1.0kg a. i ha⁻¹) at 5 WAS,

T₄-Pre-emergence application of atrazine (1.75kg a. i ha⁻¹) + 2, 4-D (0.5kg a. i ha⁻¹) at 5 WAS,

T₅-Pre-emergence application of atrazine (1.75kg a. i ha⁻¹) + 2, 4-D (1.0kg a. i ha⁻¹) at 5 WAS,

T₆-Pre-emergence application of atrazine (1.25kg a. i ha⁻¹) + 2, 4-D (0.5kg a. i ha⁻¹) at 5 WAS, T₇-Weed free check and T₈ -Weedy check which were factorially combined and laid out in a randomized complete block design with three replications. Each plot consisted of 6 ridges × 0.75m × 4m long. Alleys of 0.5m were left between plots within a block and 1m between blocks. Net plot was made up of 4 ridges × 0.75m × 4m

Data Collection

Data were collected on weed control efficiency (%), weed index (%) and grain yields.

Data analysis

Data collected on weed control efficiency (%), weed index (%) and maize grain yields were subjected to analysis of variance with the help of a statistical application for science (SAS). Duncan's Multiple Range Test was used to separate treatments means where 'F' test shows significance difference between the treatments as described by Snedecor and Cochran (1967)

Results and Discussion

Weed control efficiency (%) and Weed index (%)

The effect of variety and weed control methods on weed control efficiency (%) per square meter at 4, 8

WAS and at harvest are shown in Table 1. The effect of variety on weed control efficiency per m² was not statistically significant at both locations throughout the study periods. Significant differences were observed on the effect of weed control methods on weed control efficiency per m² at BUK among weed control methods, weed free check recorded significantly the highest weed control efficiency per m² than T₁, T₃, T₆ and T₈ and statistically at par with T₂, T₄ and T₅ at 4 WAS. T₈ had significantly lower weed control efficiency than the rest of the weed control methods at all stages of growth in both locations (Table 1). At 8 WAS, at BUK, weed free check was found to be significantly (P < 0.05) high in weed control efficiency compared to the rest of the control methods except with T₅ which was at par. At harvest, it was significantly high than all the treatments in terms of weed control efficiency.

At Bichi, at 4 WAS, weed free check had significantly high % weed control efficiency than T₁, T₃, T₆ and T₈ and was statistically the same with T₂, T₄, T₆ and T₅ (Table 1). At 8 WAS, weed free check differed significantly from T₁, T₂, T₄, T₆ and T₈ as regards to percent weed control efficiency while it was statistically the same with T₃, T₅. At harvest, the same trend was observed as at 4 WAS (Table 1). Both at BUK and at Bichi, T₂ had significantly (P < 0.05) high weed control efficiency than T₁ at 4 WAS.

The effect of variety and weed control methods on weed index is presented in Table 2. Variety had no significant effect on weed index at both locations. Weed control methods affects weed index significantly in both locations. Among all the weed control treatments, weedy check recorded significantly higher weed index at BUK, though at Bichi was found to have same percentage of weed index with T₁.

At BUK, pre-emergence application of atrazine (1.75 kg a. i. ha⁻¹) + 2, 4 - D (1.0 kg a. i. ha⁻¹) recorded significantly lower weed index which was statistically the same with pre-emergence application of atrazine (1.25kg a. i ha⁻¹) + 2, 4-D (1.0 kg a. i ha⁻¹) at 5 WAS and weed free check (T₇). T₁ and T₂ had significantly high weed index than the rest of the treatments excluding weedy check. These treatments (T₁ and T₂) were statistically at par at BUK and differed significantly at Bichi with regards to their weed index (Table 2). At Bichi, the result also revealed that T₂ and T₆ were statistically the same and had significantly high weed index than T₃, T₄, T₅ as well as T₇ (Table 2).

There was no significant interaction between the variety and weed control methods.

Weed index is a measure of yield reduction due to weed competition. The highest weed indexes were recorded in weedy check plots at both BUK and Bichi, this was caused due to reduced leaf number per plant and LAI leading to poor photosynthetic activities, the lowest maize grain yield was weedy check at BUK and Bichi that was realized due to competitions with unchecked grown weeds for nutrients, moisture, space and sunlight as indicated by poor plant growth and poor yield components.

Table 1: Weed control efficiency (%) per square meter (m²) as influenced by variety and weed control methods during 2011 rainy season at Bichi Area, Farmer's Dry land Farm and BUK, Teaching and Research Dry Land Farm

Treatments	4 WAS	BUK 8 WAS	At harvest	4 WAS	Bichi 8 WAS	At harvest
Variety						
2008SynEE-WDT STR	59.26	60.98	74.47	55.14	58.04	55.57
EV99DT-W STR	50.19	54.01	81.23	45.61	52.00	60.19
SE±	4.939	5.317	6.684	4.685	5.115	5.688
Significance	NS	NS	NS	NS	NS	NS
Weed Control Methods						
T ₁ -Atr.1.25kg ai ha ⁻¹ + SHW at 5 WAS	81.23c	65.45c	68.12d	80.56c	66.32b	69.00b
T ₂ -Atr.1.75kg ai ha ⁻¹ + SHW at 5 WAS	89.94abc	68.07c	71.34d	87.19abc	69.03b	72.30b
T ₃ -Atr.1.25kg ai ha ⁻¹ + 2, 4-D 1.0 kg ai ha ⁻¹ at 5 WAS	85.22bc	85.46b	82.11bc	85.00bc	84.91a	86.74a
T ₄ -Atr.1.75kg ai ha ⁻¹ + 2, 4-D 0.5 kg ai ha ⁻¹ at 5 WAS	91.98ab	70.42c	75.66bcd	89.97abc	69.98b	77.00b
T ₅ -Atr.1.75kg ai ha ⁻¹ + 2, 4-D 1.0 kg ai ha ⁻¹ at 5 WAS	93.50ab	88.37ab	84.16b	91.04ab	82.35a	88.97a
T ₆ -Atr.1.25kg ai ha ⁻¹ + 2, 4-D 0.5 kg ai ha ⁻¹ at 5 WAS	82.06c	65.80c	74.50cd	82.00bc	67.68b	76.95b
T ₇ -Weed free check	95.46a	94.75a	95.30a	94.93a	91.23a	93.98a
T ₈ -Weedy check	9.00d	11.00d	14.60e	10.15d	13.38c	15.83c
SE±	9.877	10.633	13.368	9.370	10.229	11.376
Significance	**	**	**	**	**	**
Interaction						
V*WCM	NS	NS	NS	NS	NS	NS

Means in a column of any set of treatments followed by same letter(s) are not significantly different at 5% level of significance $P < 0.05$ using Duncan Multiple Range Test (DMRT), SHW-Supplementary hand weeding, WAS- Weeks after sowing, NS-Not significant, Atr.- Atrazine

Table 2: Weed index (%) and grain yield (kg ha⁻¹) of maize as influenced by variety and weed control methods during 2011 rainy season at Bichi Area, Farmer's Dry land Farm and BUK, Teaching and Research Dry Land Farm

Treatments	BUK Weed index (%)	Grain Yield (kg ha ⁻¹)	Bichi Weed index (%)	Grain Yield (kg ha ⁻¹)
Variety				
2008SynEE-WDT STR	27.52	5818.4b	34.77	3550.8b
EV99DT-W STR	28.67	6175.4a	35.58	3753.8a
SE±	1.445	118.87	0.779	41.610
Significance	NS	**	NS	**
Weed Control Methods				
T ₁ -Atr.1.25kg ai ha ⁻¹ + SHW at 5 WAS	46.42b	4486.1 c	56.21a	2472.2f
T ₂ -Atr.1.75kg ai ha ⁻¹ + SHW at 5 WAS	40.67b	4945.9 c	48.56b	2894.6e
T ₃ -Atr.1.25kg ai ha ⁻¹ + 2, 4-D 1.0 kg ai ha ⁻¹ at 5 WAS	8.49d	7623.6a	17.71	4632.1c
T ₄ -Atr.1.75kg ai ha ⁻¹ + 2, 4-D 0.5 kg ai ha ⁻¹ at 5 WAS	27.18c	6065.3b	39.01c	3436.1d
T ₅ -Atr.1.75kg ai ha ⁻¹ + 2, 4-D 1.0 kg ai ha ⁻¹ at 5 WAS	7.43d	7715.3a	11.48e	4986.1b
T ₆ -Atr.1.25kg ai ha ⁻¹ + 2, 4-D 0.5 kg ai ha ⁻¹ at 5 WAS	30.034c	5766.7b	46.56b	3000.0e
T ₇ -Weed free check	0.000d	8347.2a	0.00f	5638.9a
T ₈ -Weedy check	69.62a	3416.7 d	69.69a	2278.7f
SE±	2.8891	237.74	1.559	83.220
Significance	**	**	**	**
Interaction				
V*WCM	NS	NS	NS	NS

Means in a column of any set of treatments followed by same letter(s) are not significantly different at 5% level of significance $P < 0.05$ using Duncan Multiple Range Test (DMRT), SHW-Supplementary hand weeding, WAS- Weeks after sowing, NS-Not significant, Atr.- Atrazine

However, lower weed index were recorded with T₅ at both BUK and Bichi, those that gave higher grain yield among the herbicide treatments as a result of optimum utilization of growth resources led to an excellent source and sink relationship. This result was in agreement with Raj Singh, *et al.*, 1998 who reported that, Atrazine at 1.5 kg a. i ha⁻¹ in combination with pendimethalin at 0.5 kg a. i ha⁻¹ at 45 DAS on maize recorded effective reduction on total number of weeds and gave the highest grain yield, fodder yield, weed control efficiency of (92.1%), net returns and benefit: cost ratio.

Grain yield of maize (kg ha⁻¹)

The effect of variety and weed control methods on grain yield of maize (kg ha⁻¹) is presented in Table 2. The effects of variety on grain yield of maize were statistically significant in both locations. Variety EV99DT-WSTR had recorded significantly ($P < 0.05$) higher grain yield (kg ha⁻¹) compared to variety 2008SynEE-WDTSTR in both BUK and Bichi (Table 2). Among all the weed control treatments, weed free check recorded significantly highest grains yield of

maize (kg ha^{-1}) in both locations though statistically the same with T_5 and T_3 at BUK, but at Bichi differed significantly from all the treatments. At BUK, weed free check had highest grain yield than at Bichi whereas weedy check recorded significantly the lowest grain yield at both locations.

Among the weed control treatments at BUK, T_4 and T_6 had statistically the same grain yield and significantly recorded higher grain yield than T_1 and T_2 (Table 2). Weedy check had significantly lower grain yield compared to the rest of the treatments.

At Bichi, T_1 and weedy check had significantly ($P < 0.05$) the lowest grain yield per hectare than the other treatments. Weed free check recorded significantly the highest grain yield per hectare than all the treatments. T_2 and T_6 were statistically at par in their grain yield per hectare although found to have significantly lower grain yield than T_3 , T_4 and T_5 (Table 2). Generally, grain yield at BUK was higher across the treatments than that at Bichi (Table 2).

There was no significant interaction between variety and weed control methods.

Summary and Conclusion

The result showed that, significant differences were observed on the effect of weed control methods on weed control efficiency (%), weed index, variety and grain yields of maize in both locations. Weed free check was found to be significantly ($P < 0.05$) higher on weed control efficiency and lowest on weed index followed by pre-emergence application of atrazine ($1.75\text{kg a. i ha}^{-1}$) + 2, 4-D ($1.0\text{kg a. i ha}^{-1}$) at 5 WAS - (T_5) compared to other treatments. At harvest, weed free check was found to be statistically and significantly the same with T_5 at ($P < 0.05$).

With references to the above research findings, it is recommended that pre-emergence application of atrazine ($1.75\text{kg a. i ha}^{-1}$) + 2, 4 - D ($1.0\text{kg a. i ha}^{-1}$) at 5 WAS was significantly better than other herbicide treatments as well variety EV99DT-WSTR was significantly better than variety 2008SynEE-WDTSTR and could be adopted at the study areas pending for further research findings.

References

- Anonymous, 2005, Agricultural statistics at a glance, 2006, Published by ministry of Agriculture, govt. of India
- Cosser, N.D., J.M. Godding and R.J.F. Williams. 1997. The impact of wheat cultivar, sowing - date and grazing on the weed seed bank of an organic farming system. *Aspects Appl. Biol.*, 15(1):429-432.
- Dixit, A. and Gautam, K.C., 1996. Studies on the effects of atrazine on weeds in winter maize. *Indian J. Weed Sci.*, 28(3&4): 137-139.
- FAO (2014). Retrieved as @ 25 February, 2014.
- FAO 2012, FAO-Statistical Year Book. *FAO. Organization year Book Vol. /5/5.*
- IITA (1998). *Annual Report for 1997*; Maize Improvement Programme IITA, Ibadan. pp. 26-31.
- Onwueme, I. C. and Sinha, T. D. (1997). *Field Crop Production in Tropical Africa*. the Nether-lands, CTA Wageningen. pp. 203.
- Raj Singh, Mukhopadhyay, S.K. and Patel, C.S., 1998 Economic evaluation of integrated weed management practices in upland rice. *Indian J. Weed Sci.*, 30(1/2): 79-80.
- SAS, 1989. Statistical Application for Science (SAS/STAT) User Guide Version 64: 2 SAS Inst. Inc. Carry NC, USA
- Snedecor, G. W. and Cochran, W.G. 1967. *Statistical Methods*. The IOWA State University Press 6th Editio Ames, IOWA, USA P.593