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Full Length Research Article

Effects of Weed Control and Cow Dung Manure on Growth Performance of Quality Protein Maize in Samaru, Zaria, Nigeria.

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ABSTRACT: Field trials were conducted during the 2006, 2007 and 2008 rainy seasons at the Institute for Agricultural Research Samaru, in the Northern guinea savanna zone of Nigeria to evaluate the effects of weed control and cow dung manure treatments on growth of Quality Protein Maize. The trial consisted of factorial combinations of eight weed control treatments which include application of (Atrazine + Acetochlor + Terbuthylazine at a ratio of 1:1:1, Atrazine + Metolachlor at a ratio of 1:2 each at 3.0 and 4.0kg a.i/ha, Atrazine at 4.0 and 5.0kg a.i/ha, Hoe weeding at 3 and 6 weeks after sowing and a weedy check) with four cow dung manure levels at (0, 4, 8 and 12t/ha and a recommended NPK mineral fertilizer check at the rate of 120kg N, 26kg P and 50kg K/ha). The treatments were laid out in a split plot design with three replicates. In the mean data, application of Atrazine + Metolachlor at 4.0kg a.i/ha and the two hoe weedings produced significantly ($P < 0.05$) higher and similar values for total dry matter and crop growth rate, whereas Atrazine + Metolachlor at 4.0kg a.i/ha only produced significantly ($P<0.05$) the higher values for leaf area index and harvest index. Application of Atrazine + Acetochlor + Terbuthylazine at 4.0kg a.i/ha had statistically ($P<0.05$) the higher lodging count. The highest Relative growth rate was by Atrazine + Metolachlor at 3.0kg a.i/ha ($P<0.05$). The weedy check consistently produced the least values for all parameters. Application of cow dung manure at 12t/ha and the NPK mineral fertilizer check produced significantly the highest values for all parameters ($P<0.05$) while 0 fertilizer control had the least. Based on the result of this study it can be deduced that the application of Atrazine + Metolachlor at 4.0 kg a.i/ha and cow dung manure at 12t/ha increased growth of Quality Protein Maize.
Keywords - Weed control, Cow dung manure, Growth indices, Quality protein maize

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important staple food crops in West and Central Africa (Sharifai *et al.*, 2012). The savanna zone of west and central Africa has the greatest potential for its production due to relatively higher incidence of solar radiation and lower incidence of pest and diseases during the cropping season (Badu-Apraku *et al.,* 2006). According to Food and Agricultural Organization of the United Nations, 840.3 million metric tonnes of maize were produced worldwide on over 159.5 million hectares in the year 2010. Africa produced 53.2 million metric tonnes while Nigeria produced 7.5 million metric tonnes in 2008 (FAO, 2010).

Maize is used as a food, feed and industrial crop. Due to its expanded use in agro industries, it is recognized as a leading commercial crop of great agronomic value (Rasheed *et al.,* 2003). Maize is also widely believed to have the greatest potential among food crops for attaining technological breakthroughs that will improve food production (Kamara and Sanginga, 2001). Of upmost importance is the protein component of Quality Protein Maize (QPM) in comparison to conventional maize varieties. The protein component of Quality Protein Maize (QPM) contains double amounts of lysine and arginine, higher levels of tryptophan and cystein and no change in other amino acids except lower levels of leucine. As a result, the QPM amino acid profile gives a good balance of total essential amino acids and has an amino acid digestibility score of 67% compared to 28.5, 31.0 and 33% values for pioneer dent and flint maize respectively (Zakadas *et al.,* 1995). Weed infestation and low soil fertility are the most important factors constraining the production of QPM particularly in tropical regions. In Nigeria, losses of up to 80% in the potential yield of maize had been attributed to unchecked weed growth throughout the crops life cycle (Lagoke *et al.,* 1991). Methods used to control weeds in maize include manual, mechanical and biological which are usually labour intensive, costly and not easily available at the right time of need consequently an innovative technology devoid of the above constraints such as the use of herbicides can serve as an alternative weed control measure.

Lombin (1987) reported low organic matter content, low cation exchange capacity and low inherent fertility as characteristic features of Nigerian soils. He further identified Nitrogen and phosphorus as the most limiting nutrients in the soil.

In recent times the high cost of inorganic fertilizers and its poor distribution have affected its availability to resource poor farmers thereby resulting in the use of insufficient quantities at the time of need, hence contributing to low crop yields. In order to find alternative sources of nutrition to crops, cow dung manure application can be considered. In view of its rich protein content, production of quality Protein Maize through improved crop husbandry practices would help improve the nutritional status of the populace.

This study was therefore undertaken with the objectives of evaluating weed control treatments and cow dung manure on growth indices of QPM.

MATERIALS AND METHODS

Field trials were conducted during the 2006, 2007 and 2008 rainy seasons at the research farm of the Institute for Agricultural Research Samaru (11°11' 07° 38'E and 686 meters above sea level) in the Northern Guinea savanna ecological zone of Nigeria. The physico chemical properties of the soils at the experimental sites and the cow dung manure used in the trials are presented in Tables 1 and 2. The crop variety used was SAMMAZ 14. It is late maturing and has a yield potential of 5t/ha. It was obtained from the seed production unit of the Institute for Agricultural Research Samaru, Zaria, Nigeria.

The trials consisted of factorial combinations of eight weed control treatments which includes application of (Atrazine + Acetochlor + Terbuthylazine at a ratio of 1:1:1, Atrazine + Metolachlor at a ratio of 1:2 each at 3.0 and 4.0 kg a.i/ha, Atrazine at 4.0 and 5.0 kg a.i/ha, Hoe weedings at 3 and 6 weeks after sowing and a weedy check) with four cow dung manure levels at (0, 4, 8 and 12t/ha and a recommended NPK mineral fertilizer check at the rate of 120kgN, 26kgP and 50kgK/ha. The treatments were laid out in a split plot design with three replicates. The weed control treatments were assigned to the main plots while the cow dung and NPK inorganic fertilizer treatments were assigned to the sub-plots. The gross and net plot sizes were $18m^2$ and $12m^2$ respectively. The experimental area was ploughed, harrowed and ridged 75cm apart. The land was then marked into plots and replications. Cow dung manure was incorporated on treatment basis two weeks before planting.

The seeds were planted on 19th July 2006, 10th June 2007 and 16th June 2008. Two seeds were sown per hole manually along the ridges at an intra-row spacing of 25cm. The plants were later thinned to one plant per stand at two weeks after sowing. The pre-emergence herbicides were applied immediately after sowing using a Cp3 knapsack sprayer set at a pressure of $2.1kg/m^2$. The herbicides were applied on treatment basis. Hoe weeding was carried out at 3 and 6 weeks after sowing for the hoe weeded control in each year of the trial. Inorganic fertilizers were applied by side dressing at the rate of 120kgN, 26kgP and 50kgK/ha to supply the inorganic fertilizer treatment plots. The N was applied in two split doses at 3 and 6 weeks after sowing.

Data was collected on leaf area index, total dry matter, crop growth rate, relative growth rate, shoot lodging count and harvest index.

Data collected were subjected to analysis of variance as described by Snedecor and Cochran (1967), where the 'F' test shows significance. The treatment means were separated using Duncan's multiple range test (Duncan, 1955).

RESULTS

Table 1 shows the physical and chemical properties of the soils at the experimental sites. The soils were loam and moderately acidic with low N and P, while the Na and CEC were moderate. The analyzed dry cow dung samples reveal high concentrations of both major and minor nutrients (Table 2). It was further observed that the first year manure used was richer than for other years with the second year having the least values for each of the nutrients tested except for organic carbon which was high.

The herbicide treatments and the two hoe weeding produced higher leaf area index compared to the weedy check in all the seasons and combined. In 2006, 2008 seasons and the combined, application of Atrazine + Metolachlor at 4.0 kg a.i/ha had the highest leaf area index while in 2007 season the application of Atrazine + Metolachlor at 4.0 kg a.i/ha, Atrazine at 5.0 kg a.i/ha and hoe weeding at 3 and 6 weeks after sowing had the highest leaf area index (LAI). The weedy check

consistently gave the lowest leaf area index throughout the seasons and in the combined (Table 3).

Throughout the seasons and in the combined each increase in cow dung rate from 0 – 12t/ha led to a significant increase in leaf area index. The 12t/ha treatment produced the highest LAI and was statistically comparable to the NPK fertilizer check. The interaction of the factors was not significant (Table 3). Application of Atrazine + Metolachlor at 4.0 kg a.i/ha and the two hoe weeding produced the highest total dry matter per plant in 2006, and 2008 seasons. However, in 2007 season, the application of Atrazine + Metolachlor at 4.0 kg a.i/ha produced the highest total dry matter per plant which was comparable to Atrazine + Acetochlor + Terbuthylazine at 4.0 kg a.i/ha., Atrazine + Metolachlor at 3.0 kg a.i/ha and Atrazine at 5.0 kg a.i/ha. The weedy check treatment consistently produced the least total dry matter per plant for all the three seasons (Table 3).

Each increase in cow dung manure from the control to 12t/ha led to a significant increase in total dry matter per plant in all seasons and the combined. The 12t/ha treatment gave the highest TDM which was comparable to the NPK treatment in 2006 and 2007 seasons (Table 3).

There was a highly significant interaction effect of weed control and cow dung manure in 2007 season (Table 3a). Holding cow dung at 12t/ha and the recommended NPK mineral fertilizer constant, all the weed control treatments produced similar and higher total dry matter and each was significantly superior to the weedy check and Atrazine + Acetochlor + Terbuthylazine at 3.0 kg a.i/ha that were also significantly not at par statistically (Table 3a).

In 2006, 2007 seasons and the mean application of Atrazine + Metolachlor at 4.0 kg a.i/ha and the two hoe weeding significantly produced higher crop growth rate which were similar to the application of Atrazine + Acetochlor + Terbuthylazine at 3.0 kg a.i/ha in 2007 season only. However, in 2008 season the two hoe weeding recorded significantly the highest crop growth rate than the other treatments. Weedy check had the least CGR in all the seasons and the combined (Table 4).

Each increase in cow dung from 0 to 12t/ha resulted in a significant increase in crop growth rate. The 12t/ha had the highest CGR which was at par with the NPK mineral fertilizer for all the seasons and the combined. The control produced the least crop growth rate (Table 4).

A significant interaction between weed control treatments and cow dung manure on crop growth rate was observed in 2006 season (Table 4). Generally in all the weed control treatments each increase in cow dung rate increased the crop growth rate of QPM. The highest crop growth rate was by the two hoe weeded in conjunction with NPK fertilizer treatment which was at par with application of Atrazine + Metolachlor at 4.0 kg a.i/ha in conjunction with NPK fertilizer treatment (Table 4a).

In 2006 season, application of Atrazine + Metolachlor at 3.0kg a.i/ha resulted in significantly higher RGR than the weedy check but was at par with all other weed control treatments.

In 2007, Atrazine + Metolachlor at 4.0kg a.i/ha and Atrazine at 5.0kg a.i/ha had significantly higher RGR than the rest of the treatments but were statistically at par with the two hoe weeding. However, in 2008 season, application of Atrazine + Metolachlor at both rates gave significantly higher RGR of QPM than all the other weed control treatments; while in the combined, Atrazine + Metolachlor at 3.0kg a.i/ha significantly had higher RGR than Atrazine + Acetochlor + Terbuthylazine at 3.0kg a.i/ha, Atrazine at 4.0kg a.i/ha and the weedy check which had the lowest RGR throughout the seasons and the combined.

The RGR increased with increasing cow dung from 0 – 12t/ha in 2007, 2008 and the combined and from 0 – 4t/ha in 2006 season. The interaction between the factors on RGR was not significant for all the seasons and the combined (Table 4).

Shoot lodging count was significantly increased by application of Atrazine + Acetochlor + Terbuthylazine and Atrazine Metolachlor each at 4.0 kg a.i/ha in 2006 season, while in 2007 season and the mean, application of Atrazine + Acetochlor + Terbuthylazine at 4.0 kg a.i/ha led to higher shoot lodging count. However, in 2008 application of Atrazine Metolachlor at 4.0 kg a.i/ha had the highest shoot lodging count which was statistically comparable to Atrazine at 5.0 kg a.i/ha (Table 5). Each increase in cowdung rate from 0-12t/ha led to a significant increase in shoot lodging count in 2007 season and the mean. However, in 2006 and

2008 seasons each increase in cow dung rate from 0 – 4t/ha and 8 – 12t/ha led to a significant increase in shoot lodging count. The 12t/ha treatment had the highest shoot lodging count and was statistically the same with the NPK fertilizer treatment in 2006, 2008 seasons and the combined (Table 5).

All weed control treatments with the exception of Atrazine at 4.0 kg a.i/ha in 2007 season and the mean, and Atrazine at both rates in 2008, Atrazine + Acetochlor + Terbuthylazine at 3.0 kg a.i/ha in the mean and the weedy check in all the seasons resulted in significantly higher harvest index of QPM.

Each increase in cow dung rate from 0 – 12t/ha led to a significant increase in harvest index of QPM. The 12t/ha treatment and the NPK fertilizer treatment recorded the highest harvest index (Table 5).

Table 1: Physico Chemical Properties of Soil Samples from the Experimental Sites (0 – 15cm) at Samaru, Zaria, Nigeria

Composition	2006	2007	2008
Physical Properties			
Sand (%)	43	46	41
Silt (%)	38	36	40
Clay (%)	19	18	19
Textural class	Loam	Loam	Loam
Chemical properties			
pH in H_2O (1:2:5)	5.6	5.8	5.7
pH in 0.01m $CaCl_2$ (1:2:5)	5.4	5.7	5.3
Organic Carbon (g/kg)	0.63	0.52	0.48
Total Nitrogen (g/kg)	0.61	0.36	0.68
Available Phosphorus (meq/kg)	13.4	9.8	11.3
Exchangeable Cations (Cmol/kg soil)			
Calcium	1.20	1.00	1.40
Sodium	1.00	1.00	1.20
Potassium	0.58	0.96	0.62
Magnesium	0.64	0.82	0.67
C.E.C	5.80	5.60	5.80

Table 2: Chemical Properties of Cow dung Manure Samples from Samaru, Zaria, Nigeria

Chemical composition	2006	2007	2008
Total nitrogen (%)	2.11	1.86	1.97
Available phosphorus (%)	0.72	0.64	0.67
Potassium (%)	1.87	1.73	1.82
Calcium (%)	0.52	0.36	0.48
Magnesium (%)	0.65	0.42	0.83
Organic carbon (%)	18.2	26.5	23.7

Table 3: Effect of weed control, cow dung manure and recommended NPK fertilizer rate on leaf area index and total dry matter yield of quality protein maize (QPM) at Samaru during 2006, 2007 and 2008 rainy seasons and the combined.

Treatments			Leaf Area Index 12WAS				Total Dry Matter (g) 12WAS			
Weed control	Ratio	Rate (Kg a.i/ha)	2006	2007	2008	combined	2006	2007	2008	combined
Atrazine + Acetochlor + Terbuthylazine	1:1:1	3.0	2.71b	2.15d	2.61d	2.49d	86.6c	112.2c	116.9d	105.2c
Atrazine + Acetochlor + Terbuthylazine	1:1:1	4.0	2.52c	2.59b	2.73c	2.61c	119.0b	129.1a b	124.9b	124.3ab
Atrazine + Metolachlor	1:2	3.0	2.59b	2.43bc	2.99b	2.67c	122.3	125.8a b	118.2c	122.1b
Atrazine + Metolachlor	1:2	4.0	3.02a	2.86a	3.27a	3.05a	138.0a	132.5a	150.3a	140.2a
Atrazine		4.0	2.52c	2.32c	2.54e	2.46d	84.4c	109.7c	96.8e	96.9c
Atrazine		5.0	2.67b	2.79a	2.71cd	2.72b	122.3b	124.2a	120.9b	122.4b
Hoe weeding at 3 and 6 WAS			2.72b	2.91a	2.80c	2.81b	140.7a	122.5b	148.9a	137.3a
Weedy check			2.22d	1.98e	1.84f	2.01e	46.1d	60.8d	74.1f	60.3d
SE±			0.06	0.05	0.04	0.05	5.53	2.71	2.39	5.31
Manure (Cow dung) T/ha										
0			2.17d	1.67d	2.15d	1.99d	45.1d	53.0d	47.8e	48.6e
4			2.39c	2.35c	2.41c	2.38c	58.4c	81.7c	74.1d	71.4d
8			2.67b	2.58b	2.89b	2.71b	120.2b	130.3b	132.2c	127.5c
12			2.90a	3.01a	3.02a	2.97a	174.4a	153.0a	170.9a	166.1a
NPK 120:26:50			2.98a	2.90a	2.97ab	2.95a	158.2a	154.9a	162.6b	158.5b
SE±			0.04	0.04	0.03	0.02	4.37	2.14	1.89	2.18
Interaction										
W x C			NS	NS	NS	NS	NS	**	NS	NS

Means followed by the same letter(s) within a column of each treatment group are not statistically different at 5% level of probability using Duncan's multiple range test (DMRT).
WAS – Weeks after sowing; NS - Not significant; W - Weed control, F - Fertilizer

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Table 3a: Interaction of weed control and cowdung manure on total dry matter yield of quality protein maize (QPM) at 12 WAS during 2007 wet season at Samaru , Zaria, Nigeria.

Treatments			Cow dung manure t/ha				NPK
Weed control	Ratio	Rate (Kg a.i/ha)	0	4	8	12	120:26:50
Atrazine + Acetochlor + Terbuthylazine	1:1:1	3.0	42.4g	84.3f	142.6c	140.8cd	151.2bc
Atrazine + Acetochlor + Terbuthylazine	1:1:1	4.0	55.4g	93.3e	155.3b	178.0a	163.5a
Atrazine + Metolachlor	1:2	3.0	61.0g	103.9e	123.5d	166.9a	173.6a
Atrazine + Metolachlor	1:2	4.0	66.1g	96.7e	154.7b	167.1a	177.8a
Atrazine		4.0	48.1g	55.4g	127.2d	163.5a	162.7a
Atrazine		5.0	63.3g	96.0e	135.7c	163.2a	163.2a
Hoe weeding at 3 and 6 WAS			57.3g	77.5f	135.8c	175.8a	172.2a
Weedy check			36.5h	46.5g	68.0f	69.3f	83.6f
SE±					6.07		

Means followed by the same letter(s) within a column of each treatment group are not statistically different at 5% level of probability using Duncan's multiple range test (DMRT).

Table 4: Effect of weed control and cowdung manure and recommended NPK fertilizer rate on crop growth rate and relative growth rate of quality protein maize (QPM) at Samaru, Zaria, Nigeria during 2006, 2007 and 2008 rainy seasons and the combined.

Treatments			Leaf Area Index 12WAS				Total Dry Matter (g) 12WAS			
Weed control	Ratio	Rate (Kg a.i/ha)	2006	2007	2008	combined	2006	2007	2008	combined
Atrazine + Acetochlor + Terbuthylazine	1:1:1	3.0	6.6c	7.4d	5.3e	6.4d	0.12ab	0.15c	0.17c	0.15b
Atrazine + Acetochlor + Terbuthylazine	1:1:1	4.0	8.5b	11.1a	7.9d	9.1b	0.14ab	0.17b	0.19b	0.17abc
Atrazine + Metolachlor	1:2	3.0	6.8c	9.2b	10.2	8.7b	0.20a	0.15c	0.21a	0.19a
Atrazine + Metolachlor	1:2	4.0	10.9a	11.0a	11.5	11.1a	0.12ab	0.20a	0.21a	0.18ab
Atrazine		4.0	7.2c	8.2c	7.3d	7.5c	0.11ab	0.14c	0.16c	0.14c
Atrazine		5.0	8.7b	9.6b	10.1	9.4b	0.19ab	0.20a	0.16c	0.18ab
Hoe weeding at 3 and 6 WAS			11.1a	11.6a	12.8	11.8a	0.13ab	0.19ab	0.16c	0.16abc
Weedy check			3.9d	4.3e	4.0f	4.0e	0.08b	0.10d	0.09d	0.09d
SE±			0.29	0.25	0.26	0.27	0.03	0.09	0.25	0.02
Manure (Cow dung) T/ha										
0			2.2d	2.6d	2.5d	2.4d	0.06b	0.09d	0.10e	0.09d
4			5.5c	4.4c	5.2c	5.0c	0.14ab	0.13c	0.13d	0.13c
8			8.2b	10.1b	8.4b	8.9b	0.13ab	0.19b	0.19c	0.17b
12			11.7a	14.1a	13.5	13.1a	0.17a	0.21a	0.22a	0.20a
NPK 120:26:50			12.2a	14.0a	13.6	13.2a	0.20a	0.18b	0.20b	0.19ab
SE±			0.23	0.28	0.2	0.19	0.02	0.12	0.15	0.01
Interaction										
W x C			*	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column of each treatment group are not statistically different at 5% level of probability using Duncan's multiple range test (DMRT).
WAS – Weeks after sowing; NS - Not significant; W - Weed control, F - Fertilizer

Table 4a: Interaction of weed control, cowdung manure and recommended NPK fertilizer rate on crop growth rate of quality protein maize (QPM) at 12WAS during 2006 wet season at Samaru , Zaria, Nigeria.

Treatments			Cow dung manure t/ha				NPK
Weed control	Ratio	Rate (Kg a.i/ha)	0	4	8	12	120:26:50
Atrazine + Acetochlor + Terbuthylazine	1:1:1	3.0	1.87i	5.37g	6.47f	10.19cd	9.16de
Atrazine + Acetochlor + Terbuthylazine	1:1:1	4.0	3.63h	7.33f	9.99d	11.70c	10.02d
Atrazine + Metolachlor	1:2	3.0	2.04i	5.71fg	6.22f	9.57d	10.18cd
Atrazine + Metolachlor	1:2	4.0	2.32i	7.15f	10.4d	16.32b	18.86ab
Atrazine		4.0	2.54hi	4.20g	8.25ef	10.77c	10.67cd
Atrazine		5.0	2.24i	6.52f	10.71cd	12.15c	12.26c
Hoe weeding at 3 and 6 WAS			2.25i	6.01f	9.42d	17.37	20.62a
Weedy check			1.45i	2.45i	4.27g	5.54g	6.12f
SE±					0.65		

Means followed by the same letter(s) within a column of each treatment group are not statistically different at 5% level of probability using Duncan's multiple range test (DMRT).

Table 5: Effect of weed control, cow dung manure and recommended NPK fertilizer on shoot lodging count and harvest index of quality protein maize (QPM) at Samaru, Zaria, Nigeria during 2006, 2007 and 2008 rainy seasons and the combined.

Treatments			Leaf Area Index 12WAS				Total Dry Matter (g) 12WAS			
Weed control	Ratio	Rate (Kg a.i/ha)	2006	2007	2008	combined	2006	2007	2008	combined
Atrazine + Acetochlor + Terbuthylazine	1:1:1	3.0	6.6c	7.6c	3.5c	5.9d	0.37a	0.33ab	0.40ab	0.29b
Atrazine + Acetochlor + Terbuthylazine	1:1:1	4.0	12.3 a	10.0a	4.7b	9.0a	0.40a	0.32ab	0.41ab	0.37ab
Atrazine + Metolachlor	1:2	3.0	10.2	4.8d	4.5b	6.5cd	0.39a	0.31ab	0.43a	0.37ab
Atrazine + Metolachlor	1:2	4.0	11.9	6.5c	6.0a	8.1b	0.42a	0.36a	0.44a	0.41a
Atrazine		4.0	7.2c	8.8b	4.1b	6.7c	0.37a	0.26b	0.32c	0.31c
Atrazine		5.0	7.3c	5.9c	5.0ab	6.0d	0.41a	0.32ab	0.36b	0.35ab
Hoe weeding at 3 and 6 WAS			1.5d	1.6f	1.0d	1.4e	0.40a	0.20ab	0.42a	0.34ab
Weedy check			2.0d	2.2e	1.6d	1.9e	0.30b	0.18c	0.15e	0.21d
SE±			0.36	0.29	0.44	0.36	0.01	0.01	0.01	0.01
Manure (Cow dung) T/ha										
0			6.0c	3.0e	1.7c	3.5d	0.26d	0.20c	0.21d	0.22c
4			6.9b	4.5d	2.2b	4.5c	0.30c	0.17c	0.26c	0.24c
8			7.0b	6.3c	2.6b	5.3b	0.43b	0.27b	0.37b	0.36b
12			8.7a	8.4a	6.7a	7.6a	0.47a	0.37a	0.45a	0.43a
NPK 120:26:50			8.3a	7.4b	6.8a	7.5a	0.45a	0.38a	0.45a	0.43a
SE±			0.28	0.23	0.35	0.28	0.01	0.01	0.01	0.01
Interaction										
W x C			NS	NS	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) within a column of each treatment group are not statistically different at 5% level of probability using Duncan's multiple range test (DMRT).
WAS – Weeks after sowing; NS - Not significant; W - Weed control, F - Fertilizer

DISCUSSION

The growth indices of QPM such as leaf area index, total dry mater, crop growth rate and relative growth rate were significantly affected by the weed control treatments. The application of Atrazine + Metolachlor at 4.0 kg a.i/ha throughout the seasons, the two hoe weeding in 2006, 2008 and the mean data resulted in significantly higher total dry matter of QPM, while the weedy check produced the least total dry matter of QPM. The higher dry matter recorded by these treatments could be attributed to less weed competition resulting in better use of available growth factors for maximum photosynthetic activities. This is in line with the findings of Adekpe (2004) who reported higher total dry matter of garlic with two hoe weeded control and 2.0 kg a.i/ha of Oxadiazon. Leaf area index of QPM was also significantly increased by the application of Atrazine + Metolachlor at 4.0kg a.i/ha throughout the season, Atrazine at 5.0kg a.i/ha and the two hoe weedings in 2006 season. Crops are known to attain better canopy with higher number of leaves per plant in a less weed competitive situation than in a weedy environment. Atrazine + Metolachlor is a mixture of two different herbicides, Atrazine is a broad leaf weed killer while Metolachlor is a grass killer, this will indefinitely increase the spectrum and efficacy of weed control. Throughout the seasons the herbicide treatments and the two hoe weeding resulted in higher crop growth rate and relative growth rate of QPM than the weedy check. This could be due to good weed control which allowed crops to develop more and larger leaves and consequently higher light interception for increased dry matter accumulation per plant per unit area of land. This finding agrees with earlier observation by Ishaya, (2004) who reported lower CGR and RGR by crops in the weedy check and lower rates of Oxadiazon.

In the present study it was observed that the application of cow dung manure at higher rates of 8 and 12t/ha significantly increased , growth indices such as total dry matter, leaf area index, crop growth rate, relative growth rates, shoot lodging count and harvest index of QPM. The increase of these parameters by the application of cow dung manure particularly at higher rates could be attributed to increase in mineralized nutrients which improved availability of macro and micro nutrients in the soil that were necessary for growth and development in crops (Anonymous, 2007a). Apart from increasing soil fertility manure serves as a soil amendment by adding organic matter into the soil. Cow dung manure has also been reported to greatly improve water holding capacity, soil aeration, soil structure, nutrient retention and microbial activity (Anonymous, 2007b).

CONCLUSION

Based on the result of this study it can be concluded the application of Atrazine + Metolachlor at 4.0 kg a.i/ha and cow dung manure at 12t/ha adequately controlled weeds and provided nutrients which increased growth and development of Quality Protein Maize.

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