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Evaluation of farm yard manure and some selected pre-emergence herbicides on the growth and yield of cotton in Samaru- Zaria, Nigeria

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Abstract

Field experiments were conducted in 2010 and 2011 cropping seasons to evaluate the effect of farm yard manure levels (0, 10, 20, and 30) tonnes per hectare and some selected pre-emergence herbicides (*Alachlor, Metalachlor, Diuron and Oxadiazon*) @ 1 kilogramme active ingredient per hectare on the growth and yield of cotton in Samaru, Zaria. Results obtained showed that an increase in farm yard manure level led to an increase in mean values of treatments for characters assessed. The control treatment of 0 tonnes of farm yard manure per hectare at P = 0.05 significantly produced lower mean values for characters measured, while 30 tonnes per hectare of farm yard manure at P = 0.05 significantly produced higher mean values for characters observed. *Alachlor* at P = 0.05 significantly produced lower mean values on characters assessed, while *Oxadiazon* at P = 0.05 significantly produced higher mean values on characters assessed as well.

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Introduction

Cotton (*Gossypium* spp L.) belongs to the family *Malvaceae* and the genus Gossypium. It is a perennial shrub, but under cultivation is considered to be an annual (Idem, 1999). The plant has an erect stem, varying between 60-200 cm in height depending on the species and environmental conditions it is grown (Idem, 1999). The main stem carries two types of branches vegetative (monopodia) and reproductive (sympodia) (Idem, 1999). It has tapped rooting system from which the lateral roots branch is attached (Idem, 1999). In deep well-drained soil the tap roots are about a metre long (Idem, 1999). Cotton is a warm season crop, which grows well in areas with moderate annual rain fall of about 650 mm to 1250mm (Agbede, 2009). It does well on rich, well drained, deep loams, plenty of sunshine and relatively high temperatures (Prentice, 1992). The earliest leaves of the plant are heart shaped, later leaves exhibit different characteristics by producing palmate veins which are alternate and lobed (Agbede, 2009). The lobes vary from three to five depending on the species (Dadari, 2003). The characteristics of the plant leaves are the black spots on nearly all parts of the leaves and its general hairiness (Agbede, 2009). The buds are usually surrounded by three large follower-leaves (Agbede, 2009). The flowers are regular having five small united sepals and five large petals (Agbede, 2009). On the day of opening, they are of a pale cream colour; this changes to pink or red on the second day. On the third to fourth day, the corolla drops off (Ali *et al.*, 2005). The fruit contains seeds and together with the fibres are referred to as boll. The boll is spherical in shape and varies in size with the variety (Jaibir *et al.,* 2004; Ali *et al.*, 2005). The surface of the boll is marked with furrows along which the boll splits open on maturity to expose the three to five rows of seeds, each containing between six to nine seeds. The seeds are usually about 9 mm long, oval and printed at the hilum end (Khan *et al.*, 2000; Hiremath and Rao, 2001). The seeds bearing the fibres are called seed cotton. The value of the fibre is determined by its length, strength, maturity, fineness, uniformity and gloss (Khan *et al.*, 2000; Hiremath and Rao, 2001). The longest fibres are observed to be the finest and are used in the manufacture of valuable cotton fabrics (Khan *et al.*, 2000; Hiremath and Rao, 2001). It is one of the major cash crops grown in different regions of the world. Production of the crop around the world is restricted to upland cotton such as *G.hirsutum, G.barbadense, G.arboreum and G.herbaceum*. The crop is usually grown mainly for its lint fibres which are used in textile industry, although other by-products such as cotton seed oil and seed cake are often extracted from the seed for a number of purposes which include serving as raw material in the textile industry, paper, rayon, chemical industry, explosives fertilizers, oil, hulls, press cakes and press meal (Ngouajio *et al.,* 1997; Bukun, 2004). Cotton is believed to have been originated from Tropical and subtropical regions of the world (Ngouajio *et al.,* 1997; Bukun, 2004). The recognition of cotton as a crop dates back to early history when man used leaves as clothes. Thus, before the advent of European-Asian trade links, small rudimentary gins were already in existence by the Ancient Hindus of India (Ngouajio *et al.,* 1997; Bukun, 2004). Cotton textiles were found in archaeological excavations in the Indus valley and North central Peru, are both dated back about 3,000 BC (Panswar *et al.*, 2001; Siver *et al.*, 2003). The useful genus of cotton Gossypium however has spread to several favourable Agro-climatic regions of the world due to its importance as an economic crop (Ali *et al.*, 2005). There has been a significant change in the world on cotton production (Ngouajio *et al.,* 1997; Bukun, 2004). The number of Countries growing cotton and the volume of production are on the increase particularly in developing Countries of Latin America (Ali *et al.*, 2005). It is evident that cotton production in Africa is still too low. The production figure of USA tripled that of Africa (Ali *et al.*, 2005). Also Egypt which is Africa's largest producer occupies as far as eighteen positions on the world production scale (Ali *et al.*, 2005). In Nigeria yields of cotton are still low ranging between 168 to 392 kg per hectare (Baba, 1981; Mathew and Screenivasan, 1998). The primary reasons of Nigeria's low production yield is low nutrition and non- adoption of the use of chemical weed control with herbicides. Other factors

for low yield include; non adoption of improved varieties of cotton, late planting, poor pest and disease control measures etc (Baba, 1981; Mathew and Screenivasan, 1998). In view of the above constraints the research was designed to address the issues of selecting the most suitable farm yard manure level in combination with suitable herbicides that would improve the growth and yield of cotton in Samaru, Zaria.

Materials and methods

Two field experiments were conducted in 2010 and 2011 cropping seasons at the Teaching and Research Farm of the Institute for Agricultural Research, Ahmadu Bello University Zaria located on latitude11°11'N, longitude7°38'E and 686m above sea level in the Northern Guinea Savannah Ecological zone of Nigeria. The trial site was ploughed and harrowed with a tractor. Thereafter, it was pulverised with a hand hoe to make the soil level smooth and suitable for easy germination and establishment of the crop. Soil samples were randomly collected from the field at a soil depth of 0-15cm for chemical analysis before the cropping seasons of 2010 and 2011. The treatments consist of four levels of farm yard manure (0, 10, 20 and 30 tonnes per hectare) and four herbicide types (Alachlor, Metolachlor, Diuron and Oxadiazon) @ 1 kilogramme active ingredient per hectare, replicated three times. Farm yard manure treatment was applied as main plot treatments two weeks before planting to allow proper decomposition for ease of nutrients release and utilization by the crop, while herbicide types were assigned as sub plot treatments and were applied immediately after planting the crop @1000 g active ingredient per hectare for each herbicide. Gross plot size was 3m x 2m and Net plot size was 3m x 1.5m. The crop was sprayed against pest attack especially cotton stainer (*Dysdercus* spp.), cotton boll worm (*Diperopsis* spp.) and cotton leaf roller (*Sylepta derogata*) with karate EC at the rate of 2.0 Litres per hectare. Growth parameters observed at 3WAP, 6WAP, 9WAP and 12WAP which were summed and averaged to give plant height (cm), number of leaves per plant, number of branches per plant and yield parameters observed at 9WAP and 12WAP which were summed and averaged to give number of bolls per plant, boll yield per plot (kg) and boll yield ha^{-1} . Data collected was subjected to statistical analysis of variance using Gen stat. Treatment means were compared using Duncan's' multiple range test (DMRT) according to Gomez and Gomez (1984).

Results

Table 3 shows that there was a significant difference at P = 0.05 among the treatment means on plant height due to farm yard manure and pre –emergence herbicides applied in 2010 and 2011 cropping seasons. The control treatment of no farm yard manure at P = 0.05 significantly produced 35.14 cm and 34.98 cm, respectively on plant height in 2010 and 2011 cropping seasons, while 30 tonnes per hectare of farm yard manure at P = 0.05 significantly produced 80.48 cm and 80.18 cm on plant height in 2010 and 2011 cropping seasons. However, there was no significant difference at P = 0.05 due to farm yard manure applied on number of leaves per plant. The control treatments of 0 tonnes ha^{-1} of farm yard manure produced lower mean values but were not significantly different on leaf number per plant, while treatment 30 tonnes ha^{-1} of farm yard manure ha^{-1} produced higher mean values in both cropping seasons but were not significantly different on number of leaves per plant. Significant variations at P = 0.05 were equally observed among treatment means due to pre-emergence herbicides on number of leaves per plant in 2010 and 2011cropping seasons. Alachlor at P = 0.05 significantly produced lower mean values of 13.56 and 15.26 leaves per plant in 2010 and 2011 cropping seasons, while Oxadiazon at P = 0.05 significantly produced higher mean values of 16.30 and 15.26 leaves per plant in 2010 and 2011 cropping seasons. There was no significant difference observed at P = 0.05 among treatment means due to farm yard manure and pre-emergence herbicides applied on number of branches per plant and days to 90% flowering in 2010 and 2011 cropping seasons. Significant variations at P = 0.05 were observed on number of bolls per plant, boll yield per plot and boll yield per hectare due to farm yard manure applied.

Table 1. Physical and chemical properties of soil and Farm yard manure used for the study.

Property	Soil ($cmolkg^{-1}$) 2010	Soil ($cmolkg^{-1}$) 2011	Farm yard manure ($mgkg^{-1}$) 2010	Farm yard manure ($mgkg^{-1}$) 2011
PH (H_2O)	4.68	3.72	1.95	1.93
OC (%)	0.81	0.93	19.51	20.05
Total N $mgkg^{-1}$	0.20	0.10	3.10	3.17
P $mgkg^{-1}$	2.40	2.90	7.86	6.96
Exch K $cmolkg^{-1}$	1.72	1.65	5.74	4.84
Exch Ca $cmolkg^{-1}$	0.51	0.46	8.45	7.65
Exch Na $cmolkg^{-1}$	0.62	0.54	0.62	0.58
Exch Mg $cmolkg^{-1}$	1.40	1.38	2.60	2.45
Cu $mgkg^{-1}$	5.97	4.89	26.98	25.78
Mn $mgkg^{-1}$	8.98	6.87	7.85	6.95
Fe $mgkg^{-1}$	9.20	7.90	10.92	09.62
Zn $mgkg^{-1}$	5.43	4.73	18.00	16.61
Silt $mgkg^{-1}$	11.96	09.46	NA	NA
Clay $mgkg^{-1}$	5.86	6.92	NA	NA
Sand $mgkg^{-1}$	81.51	88.15	NA	NA
ECEC $mgkg^{-1}$	9.20	8.16	NA	NA

Source: Soil Science Department, ABU, Zaria 2010 and 2011 cropping seasons

Table 2. Some weeds identified at the trial site in 2010 and 2011 cropping seasons.

Weeds type identified on the trial site
Ageratum conyzoides
Amaranthus spinosus
Chenopodium album
Cynodon dactylon
Cyperus esculentus
Cyperus rotundus
Digitaria Scalarum
Echinochloa colonum
Eleusine indica
Imperata cylindrica
Solanum incanum

Source: Field survey 2010 and 2011 cropping seasons

The control treatment of no farm yard manure at P = 0.05 significantly produced lower mean values of 04.18 and 05.78 as number of bolls per plant, 1.22 and 1.20 as boll yield per plot, 1.27 and 1.23 as boll yield per hectare in 2010 and 2011 cropping seasons, respectively. On the other hand, farm yard manure of 30 tonnes per hectare at P = 0.05 significantly produced higher mean values of 10.36 and 11.27 as number of bolls per plant, 3.75 and 3.67 as boll yield per plant, 3.50 and 3.52 as boll yield per hectare in 2010 and 2011 cropping seasons. However, no significant difference at P = 0.05 was observed on number of bolls per plant, boll yield per plot and boll yield per hectare due to pre-emergence herbicides applied in both 2010 and 2011 cropping seasons. Significant interactions at P = 0.05 were observed between farm yard manure and pre-emergence herbicides applied on plant height, number of leaves per plant, number of bolls per plant, boll yield per plot and boll yield per hectare in2010 and 2011 cropping seasons. However, there were no significant interactions at P = 0.05 between farm yard manure and pre-emergence herbicides on number of branches per plant and days to 90% flowering in 2011 and 2012

cropping seasons. An increase in treatment from 0 tonnes ha^{-1} of farm yard manure to 30 tonnes ha^{-1} of farm yard manure significantly increased mean values of treatments. A change on the pre-emergence herbicide applied, at P = 0.05 significantly increased the mean values of treatments on characters assessed from Alachlor to Oxadiazon. Alachlor at P = 0.05 significantly produced lower mean values of characters, while Oxadiazon at P = 0.05 significantly produced higher mean values on characters assessed in 2010 and 2011 cropping seasons, respectively.

Table 3. Evaluation of farm yard manure and some selected pre-emergence herbicides on the growth and yield of cotton in Samaru, Zaria in 2010 and 2011 cropping seasons

Treatments Treatments	Plant height (cm)	Number of leaves per plant	Number of branches per plant 2010	Days to 90% flowering	Number of bolls per plant	Boll yield per plot (kg)	Boll yield per ha^{-1} in tonnes
Farm yard manure in tonnes ha^{-1}							
	35.14d	12.34a	5.16a	53.94a	04.18d	1.22c	1.27b
0	34.98d	12.18a	5.27a	52.85a	05.78d	1.20c	1.23b
10	57.55c	15.15a	6.14a	57.30a	06.61c	2.23a	3.34a
20	56.43c	16.30a	6.18a	56.61a	07.43c	2.21a	3.28a
30	70.28b	18.13a	7.26a	59.42a	08.74b	2.44a	3.42a
Pre-emergence herbicides @ 1000 g active ingredient ha^{-1}							
Alachlor	34.25d	13.56c	4.21a	57.11a	05.45a	1.31a	3.11a
Metalachlor	33.84d	12.47c	5.18a	58.15a	05.50a	1.18a	3.10a
Diuron	53.84c	14.17b	5.23a	58.12a	05.44a	1.45a	3.47a
Oxadiazon	55.78c	13.47b	6.10a	59.18a	04.88a	1.66a	3.43a
	78.20b	15.18b	4.65a	59.24a	07.36a	1.66a	3.24a
	77.36b	14.24b	5.70a	60.21a	05.64a	1.52a	3.25a
	84.15a	16.30a	6.46a	60.26a	10.11a	1.57a	4.26a
	79.44a	15.26a	6.30a	61.24a	09.42a	1.64a	4.25a
Interactions							
FYM x PRE-EM	*	*	NS	N NS	N *	*	*

Means with the same letter (s) within a column are not significantly different at P = 0.05 Duncan's' Multiple Range Test (DMRT).

NS = Not significant at 5% level of significance

* = Significant at 5% level of significance

FYM = Farm yard manure

PRE-EM = Pre-emergence herbicides

Discussion

The observations made on the results of this experiment in Table 3 indicated that the control treatment of 0 tonnes of farmyard manure ha^{-1} could not provide plants under it with adequate nutrition which made them to perform below expectations in producing lower mean values on all characters assessed. This means that the photosynthetic performance of plants under this treatment was very low thereby making them to produce low photos assimilate and lower partitioning ability in both cropping seasons of 2010 and 2011. On the other hand, 30 tonnes ha^{-1} of farmyard manure was able to supply adequate nutrients for plants under it enabling them to photosynthesise very well and partition enough photos assimilate for higher production of

mean values on all characters assessed in 2010 and 2011 cropping seasons. These observations are in line with works of (Hiremath and Rao, 2001; Duggan *et al.*, 2004; Idem, 1999; Ngouajio *et al.,* 1997; Ali *et al.*, 2005; Agbede, 2009). The variations on the types of herbicide applied showed that Oxadiazon controlled more weeds than the rest of herbicides used, while Alachlor controlled lesser weeds than the rest of herbicides applied in both seasons. These observations are similar to those of (Bukun, 2004; Idem, 1999; Ngouajio *et al.,* 1997; Ali *et al.*, 2005; Agbede, 2009). They earlier reported that the control ability of weeds by different herbicides is not the same as some are more effective in controlling weeds than others.

Conclusion

Field experiments were conducted in 2010 and 2011 cropping seasons to 'evaluate the effect of farm yard manure (0, 10, 20 and 30) tonnes per hectare and some selected pre-emergence herbicides (*Alachlor, Metalachlor, Diuron and Oxadiazon*) at 1 kilogramme active ingredient per hectare on the growth and yield of cotton in Samaru, Zaria'. Results obtained in Table 3 showed that an increase in farm yard manure level led to an increase in mean values of treatments for characters assessed. The control treatment of 0 tonnes of farm yard manure per hectare at P = 0.05 significantly produced lower mean values of treatments for characters measured, while 30 tonnes per hectare of farm yard manure at P = 0.05 significantly produced higher mean values of treatments for characters observed. Similarly, a change on the type of herbicide used from *Alachlor* to *Oxadiazon* led to an increase in the mean values of plant height, number of branches per plant, number of bolls per plant, boll yield per plot and boll yield per hectare. *Alachlor* at P = 0.05 significantly produced lower mean values of treatments on plant height and number of leaves per plant, while *Oxadiazon* produced higher mean values for characters assessed but were not significantly different from mean values produced by other herbicides. Significant interactions were observed between farm yard manure and pre-emergence herbicides at P = 0.05 on plant height, number of leaves per plant, number of bolls per plant, boll yield per plot and boll yield per hectare. However, there were no significant interactions between farm yard manure and pre-emergence herbicides at P = 0.05 on number of branches per plant and days to 90% flowering.

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