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Research Article
Phytotoxicity of Primextra Gold Herbicides on Groundnut (*Arachis hypogeal*) and Okra (*Abelmoschus esculentus* L).

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Abstract

Background and Objective: Primextra gold has been effective in controlling weeds of some arable crops and this experiment was carried out to evaluate the Phytotoxicity of Primextra Gold herbicide in controlling weeds of *Arachis hypogeal* L. and *Abelmoschus esculentus* L. conducted in pots. **Materials and Methods:** The experiment was laid out in a completely randomized design with four replicates and weed control treatments-0.0, 0.5, 1.0, 1.5 and 2.0 kg a.i/pot were applied after planting but before seedling emergence. Parameters such as Weed Control Efficiency (WCE %), plant height, number of leaves, shoot dry weight and crop phytotoxicity were used to determine the herbicide efficacy. **Results:** Results show that the effects of the treatments were mostly significant ($p = 0.05$) for all parameters measured. The control showed the highest values in all the measured parameters. Treatments were phytotoxic to the crops and were proportional to the concentration of the treatment. The phytotoxicity of the herbicide to the crops was highly recorded in okra and there was no injury on groundnut plant. The number of leaves in the treated pots were significantly ($p = 0.05$) lower than in the untreated (control) pots in all crops tested. The decrease in the number of leaves was also observed to be herbicides concentration dependent. Dry shoot weight in control (untreated) pots showed highest weight than the treated pots making primextra gold to be an effective herbicide in controlling weeds associated with groundnut and okra. **Conclusion:** The control of weeds by primextra gold was more effective in groundnut than in okra. Further studies can be carried out in the filed as this were potted experiment.

Key words: Weeds, pre-emergent herbicides, primextra gold, groundnut, okra, phytotoxicity treated, control, pot

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Okra *Abelmoschus esculentus* (L.), is a member of the family Malvaceae widely cultivated mostly by peasant farmers in Nigeria as a fruit vegetable also grown in tropical and sub-tropical part of the world. It is found in almost every market in Nigeria. Okra is cultivated for its fibrous fruits or pods containing round, white seeds. The fruits are harvested when mature and eaten as a vegetable. The roots and stems of okra are used for cleaning the cane juice from which brown sugar is prepared. Groundnut (*Arachis hypogea* L.), a member of the legume family, is an important food and oil crop. It is the third major oil seed of the world after soybean and cotton[1]. These arable crops are cultivated and consumed all over the world, but these crops are easily affected by weeds which affect their growth, development and crop yields[2]. It is grown mainly for human consumption, has several uses as whole seeds or processed to make peanut butter, oil and other products. The seed contains 25-30% protein (average of 25% digestible protein) and 42-52% oil. These arable crops are cultivated and consumed all over the world. They provide important source of vitamins, calcium, potassium and other mineral matters which are often lacking in the diet of developing countries but these crops are widely affected by weeds[3]. Weeds reduce crop yields by competing with crops for light, water, nutrients and space. Weeds constitute a major limiting factor to cowpea production[4]. Weed problems are more severe in African tropical regions than in Europe and north America because weeds grow more vigorously and regenerate more quickly because of the heat and higher light intensity[5]. Numerous studies have documented the negative effects on yield of season-long weed competition in Africa[6]. In Nigeria, yield losses due to weed interference vary between 40 and 100% depending among other things on type of crops, type of weeds and weed density[7]. For instance, competition from spear grass can cause crop yield losses of over 50% in maize and soybean and over 90% in cassava. However, the introduction of chemical weed control is necessary to replace traditional weed control because chemical weed control has merit and has more economical values. Herbicides provide a convenient, economical and effective way to help manage weeds. Herbicides influence weeds physiological procedures. Herbicides are the key to sustainable crop production throughout the world and will remain the main stay for weed control for the foreseeable future[8]. Primextra Gold herbicide contains two active constituents, 290 g L^{-1} S-Metolachlor and 370 g L^{-1} Atrazine. It is used to control annual grasses and broad leaf weeds in maize, sugar cane, sweet corn and oxabetrinil (Concepsafener) treated sorghum. Primextra Gold have been effective in the of control weeds in cucumber[9] and melon[10]. This study examines the Phytotoxicity of Primextra Gold herbicide in controlling weeds of *Arachis hypogea* (L.) and *Abelmoschus esculentus* (L). The reason for the study is to determine the efficacy of the herbicide on the weeds associated with groundnut and Okra plants. This herbicide has been tested on cucumber[9] on melon[10] and on Maize[2].

MATERIALS AND METHODS

The field experiment was conducted at the Centre for Ecological Studies of the University of Port Harcourt, Nigeria. It is on geographical coordinates: latitude 4°52`N and 4°55'N longitudes 6°54`E and 6°56`E in Obio/Akpor Local Government Area (LGA) Rivers state. It is situated in the Niger Delta wetland of southern Nigeria. The climatic weather condition of the area is characterized by tropical monsoon climate with mean annual temperature of 25-28°C and annual rainfall over 3000 mm. The relative humidity is very high with an annual mean of 85% while, the soil is usually sandy or sandy loam underlain by a layer of impervious pan.

Sources of materials: Primextra gold herbicide was obtained from the ADP (Agricultural Development Programme) Port Harcourt, River state. The Primextra gold herbicide contains two active constituents, 290 g L^{-1} S-Metolachlor and 370 g L^{-1} Atrazine. While Okra (Var 45-days) and Groundnut (Kano-5), were obtained from the Centre of Ecological Research. The soil used was obtained from the back of the Centre of Ecological Research, University of Port Harcourt, Nigeria. The plastic buckets used of surface area of 0.026 m^2 and height 10 cm were bought from Mile III market, Port Harcourt.

Experimental design: The analysis was laid out in a Completely Randomized Design with 5 treatments and each treatment replicated 4 times. The analysis on seed sowing, herbicides application weed emergence, weed identification and weed counting, injury scoring/rating were all carried at the greenhouse of the University of Port Harcourt.

Treatment application: Primextra gold was applied as the weed control treatment at the pre-emergence stage of the crop at the following concentration shown in Table 1.

Viability test: Seed viability test for all the crops was done using the germination techniques in different Petri-dishes. This was done by placing the seeds of the test plants on filter paper saturated with distilled water and covered in a

Table 1: Primextra gold treatments applied

Treatments	Primextra gold concentration (kg a.i pot^{-1})	Primextra gold concentration (kg ai ha^{-1})
T1	Control-0.0	0.00
T2	0.5	0.758
T3	1.0	1.515
T4	1.5	2.272
T5	2.0	3.029

Petri dish. About 5 seeds of each test plant were placed in each Petri dish. The number of seeds that germinated from each Petri dish was summed up after 4 days. The germination percentage in each treatment was calculated using the equation:

$$\text{Viabilty } (\%) = \frac{\text{Number of seedling that germinated per pot}}{\text{Number of seeds planted per pot}} \times 100$$

A mean value of 75% seed germination for all the plant seed tested was recorded, thus indicating that the seeds of the plants were viable. The same seeds were subsequently used for the entire experiment.

Seeding: The planting pots were filled with 10 kg of loamy soil and levelled, letting out 1 cm at the top of the pot for easy watering and application of treatment. About 5 seeds of the crops (maize and groundnut) each were planted separately on each of the container. About 20 pots were used per crop making a total of 40 pots.

Herbicide application: The pre-emergence herbicide (Primextra Gold) was applied a day after planting. This was applied with CO_2 pressurized backpack sprayer. The application was done at the pre-emergence stage (post planting) of the crops. The weed properties and crop growth parameters were monitored and assessed at every 7 days' intervals. That is, at 7, 14 and 21 DAT (day after planting). Watering was done on the experimental pot when the need arose.

Test crops assessment parameters: The following growth parameters such as height measurement, number of leaves, plant shoot dry weights; weed control efficiency and crop phytotoxicity were used as quantitative measure representative of plant vigour.

Plant height (cm): The plant height was measured with a metre rule from the base of the plant (at soil surface) to the tip of the main shoot of the plants. The mean of plant height was determined and expressed in centimetres per pot. It was taken at 7, 14 and 21 DAT.

Table 2: System of phytotoxicity rating

Rating	Description of main categories	Detailed description
0	No effect	No crop reduction or injury
10		Slight crop discoloration or stunting
20	Slight effect	Some crop discoloration, stunting, or stunt loss
30		Crop injury more pronounced, but not lasting
40		Moderate injury, crop usually recovers
50	Moderate effect	Crop injury more lasting, recovery doubtful
60		Lasting crop injury, no recovery
70		Heavy crop injury and stand loss
80	Severe effect	Crop nearly destroyed. A few surviving plants
90		Only occasional live crop plants left
100	Complete effect	Complete crop destruction

Sources[5]

Number of leaves per plant: The leave number was taken at 7, 14 and 21 DAT. The mean number of leaves per pot was calculated.

Shoot dry matter accumulation (g): The two crop samples were harvested at 21 DAT. Their shoots were cut at the soil surface and the collected samples were oven-dried at 70°C for one week to a constant weight. The shoot dry weight was taken using a weighing balance.

Weed control efficiency (WCE %) of primextra gold herbicides: It expresses the capacity of the herbicide to control weeds by reduction or elimination. The result for weed control efficiency (WCF %) was taken at 14 and 21 Days-After-Treatment (DAT).

Crop phytotoxicity: Visual ratings of crop toxicity were taken at 14 and 21 Days-After-Treatment (DAT) as shown in Table 2.

Statistical analysis: The data collected was subjected to analysis of variance (ANOVA). Means were separated using least significant differences (LSD) at $p = 0.05$. The results were presented in bar graphs.

RESULTS AND DISCUSSION

Test crops assessment parameters

Plant height measurement (cm²): The results of height of the tested crops at 7, 14 and 21 DAT are presented in Fig. 1a. All the crops showed progressive increase in height with time. In okra, there was a slow growth in height with increase concentration of the herbicides treatment from 1.0-2.0 kg a.i/pot especially at 7-14 DAT. But it showed increased at 21 DAT.

In groundnut plant at 7 DAT the height was significantly affected in all the treatment from 0.5-2.0 kg a.i/pot this was

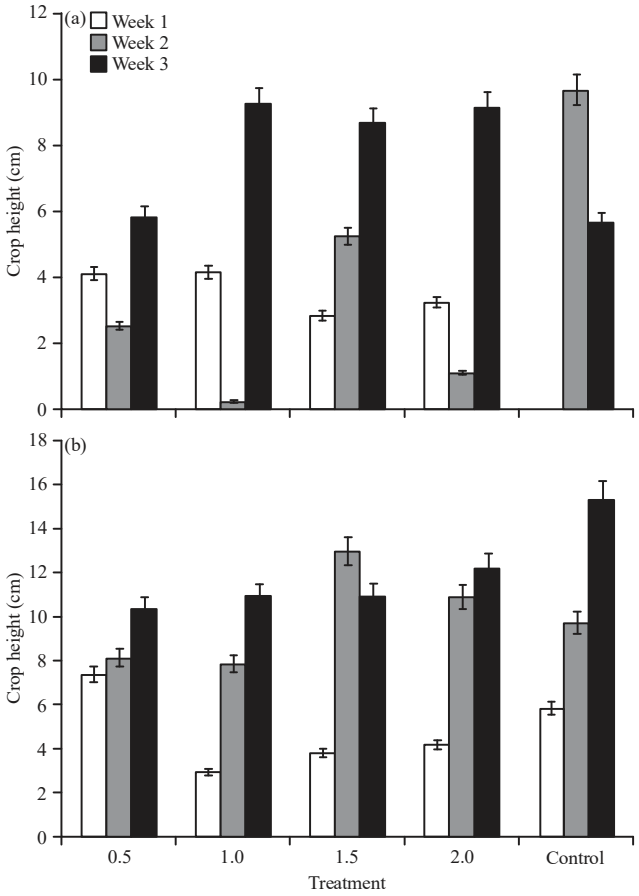

Fig. 1(a-b): Effects of primextra gold herbicides on the height measurement (a) Okra plant and (b) Groundnut

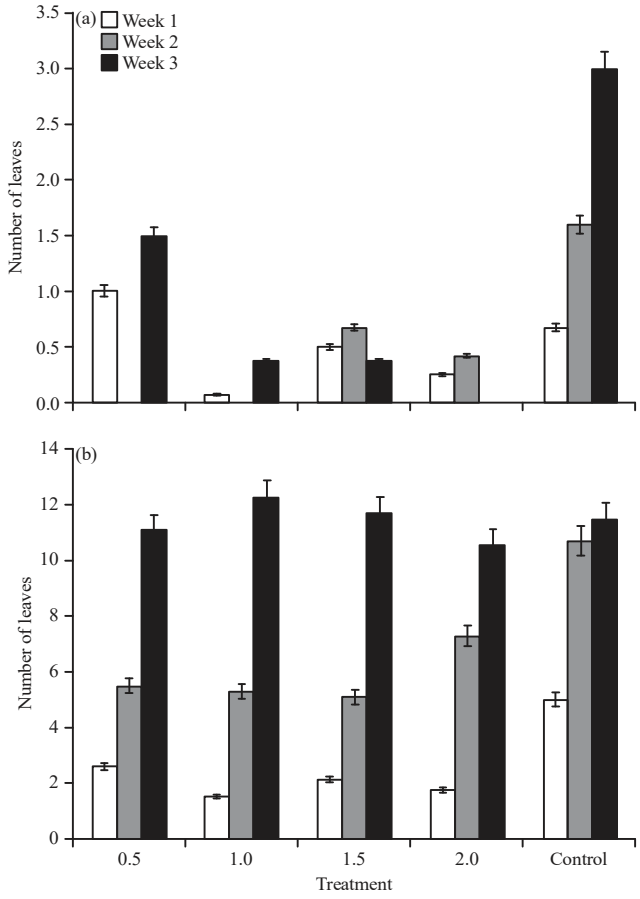

Fig. 2(a-b): Effect of primextra gold herbicides treatment on number of leaves on (a) Okra and (b) Groundnut at different stages plant growth

not the case at 14-21 DAT because the plant showed increased in the height. The height of the groundnut plant which served as control was found to be significantly ($p = 0.05$) higher than the treated pot (Fig. 1b).

Number of leaves in the tested crop: Figure 2a showed the leaf number in groundnut and okra plants, respectively at the different concentration treatment of Prim extra gold herbicides. The number of leaves in the treated pots were significantly ($p = 0.05$) lower than in the untreated (control) pots of groundnut and Okra plants. The decrease in the leaf number was also observed to be herbicides concentration dependent and day after treatment (DAT). While the leaves of the groundnut were adversely affected at 7 DAT that of Okta was at 14-21 DAT (Fig. 2a).

Shoot dry weight of the treated crops: There was a significant difference in the shoot dry weight between the treated pot and the untreated pots.

Okra shoot was adversely affected from the herbicides concentration of 0.5-2.0 kg a.i/pot. Pot treated with 0.5 kg a.i/pot showed 1 kg and it's seen as the lowest. While the pot treated with 1.0-2.0 kg a.i/pot show the same weight of 2 kg.

In groundnut where there was no significant difference between the different herbicides treatment in terms of shoot dry weight. The highest was recorded in the control pot. And the pot treated with 1.5 and 2.0 kg a.i/pot showed the same weight of 4 kg and it's seen as highest weight. While the least weight was recorded for pot treated with 0.5 kg a.i/pot as shown in Fig. 3.

Weed control efficiency (WCE %) of primextra gold: It expresses the capacity of the herbicide to control weeds by reduction or elimination. The result for weed control efficiency is presented in Fig. 4.

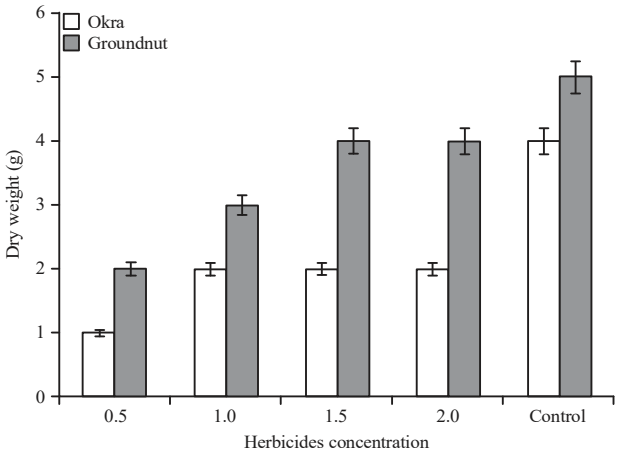

Fig. 3: Effect of primextra gold herbicides treatment on the dry shoot of Okra and groundnut plants

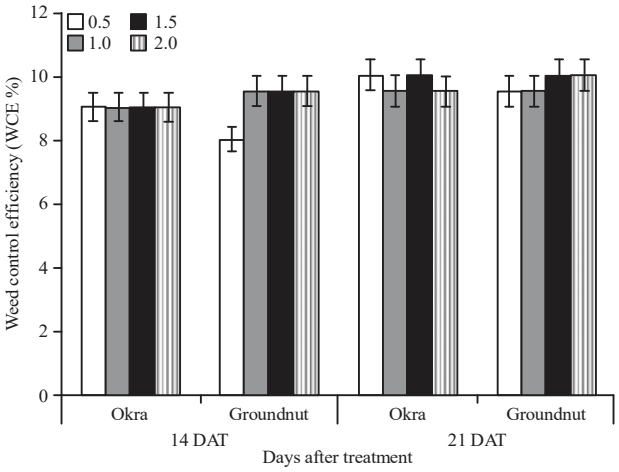

Fig. 4: Weed control efficiency of groundnut and Okra plants at 14 and 21 days after treatment (DAT)

In okra at 14 DAT, treatment 0.5-1.5 kg a.i/pot showed 90% at 14 DAT. WCF (%) increased to 95-100% from treatment 5.0 kg a.i/pot to treatment 2.0 kg a.i/pot at 21 DAT.

In groundnut treatment 0.5 and 1.00 kg a.i/pot showed 80-90% of WCF (%), while 1.5-2.0 kg a.i/pot showed 95-100% at 14 and 21 DAT.

Crop phytotoxicity: Visual evaluation of crop toxicity was taken 14 and 21 DA) to know the degree of harmfulness or toxicity caused by the herbicide treatments on the tested crops using a scale of 0-100.

There was no phytotoxicity observed in groundnut plant. In okra crop, the highest phytotoxicity level was observed at 1.5 kg a.i/pot at 21 DAT, while the least was recorded at 0.5 kg a.i/pot (Fig. 5a).

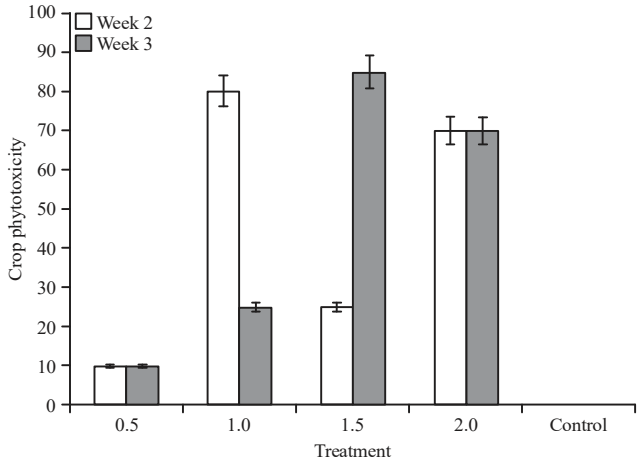

Fig. 5: Phytotoxicity of primextra gold herbicides on Okra crop

DISCUSSION

Results showed that herbicides were more harmful to okra than groundnut. The effectiveness of prim extra gold herbicide were seen in the number of leaves, plant height, dry shoot and weed control efficiency.

Studies have shown that Malvaceae and cucurbits might be harmed by herbicides to an alternate degree and the weakness to the herbicide may change contingent upon the species[2,5,9-13].

Over 90% damage was recorded in the Okra plants except in treatment1.0 and 2.0 kg a.i/pot.

Weed control efficiency is utilized to show the limit of the herbicide to control weeds by reduction or elimination. The WCE for untreated pots was viewed as zero (0) since there was no measure connected to control weeds. The WCE (%) of the herbicide recorded in the tested crops of okra and groundnut pots was above 50% and some of the pots recorded 100%.

The total dry matter produced is an indication of the overall utilization of resources and better light interception[11]. The pre-requisite for getting higher yield in any crop is higher total dry matter production and its distribution to the various plant parts, the distribution of dry matter in leaves, stems and reproductive parts that indicate greater biological efficiency[8]. In the tested crops, the higher values in dry weight was recorded in the untreated pots[12]. The shoot dry weights of treated products were altogether influenced by the herbicide, in spite of the fact that the impact was high on the groundnut when contrasted with the impact on okra dry weight likewise reported that herbicide causes reduction in the weight of the crops.

Data concerning plant height of the plants subjected to primextra gold herbicides at different concentrations showed

that plant height was significantly different in all the stages of treatment. From the result obtained, the control had the highest height at 7, 14 and 21 DAT, respectively. The slow growth in the height of the plants is an indication of the inhibitory property of the herbicide applied.

CONCLUSION

From the experiment, the outcome has shown and recommends the following:

- Primextra gold herbicides showed 80-100% weed control Efficiency in the crops treated
- Primextra gold herbicide was able to reduce the invasion of weeds species effectively and should be recommended for use in weeds control especially in Okra and groundnut, but despite the adequacy of primextra gold as a herbicide for controlling weeds however ought not be utilized, at a higher treatment for controlling weeds in okra
- Further studies are required to find out the reaction of these yields to primextra gold in various environments, (field test), seasons and different conditions that may impact the herbicide viability and plants susceptibility

SIGNIFICANCE STATEMENT

This study discovered the primextra gold herbicide is highly effective in the control of weeds associated with groundnut and okra and this study will help the researchers to uncover the critical areas of herbicide study that many researchers were not able to explore. Thus a new theory on the control of weeds on groundnut and Okra fields may be arrived at.

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