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Effects of Galex[(R)] on Growth and Fruit Nutrient Composition of Okra (Abelmoschus esculentus (L.) Moench)

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Abstract

The fruit yeild and nutrient composition of Okra, Abelmoschus osculentus (L.) Moench, Variety NHAe 47–4, at four levels of Galex treatment, (Preemergence herbicide) and two controls of the herbicide was made using CP 15 knapsack sprayer.

Emergence count of Okra seeds at five days after planting (DAP) was not affected by Galex treatments. At 15 DAP, plants under the two controls and 1.5kgai/ha were normal and healthy while those under 2.0kgai/ha suffered severe phytotoxicity and those under 2.5kgai/ha and 3.0kgai/ha were completely killed. Plants height, flower number and fruit number were significantly affected by Galex treatments. The fresh fruit yield at 1.5kgai/ha and two weedings at 3 and 6 weeks after plantings (WAP) were not statistically different.

The untreated control had the statistically significant lowest yield. Application of 1.5kgai/ha led to significant increases in calcium (Ca) and potassium (K) contents of Okra fruits while the nitrogen (N) content of the untreated control was significantly lower than for two weedings at 3 and 6 WAP and 1.5kgai/ha. The phosphorus (P) and Iron (Fe) contents were not significantly affected by the treatments. *Keywords: Galex, NHAe 47–4, nutrient composition, Phytotoxicity.*

Introduction

Okra, Abelmoschus esculentus (L.) Moench, a member of Malvaceae family is a fruit vegetable that is widely grown in Nigeria. The immature

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fruits are used as a boiled or fried vegetable and are particularly useful for adding to soup or stews. Okra is also known to contain mineral elements which are necessary for human growth and development. However, the mineral composition of plant, organs and products according to Purseglove (1987) often varies with the cultivar grown, the environment, the season and the cultural treatments, including weed control method.

Several workers including FedtKe (1982), Ebert and Ramsteiner (1984) and Wilklinson and Hardcastle (1970) reported that metolachlor (a constituent of Galex (R)) is a lipid metabolism inhibitor. Also, Ashton and Crafts (1981) implicated chloroacetamide, including metolachlor in protein synthesis inhibition, while Ray (1982) implicated metolachlor in the interference with ions uptake especially those required as cofactor component. Metobromuron (the second constituent of Galex (R)) is a photosynthetic inhibitor (Geissbuhler *et al.*, 1975). In his study with Okra, Braithwaite (1981) did not observe any significant herbicide treatment effect on total carbonhydrate, protein, fat and moisture content of Okra fruits while Adejonwo *et al.* (1992) observed significant increases in protein content of Okra fruits treated with metolachlor and alachlor compared with prometryne and terbutryne. The study reported here investigated the effect of Galex (R)' on fruit yield and fruit nutrient composition of Okra.

Materials and Methods

Two separate studies were carried out in May and April of 1992 and 1993, respectively. The site was located at the Teaching and Research Farm of the University of Ibadan, Ibadan. Nigeria (07' 30'N, 03" 31' E). A gentle sloping piece of land, alfisol, Oxic Paleustalf (Harpstead, 1973) having a pH 6.5, Organic matter 0.35%, CEC 9.25 Total N. 0.0% and available P. 4.25pprn was used.

Improved seed of Okra, variety NHAe 47–4 was procured from the National Institute of Horticultural Research and Training (NIHORT) Ibadan. The Galex(R) used for the study was obtained from the International Institute of Tropical Agricultural (IITA), Ibadan.

A randomized complete block design (RCBD) replicated four times was used for the two studies. There was six plots, each of 1.50m x 2.5m with a path of 1.0m in-between, in each replicate. Adjacent replicates were separated by a path of 1.0m. Plantings were done on May 11, 1992 and April 21, 1993 at a spacing of 30cm x 50cm at two plants per stand. Four herbicide treatments (1.5, 2.0, 2.5 and 3.0 kgai/ha) were compared with two (two weedings at 3 and 6 weeks after planting (WAP) and Untreated) controls. The herbicide rates were selected based on Soyinka (1991) report that Okra could tolerate 2.5kgai/ha of Galex[2]. Herbicide application was made preemergence with knapsack sprayer calibrated to deliver 250L/ha spray solution at a pressure of 2.1 kg/cm^2.

Data were collected on emergence count at five days after planting (DAP), seedling survival at 15DAP, plant height at the start of flowering, number of flowers, number of fruits, fresh fruit yield and nutrient analysis.

A random sample of ten fruits per plot was oven-dried at 70^{0}C and ground in a Wiley microhammer stainless steel mill prior to chemical analysis. Ground samples were digested in a 2:1 perchloric acid/ trioxonitrate V acid mixture in a fume cupboard. Micor-Kjeidahi method was used for N determination and the value multiplied by 6.25 to obtain the crude protein content. The P content was determined by the Vanadomolydate yellow method, Fe by orthophenathroline colorimeteric method, Ca by flame photometry and K by atomic absorption spectrophotometry (AOAC, 1980).

All data collected were subjected to analysis of variance and means were separated by using the least significant difference at 5% level of probability as described by Steel and Torrie (1980).

Result and Discussion

Table 1 shows the effect of different concentrations of Galex$^{(R)}$ on agronomic traits and fruit yield of Okra. Statistical analysis shows that the emergence count of Okra seedlings at 5 DAP was not affected by the herbicide treatments ($P < 0.05$). This shows that Galex is not a contact poison to Okra seeds. This result is consistent with the report of Soyinka (1991) and Akobundu (1987) that Galex did not affect the emergence of Okra and Cowpea, respectively. The seedling survival at 15 DAP was significantly affected by Galex treatments both in 1992 and 1993 trials. Okra plants under 2.5 and 3.0 kgai/ha were completely killed at 15DAP while those under 2.0 kgai/ha were reduced in stands and those under 1.5kgai/ha, untreated control and two weedings at 3 and 6 WAP were normal and healthy. The surviving plants under 2.0 kgai/ha showed severe stunting and yellowing indicating phytotoxicity. This observation could be attributed to the development of root system through which the toxic herbicide concentration was taken up at 15 DAP (Akobundu, 1987). The difference in the responce is principally to the difference in the concentration of the Galex. However, this result contradicts the report of Soyinka (1991) that Okra can tolerate 2.5kgai/

2. Galex is a premergence herbicide manufactured by Ciba Geigy. It comprises metolachlor and metobromuron

ha of Galex without any phytotoxicity. The difference between Soyinka (1991) report and this study could be attributed to the age of the Galex used as indicated (Ayeni, 1994, Pers.comm.) that the efficacy of Galex is reduced after about three years of storage. The Galex used for this study was manufactured in December, 1991 whereas there was no information on the age of the Galex used by Soyinka (1991).

The average plant height under 2.0kgai/ha was reduced by 94.7%, 80.9% and 94.3% compared to the 1.5kgai/ha, untreated and two weedings at 3 and 6 WAP plants, respectively. The growth retardation observed at 2.0 kgai/ha could be due to protein metabolism inhibition, enzyme action inhibition, photosynthesis inhibition; and arrest of root growth and ion uptake which are induced by metolachlor and metobromuron on susceptible plant species (FedtKe, 1982; Ray, 1982; Ashton and Crafts, 1981; Ahrens and Davis, 1978).

The number of flowers per plant was significantly affected by Galex treatments both in 1992 and 1993 ($P < 0.05$). Okra plants under 1.5kgai/ha and two weeding at 3 and 6 WAP produced the same average number of flowers which was significantly higher by 72.4% and 31.6% than the 2.0kgai/ha and untreated plants, respectively.

The low number of flowers produced by untreated plants could be atrributed to competition between Okra plants and weeds for nutrient, gases, light and moisture. The lowest number of flowers obtained for 2.0kgai/ha plants could be attributed to severe phytotoxicity induced by the herbicide. Taylor *et al.* (1984) reported significant reduction in stand count and flower count of Okra treated with Linuron at 1.0 and 2.0 kgai/ha. This was attributed to inhibition of protein synthesis and partial arrest of photosynthesis (Taylor *et al.,* 1984).

It is interesting to note that though the 2.0 kgai/ha plants produced flowers, no fruit was produced as flowers aborted before buds could open. Significantly lower number of fruit was produced by untreated control compared to 1.5 kgai/ha and two weedlings at 3 and 6 WAP ($P< 0.05$). In earlier report Akobundu (1989) stated that herbicides that move mainly in the apoplast e.g. Galex may enter the cytoplasm of both the epidermal and endordermal cells to inhibit vital physiological processes involved in vegetative and reproductive development. The flower abortion can also be attributed in part to protein metabolism inhibition (Ashton and Crafts, 1981). The fruit yield at 1.5kgai/ha and two weedings at 3 and 6 WAP was significantly higher than the untreated plots. The lowest yield obtained in untreated plots could be attributed to competition for nutrient, moisture, gases and light between the Okra and the weeds (Akobundu, 1989). The comparable yields obtained for 1.5 kgai/ha and two weedings at 3 and 6 WAP could be attributed to effective weed control that allowed for effective light interception for photosynthesis and improved ion uptake (Oputa, 1992 per comm.). It is suggested that at 1.5kgai/ha assimilate flow to the developing buds and fruits may have proceeded without hindrance.

Table 2 shows the effect of different concentrations of Galex on Okra fruit nutrient composition on percent dry matter basis. There was no significant difference in P and Fe content of Okra fruits ($P < 0.05$) both in 1992 and 1993. The 1.5kgai/ha and two weedings at 3 and 6 WAP plants did not differ significantly in the N and crude protein content but were significantly higher than the untreated plants. Generally the untreated plants leaves were yellow indicating poor light interception, in part and nutrient deficiency especially, N, in another part. These could be responsible in part, for the low N and crude protein content of Okra fruits in the untreated plots. Braithwaite (1981) reported that herbicides treatments did not have any significant effect on Okra carbohydrate, crude protein, moisture contents or fruit quality while Adejonwo *et al.* (1992) reported singificantly increases in crude protein content of Okra fruit treated with alachlor and metolachlor. The variation in these results may be due to differences in the herbicides tested by these workers and the one (Galex) tested in this study, also, the varieties tested and the study environment differ. In an earlier report Purseglove (1987) reported that the nutrient composition of plants, organs and products varies with the cultivar, environment, season and cultural practices, including weed control methods.

The Ca, and K contents of Okra fruits under 1.5kgai/ha was significantly higher than the untreated control and two weedings at 3 and 6 WAP both in 1992 and 1993 trials ($P<0.05$). The 1.5 kgai/ha plants produced 34.9% and 31.7% increase in average Ca contents compared to untreated control and two weedings at 3 and 6 WAP, respetively while the average K content was 38.0% and 35.8% higher in 1.5 kgai/ha than untreated control and two weeding at 3 and 6 WAP plants, respectively. Ahrens and Davis (1978) implicated metolachlor in ion uptake inhibition. It could therefore be inferred from the above that Galex or its additives may probably not inhibit K and Ca but rather enhance the uptake from the soil.

Conclusion

Since Okra reacted sharply to increase in Galex concentrations between 1.5 – 2.0 kgai/ha, it is recommended that rates higher than 1.5kgai/ha should be avoided for Okra, also an agroecological evaluation of this herbicide for weed control on Okra is recommended. Since Ca and K contents of Okra were significantly increased by Galex treatments, this may be a way of increasing the Ca and K intake for man. However, the effect of Galex, if any, on human health and a study of the chemistry of Galex additives are recommended.

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Table 1: **Effect of Different Concentrations of Galex on Agronomic Traits and Fresh Fruits Yield of Okra at Ibadan in 1992 and 1993**

Galex Cond. (Kgal/Ha)	Emergence Count. (Plants/plot)			Seedling Survival (15DAP) (Plants/Plots)			Average Plant Height at Flowering (CH/Plant)			Average No. of Flower (Flowers/Plant)			Average No. of Fruits (Fruits/Plant)			Fresh Fruits Yield (Kg/Ha)		
	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN
T^0 (Untreated)	72.0	70.0	71.0	72.0	70.0	71.0	39.4	39.4	37.8	10.6	10.0	10.4	8.2	8.2	8.2	480	520	500
T^1 (Weeding)	72.0	72.0	72.0	72.0	70.0	71.0	40.3	40.3	40.6	15.0	15.4	15.2	13.2	14.0	13.6	1750	1754	1752
T^2 (1.5)	72.0	70.0	71.0	72.0	70.0	71.0	41.0	40.3	40.7	15.2	15.1	15.2	14.2	14.0	14.1	1751	1755	1753
T^3 (2.0)	70.0	70.0	70.0	30.0	30.0	32.5	20.4	21.4	20.9	3.4	5.0	3.4	NFP	NFP	-	NFP	NFP	-
T^4 (2.5)	72.0	70.0	71.0	NSP	NSP	-	NSP	NSP	-	NSP	NSP	NSP	NSP	NSP	-	NSP	NSP	-
T^5 (3.0)	70.0	70.0	70.0	NSP	NSP	-	NSP	NSP	-	NSP	NSP	NSP	NSP	NSP	-	NSP	NSP	-
Lsd[a] 5%	NG	NG	-	0.9	0.5	-	0.5	0.51	-	0.5	0.4	-	0.7	0.6	-	1.03	1.01	-

NS: Not Significant at 5%
bNFP: No Fruit Produced
cNSP: No Surviving Plant

Table 2: **Effect of Different Concentrations of Galex on Fruits Nutrients Composition of Okra in 1992 and 1993**

Galex Concentration. (Kgal/Ha)	% NITROGEN			% PHOSPHOROUS			% IRON			% CALCIUM			% POTASSIUM			% CRUDE PROTEIN		
	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN	1992	1993	MEAN
T^0 (Untreated)	2.20	2.20	2.20	0.58	0.56	0.57	2.80	2.80	2.79	1.60	10.0	1.64	1.69	1.67	1.68	13.8	12.8	13.8
T^1 (2 Weedings)	2.47	2.44	2.46	0.61	0.58	0.60	1.79	1.79	2.80	1.73	15.4	1.72	1.73	1.75	1.74	15.4	15.3	15.4
T^2 (1.5)	2.44	2.41	2.43	0.60	0.63	0.62	2.86	2.86	2.84	2.50	15.1	2.52	2.73	2.68	2.71	15.3	15.1	15.2
T^3 (2.0)	NFP	NFP	-	NFP	NFP	-	NFP	NFP	-	NFP	NFP	-	NFP	NFP	-	NFP	NFP	-
T^4 (2.5)	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-
T^5 (3.0)	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-	NSP	NSP	-
Lsd 5%	0.06	0.04	-	NS	NS	-	NS	NS	-	0.14	0.15	-	0.22	0.18	-	0.3	0.2	-

NS: Not Significant at 5% Level
NFP: No Fruit Produced
NSP: No Surviving Plant
a: Expressed on % DM basis.