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INTERACTION BETWEEN *CROTON LOBATUS* L., *EMILIA SONCHIFOLIA* L., AND *SPIGELIA ANTHELMIA* L. AND TWO POTHERBS ; *AMARANTHUS HYBRIDIS* AND *CELOSIA ARGENTEA* AT DIFFERENT GROWTH STAGES.

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ABSTRACT
The effects of the interaction between the weed species C. lobatus, E. sonchifolia and S. anthelmia on the growth and productivity of two potherbs; A. hybridus and C. argentea were examined in this study. The potherbs were grown in monoculture and also in mixture with the weed species at different ratios. Results showed that there was over 60% reduction in the growth and yield of the potherbs at the end of the study. The growth and yield of the potherbs in the mixture were significantly different from those grown in the monoculture ($P < 0.05$). The results confirm that these weed species when present with these potherbs will reduce their yield, the degree of reduction in yield being higher at the early stage of their growth. These weed species must thus be controlled during cultivation of the potherbs in the early stages of growth.

INTRODUCTION
Weeds are unwished plants in places that are not expected and reduce production and quality of crops or disturb landscape (Barbiel and Kropff, 2002). One of the greatest hindrances to improving food production in Africa is inadequate control of weeds. Many fields are not harvested because of severe weed infestation. It is generally believed by agronomists that the presence of large weed population in arable land poses a trait to crop yield (Arregui *et al*, 2000, Mortimer, 2000, Atris and Partov, 2004, Lireza and Baghestani, 2004, Vasilokolgou, 2005). Toit and Mulder (2000) showed that germination and vigour of maize cryopsis decreases with an increase in *Datura stramonium* density. Askew and Wileut (2000) found that tropical *Croton* height was not affected by weed density, but cotton height decreased with increased weed density ten weeks after planting. They also found that tropical *Croton* biomass per plant was not affected by weed density while cotton lint yield decreased linearly 2 kg ha $^{-1}$ with each grain increase in weed dry biomass per metre of row. Danapal (2004) showed that *Alternanthera philoxeroides* inhibited the growth of *Eichhornia crassipes*. Pimentel *et al* (2000) reported that in United States alien weeds cause an overall reduction of 12% in crop yield, which represented approximately $23.4 billion in lost crop annually. Weeds that emerged the same time as the crops are most damaging to yield at an early stage of soy bean growth resulting in yield losses up to 1% per day. Weeds cause severe crop losses to small scale farmers in developing countries and families spend a considerable time in weeding which limits

further economic developments (Labarada, 2000 ,Gianessi, 2008). Results from this study will help in the development of proper weed management control in the tropics. This will not only increase crop production ,but will also free millions of people from the drudgery of hand weeding making it possible for them to pursue other productive activities and schooling.

MATERIALS AND METHODS:

Investigation of the interaction of the weeds with Potherbs

Plant population studies:

Preliminary population studies of the weed species; *C. lobatus*, *E. sonchifolia* and *S. anthelmia* were carried out using a quadrat of dimensions 25 cm by 25 cm where they are in monoculture. Five quadrats were randomly placed in each location, the number of plants in each quadrat were counted. From the above counts, the density of each weed species was calculated thus:

$$\text{Density} = \frac{\text{Total number of individual plants in all quadrats}}{\text{Total number of quadrats studied}} \times \frac{10000}{625}$$ (Akobundu, 1987)

The following results were obtained: *C. lobatus* 80 /m^2, *E. sonchifolia* 96 /m^2 and *S. anthelmia* 480 /m^2.

Agronomy of vegetables:

Agronomy of the vegetable crops revealed that the optimal spacing for plants to be harvested by uprooting for *A. hybridus* is 10 X 10 cm and 15 X 30 cm for *C. argentea* (Badra,1991). This information was used to obtain the optimal densities of the three weed species and the two vegetable crops used in the study.

Experiment layout

One hundred and twenty plastic pots (19.5 cm diameter and 20 cm depth) were three –quarter filled with 5 kg soil. The seeds of the plant species were sown in plastic pots in the following proportions:

Treatment	***Amaranthus hybridus***	***Celosia argentea***
A (Monoculture)	3 plants	1 plant
B (Mixed)	3 plants + 2 *C. lobatus*	1 plant + 2 *C. lobatus*
C (Mixed)	3 plants + 3 *E. sonchifolia*	1 plant + 3 *E. sonchifolia*
D (Mixed)	3 plants + 14 *S. anthelmia*	1 plant + 14 *S. anthelmia*

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Each treatment was replicated fifteen times for each and placed in a green house in the Biological garden at University of Lagos. The plants were watered twice a week. They were allowed to stabilize for two weeks after which four from each treatment were randomly selected for assessment every two weeks until twelve weeks after planting. At each harvest, the leaf areas were measured, and their fresh weight measured with an Acculab Electronic scale. The samples were thereafter packed in paper bags and oven dried at 85°C in an oven (Memmert 854 Mchwabach model) for 72 hours. The dry weight was then taken. The LAR, NAR and RGR were calculated for comparison with those of the monoculture. Results were analysed with one – way analysis of variance. Further comparison of the treatments was carried out using LSD and Pearson's correlation coefficient at 0.05 probability level.

RESULTS

Dry weight

Tables 1a and b showed the results of the mean dry weight of *A. hybridus* and *C. argentea* in monoculture and in mixture with weed species. *A. hybridus* and *C. argenteai* recorded their highest mean dry weights from the monoculture and the least from plants grown in mixture with *S. anthelmia* at all harvest periods (Tables 1a and b). The mean dry weights of the monocultures vary significantly from those of the mixed cultures ($P < 0.05$).

Table 1a: Mean Dry Weights (g) Per Plant of *A. hybridus, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Harvest period (two weeks intervals)	*A. hybridus* in monoculture	Dry weights of plants of *A. hybridus*			LSD (P<0.05)	Dry weights of plants of weed species		
		A. hybridus + *C. lobatus*	*A. hybridus*+ *E. sonchifolia*	*A. hybridus* + *S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	0.033±0.01	0.012±0.02	0.025±0.002	0.01±0.01	0.0220	0.008 ±0.0002	0.004 ±0.0002	0.002 ±0.0004
Yield as % of monoculture	-	36.36	75.76	30.30				
Second	0.095±0.03	0.04±0.04	0.07±0.002	0.03±0.004	0.0190	0.01±0.005	0.005 ±0.0002	0.003 ±0.0004
Yield as % of monoculture	-	42.11	73.47	31.58				
Third	0.37±0.07	0.14±0.02	0.15±0.02	0.09±0.001	0.0240	0.037±0.003	0.032±0.007	0.03±0.004
Yield as % of monoculture	-	37.87	37.50	25.00				
Fourth	0.98±0.04	0.30±0.10	0.56±0.02	0.26±0.01	0.2999	0.08±0.003	0.063±0.002	0.057 ±0.003
Yield as % of monoculture	-	30.61	57.14	26.53				
Fifth	3.86±0.16	0.94±0.01	1.60±0.11	0.65±0.02	0.9904	0.16±0.059	0.136±0.005	0.094 ±0.005
Yield as % of monoculture	-	24.35	41.5	16.84				

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Table 1b: Mean Dry Weights (g) Per Plant of *C. argentea, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Harvest period (two weeks intervals)	*C. argentea* in monoculture	Dry weights of plants of *C. argentea*			LSD (P<0.05)	Dry weights of plants of weed species		
		C. argentea + C. lobatus	*C. argentea + E. sonchifolia*	*C. argentea + S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	0.027±0.069	0.02±0.001	0.025±0.002	0.015±0.001	0.0192	0.0035±0.0002	0.0018±0.00015	0.0012 ±0.0002
Yield as% of monoculture	-	74.07	92.59	55.56				
Second	0.090±0.004	0.05±0.025	0.07±0.012	0.036±0.002	0.0449	0.028 ±0.008	0.003 ±0.00041	0.0130 ±0.0009
Yield as% of monoculture	-	55.56	77.78	40.00				
Third	0.487±0.158	0.12±0.010	0.306±0.104	0.05±0.009	0.0527	0.0466±0.0012	0.0233 ±0.0021	0.024 ±0.0022
Yield as % of monoculture	-	62.83	62.83	10.27				
Fourth	1.536±0.202	0.36±0.074	0.685±0.089	0.30±0.009	0.2883	0.270 ±0.0334	0.1699 ±0.0087	0.046 ±0.0007
Yield as% of monoculture	-	23.11	44.60	19.53				
Fifth	6.70±0.016	1.09±0.037	1.12±0.176	1.055±0.010	0.9860	0.3475 ±0.054	0.1915 ±0.017	0.1215 ±0.0002
Yield as% of monoculture	-	16.27	16.72	15.75				

Leaf Area (LA)

Results of the mean LA of *A. hybridus* and *C. argentea* interacting with the weeds are shown in Tables 2a and b. Variations in LA of both potherbs follow the same pattern with those of their dry weights. Plants from the monoculture recorded the highest LA and those from crop – *S. anthelmia* grown in mixture the least at all harvest periods as the experiment progressed with a positive significant correlation in the LA of the plants from all the treatments ($P < 0.05$).

Table 2a: Mean Leaf Area (cm^2) Per Plant of *A. hybridus, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Harvest period (two weeks intervals)	*A. hybridus* in monoculture	LA of plants of *A. hybridus*			LSD (P<0.05)	LA of plants of weed species		
		A. hybridus + C. lobatus	*A. hybridus + E. sonchifolia*	*A. hybridus + S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	1.44 ± 0.01	0.75 ± 0.16	0.96 ± 0.03	0.63 ± 0.04	0.0442	2.81 ± 0.30	2.02 ±0.07	1.87 ± 0.02
LA as % of monoculture	-	52.08	66.67	43.75				
Second	3.34 ± 0.26	1.88 ± 0.22	2.69 ± 0.33	1.84±0.19	0.1876	3.17 ± 0.07	2.50 ± 0.25	2.38 ± 0.25
LA as % of monoculture	-	56.29	80.54	55.09				
Third	7.97 ± 0.49	3.94 ±0.10	4.38 ± 0.37	2.73±0.05	1.3401	5.91 ± 0.29	4.11± 0.39	3.47±0.07
LA as % of monoculture	-	49.44	54.96	34.25				
Fourth	16.19 ± 0.10	6.35 ±0.14	7.83 ± 0.03	6.00 ± 0.25	0.1584	8.08 ± 0.19	6.49 ± 0.18	5.86 ± 0.35
LA as % of monoculture	-	39.22	48.36	26.53				
Fifth	30.50 ± 2.4	11.45±0.41	12.2 ± 0.13	10.42±0.19	0.3034	12.27±0.47	10.52 ± 0.22	8.14 ± 0.29
LA as % of monoculture	-	37.54	40.00	14.16				

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Table 2b: Mean Leaf Area (cm^2) Per Plant of *C. argentea, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Harvest period (two weeks intervals)	*C. argentea* in monoculture	LA of plants of *C. argentea*			LSD (P<0.05)	LA of plants of weed species		
		C. argentea + C. lobatus	*C. argentea + E. sonchifolia*	*C. argentea + S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	1.36± 0.28	1.23 ± 0.09	1.25 ± 0.34	1.20 ± 0.03	0.2239	3.03±0.10	1.80 ±0.11	1.42 ± 0.058
LA as % of monoculture	-	90.44	91.91	88.24				
Second	6.95± 0.59	3.60 ± 0.85	4.16 ± 1.14	2.31± 0.57	0.4377	4.25 ±0.19	2.35 ± 0.26	2.27 ± 0.06
LA as % of monoculture	-	48.20	59.86	33.24				
Third	13.87 ± 3.42	3.63 ± 0.36	9.87 ± 2.60	3.18 ± 0.11	2.9334	4.70 ±0.31	4.27 ± 0.24	2.52 ± 0.097
LA as % of monoculture	-	26.17	71.16	22.93				
Fourth	24.57 ± 0.44	11.91±2.22	15.93 ± 1.03	7.30 ±0.17	0.5030	12.29±0.86	4.67 ± 0.20	3.33 ± 0.27
LA as % of monoculture	-	48.84	64.84	29.71				
Fifth	44.04 ±1.2.7	15.65±2.05	1.8.91 ± 0.15	13.45±1.55	0.4903	16.20±0.29	8.88 ±0.30	5.61 ± 0.205
LA as % of monoculture	-	35.54	42.94	30.54				

Leaf Area Ratio (LAR)

The data for the LAR of the plants interacting with the weeds are summarized in Tables 3a and b. Results showed that both *A. hybridus* and *C. argentea* experienced a gradual decrease in LAR values as the experiment progressed; from the first to the last growth stage in all treatments except for crop – *C. lobatus* grown in mixture which showed a sharp increase in their LAR values at the last sampling interval. There are significant differences in the LAR values of the monocultures compared with those of the mixed cultures ($P< 0.05$).

Table 3a: Mean Leaf Area Ratio (cm^2/g) Per Plant of *A. hybridus, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Growth stages	*A. hybridus* in monoculture	LAR of plants of *A. hybridus*			LSD (P<0.05)	LAR of plants of weed species		
		A. hybridus + C. lobatus	*A. hybridus + E. sonchifolia*	*A. hybridus + S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	38.42 ± 0.04	97.98±0.355	42.56 ± 0.36	58.15±0.34	0.7345	293.82±0.91	513.79 ±0.31	1,115.03 ± 2.38
Second	26.52 ± 0.86	36.29 ±0.74	33.57 ± 0.58	38.53±0.15	1.3544	174.44±1.65	221.58± 1.24	260.42 ± 3.31
Third	18.97 ± 0.37	23.79 ±0.50	18.89 ± 0.49	25.44±0.36	0.7740	116.62±0.70	113.93± 0.91	107.61 ± 0.48
Fourth	10.89±0.155	71.18±0.22	9.95 ± 0.29	18.81±0.15	0.6292	87.58 ± 0.51	19.25± 1.14	16.00 ± 0.24

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Table 3b: Mean Leaf Area Ratio (cm^2/g) Per Plant of *C. argentea, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Growth stages	*C. argentea* in monoculture	LAR of plants of *C. argentea*			LSD (P<0.05)	LAR of plants of weed species		
		C. argentea + *C. lobatus*	*C. argentea* + *E. sonchifolia*	*C. argentea* + *S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	65.40 ± 0.43	67.37±0.37	55.34 ± 0.31	70.54±0.80	21.3021	78.01 ± 2.16	899.32 ±09.1	362.28±0.76
Second	42.61 ± 0.63	45.00±0.38	4132 ± 0.36	74.04±0.70	0.8084	122.12±1.88	355.97± 1.78	131.80±0.57
Third	20.48 ± 0.38	23.15±0.38	26.91 ± 0.11	40.09±1.02	13.5488	61.36 ± 1.83	60.55 ± 0.95	75.14 ± 1.77
Fourth	9.52 ± 0.20	35.36±0.24	19.44 ± 0.38	16.76±0.61	8,8024	46.09 ± 1.40	38.35 ± 1.06	45.43±1.31

Net Assimilation Rate (NAR)

Results showed that the NAR of crops from the monoculture are significantly higher than those of crops from the mixed culture (Tables 4a and b $P < 0.05$). In *A. hybirdus*, the monoculture recorded the highest NAR and the crop - *C. lobatus* grown in mixture the least in all but last growth stage where the crop - *C. lobatus* grown in mixture recorded the highest NAR value and the crop – *S. anthelmia* grown in mixture the least. For *C. argentea* however, the monoculture recorded the highest NAR values at all growth stages.

Table 4a: Mean Net Assimilation Rate (g/cm^2/wk) Per Plant of *A. hybridus, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Growth stages	*A. hybridus* in monoculture	NAR of plants of *A. hybridus*			LSD (P<0.05)	NAR of plants of weed species		
		A. hybridus + *C. lobatus*	*A. hybridus* + *E. sonchifolia*	*A. hybridus* + *S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	0.006 ± 0.0006	0.00407 ± 0.0009	0.00492 ± 0.0004	0.00446 ± 0.0004	0.0069	0.00039 ± 0.00011	0.00011 ± 0.00014	0.00051 ± 0.00048
Second	0.01097± 0.0013	0.00184± 0.0004	0.00544 ± 0.0008	0.0059 ± 0.0008	0.0193	0.00126 ± 1.00014	0.00183 ± 0.00012	0.00208 ± 0.0026
Third	0.01093 ± 0.0004	0.0068 ± 00006.	0.0149 ± 0.0012	0.00865 ± 0.0006	0.0003	0.00142 ± 0.00018	0.00126 ± 0.00016	0.00128 ± 0.00012
Fourth	0.02798 ± 0.0007	0.1610 ± 0.0091	0.0229 ± 0.0013	0.02115 ± 0.0013	0.0084	0.00176 ± 0.00022	0.00190 ± 0.00021	0.00683 ± 0.00018

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Table 4b: Mean Net Assimilation Rate (g/cm^2/wk) Per Plant of *C. argentea, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Growth stages	*C. argentea* in monoculture	NAR of plants of *C. argentea*			LSD (P<0.05)	NAR of plants of weed species		
		C. argentea + *C. lobatus*	*C. argentea* + *E. sonchifolia*	*C. argentea* + *S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	0.0040 ± 0.0009	0.0030± 0.0003	0.0040 ± 0.00041	0.0027 ± 0.00048	0.00134	0.99579 ± 0.00022	0.00012 ± 0.0000183	0.00141± 0.000085
Second	0.0086 ± 0.0006	0.0042 ± 0.0009	0.00775 ± 0.00082	0.0010 ± 0.00013	0.001	0.00904 ± 0.00052	0.00126 ± 0.000135	0.00101± 0.000216
Third	0.0133 ± 0.0008	0.0073 ± 0.0006	0.0065 ± 0.00091	0.0097 ± 0.00239	0.004	0.00622 ± 0.000183	0.00713 ± 0.0027	0.00188 ± 0.000189
Fourth	0.0336 ± 0.0006	0.01170 ± 0.0108	0.0055 ± 0.00088	0.0163 ± 0.00065	0.0017	0.00119 ± 0.000217	0.00674 ± 0.00015	0.00664 ± 0.000216

Relative Growth Rate (RGR)

Tables 5a and b show that the RGR of *A. hybridus* and *C. argentea* from the monoculture vary significantly from those of the mixed cultures ($P < 0.05$).

Table 5a: Mean Relative Growth Rate (g/wk) Per Plant of *A. hybridus, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Growth stages	*A. hybridus* in monoculture	RGR of plants of *A. hybridus*			LSD (P<0.05)	RGR of plants of weed species		
		A. hybridus + C. lobatus	*A. hybridus + E. sonchifolia*	*A. hybridus + S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S .anthelmia*
First	0.229 ± 0.011	0.236 ± 0.022	0.211 ± 0.013	0.259 ± 0.009	0.2225	0.116 ± 0.001	0.059 ± 0.020	0.057 ± 0.002
Second	0.3332 ± 0.013	0.306 ± 0.010	0.183 ± 0.008	0.277 ± 0.022	0.0268	0.220 ± 0.003	0.400 ± 0.011	0.528 ± 0.02
Third	0.208 ± 0.009	0.162 ± 0014.	0.282 ± 0.011	0.221 ± 0.015	0.0379	0.165 ± 0.003	0.144 ± 0.002	0.141 ± 0.00
Fourth	0.305 ± 0.009	0.273 ± 0.013	0.228 ± 0.021	0.199 ± 0.015	0.9135	0.155 ± 0.003	0.168 ± 0.002	0.100 ± 0.00

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Table 5b: Mean Relative Growth Rate (g/wk) Per Plant of *C. argentea, C. lobatus, E. sonchifolia* and *S. anthelmia* Grown in Mono and Mixed Cultures

Growth stages	*C. argentea* in monoculture	RGR of plants o- *C. argentea*			LSD (P<0.05)	RGR of plants of weed species		
		C .argentea + C. lobatus	*C. argentea + E. sonchifolia*	*C. argentea + S. anthelmia*		*C. lobatus*	*E. sonchifolia*	*S. anthelmia*
First	0.261 ± 0.005	0.1944 ± 0.010	0.224 ± 0.008	7..190 ± 0.011	0.0410	0.111 ± 0.001	0.111 ± 0.002	0.510 ± 0.019
Second	0.367 ± 0.005	0.190 ± 0.010	0.320 ± 0.010	0.071 ± 0.010	0.0266	0.111 ± 0.001	0.445 ± 0.002	0.133 ± 0.001
Third	0.250 ± 0.009	0.236 ± 0.010	0.495 ± 0.009	0.389 ± 0.010	0.0155	0.382 ± 0.002	0.431 ± 0.002	0.141 ± 0.001
Fourth	0.506 ± 0.011	0.412 ± 0.010	0.354 ± 0.010	0.273 ± 0.012	0.0224	0.055 ± 0.001	0.026 ± 0.002	0.0211 ± 0.001

DISCUSSION

The lower mean dry weights, mean leaf areas and mean NAR obtained from plants grown in mixture with weeds is an indication that competition for essential nutrients reduced the yield components of the plants. This is in agreement with the findings of Labarada (2000) and Gianessi (2008) that weeds cause severe losses to small scale farmers in developing countries. The marked reduction in the dry weights of plants from crop plants and *S. anthelmia* grown together is an indication that competition is most severe in that treatment. This is probably due to production of poisonous substances by *S. anthelmia* which inhibits plants' growth. This is also in line with the findings of Danapal (2004) that *Alternanthera* philoxeroxeroides inhibited the growth of *Eichhornia* crassipes. The variation of the dry weights of *A. hybridus* and *C. argentea* in the mixture is an indication that the degree of plant – weed interaction differ not only between weeds, but also between plants. The higher percentage yield loss of both *A. hybridus* and *C. argentea* at the early stage of the experiment confirmed the fact that weeds which emerged at the same time as the crop are more damaging at the early stage of their growth.

REFERENCES

Akobundu, I.O. (1987). *Weed Science in the tropics: Principles and Practice.* John Wiley and Sons. New York, 522pp.

Arregui, M. C., D. Sanchenz, and R. Scotta (2000). Comparative effect of *Setaria parviflora*, Poir, Kerguelen, on alfalfa growth during summer. *Abstracts of the 3rd International Weed Congress* 267pp.

Askew, S. D., and J. W. Wileut (2000). Tropical *Croton* interference in Cotton. *Weed Science* 49 (2) : 184 - 189.

Atris, A., M. Partov (2004). Assessment of Competition between tomatoes (*Lycopersicon esculentum* Miller) and Barnyardgrass (*Echinochloa crus-galli* (L)) with a reciprocal yied model. *Abstracts of the 4th International Weed Science Congress.*

Badra, T. (1991). Lagos spinash, pp 131-165. In: Pulses and Vegetables. Williams, J. T. (ed.) London: Chapman and Hall.

Barbieri, P. and Kropff, Y. (2002). What is the trend in weed research. European Weed Research Society Newsletter No. 81.

Danalpal, G. N. (2004). Competitive Interaction between two weeds: Water hyacinth (*Eichhornia crassipes* (MART.) griseb). *Abstracts of the 4th International Weed Science Congress.*

Gianessi, L. (2008). Solving the Weed Problem in Africa would increase food production and improve the lives of women and children. *Abstracts of the 5th International Weed Science Congress*, pp 333.

Labrada, R. (2000). Problems related to the development of Weed Management in the developing World. Plant Protection Bulletin, FAO, Rome.

Lireza, L., and M. A. Baghestina (2004). Quantitative Competition of Volunteer rye (*Secale cereale* L.) in wheat (*Triticum aescutivum* L.). *Abstracts of the 4th International Weed Science Congress.*

Mortimer, M. (2000). The need for Studies on Weed Ecology to Improve Weed Management. *International Rice Research Institute* : 15 – 21

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© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Pimentel, D., Lach, L., Zuniga, R. and Morrison, D. (2000). Environmental and Economic cost associated with non-indigenous species in the United States. *Bioscience* 50: 53-64.

Vasilokolgou, L. V., K. Dhima, and I. Eleftherohorinos (2005). Allelopathic Potential of Bermudagrass and Johnsongrass and their interference with Cotton and Corn. *Agronomy Journal* 97:303 – 313.