IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 9, Issue 2 Ver. II (Feb 2015), PP 01-07
www.iosrjournals.org

Interactive effects of *Croton lobatus* L., *Emilia sonchifolia* L., and *Spigelia anthelmia* L. on *Zea mays* L. in Lagos.

Chukwu, M. N.
School of Science and Technology National Open University of Nigeria 14 /16 Ahmadu Bello way, Victoria Island, Lagos

Abstract: *This study examined the competitive effects of some tropical secondary successional weed species; Croton lobatus L., Emilia sonchifolia L. and Spigelia anthelmia L. on the growth of Maize (Zea mays). Yellow (su) Maize were grown in monoculture (10 crop plants) and also in mixtures with the weed species in the ratio of (10 crop plants: 15 individual weed species) on plots of 4 m^2 each in the Biological garden at University of Lagos. Four treatments were prepared each in six replicates. The plants were watered twice a week with tap water and harvested at growth stages of 3 leaf (V3), 6 leaf (V6), 9 leaf (V9), 13 leaf (V13) and tasseling (VT) based on the phenological stages of maize development. On harvesting, the leaf area and fresh weights were measure and some parameters such as biomass, Relative growth rate and weed growth rate were estimated for comparison. Data were analyzed using analysis of variance. Further comparison of the treatments was carried out using LSD and Pearson's correlation coefficient at 0.05 probability level. Results showed that the competition of the weeds; C. lobatus, E. sonchifolia and S. anthelmia caused significant reduction in the growth of the maize; S. anthelmia causing the highest reduction. The results confirmed that these weed species when present with the maize will reduce their yield, thus there should be an effective weed control during cultivation of the corn to provide maximum grain yield.*

Key words: *Maize (Zea mays L.), monoculture, mixtures, yield, weed control.*

I. Introduction

I.I Introduction

Plant competition is a natural force whereby crop and weed plants tend to attain a maximum combined growth and yield, with the development of each species being to some extent at the expense of the other. Competition may occur between crop and weed plants and also between individual plants of each species. According to [1, 2, 3 and 4], weeds are considered to be the most important factors that influence the agricultural production systems. Studies had reported numerous adverse effects of weeds on crop plants [5]. This is due to the fact that weeds use resources that would be available to the crop plants. Weeds competition causes an average of 12.8% yield losses worldwide where there is weed control applications and 29.2% where there is none [6]. In USA alien weeds caused an overall reduction of 12% in crop yield, representing approximately $23.4 billion loss in crop annually [7]. [8] asserted that plant growth rate is another important factor in competitive relationship. Plants with higher growth rates are found to be better competitors than those with lower growth rates [9, 10].

Relative Growth Rate (RGR) is another parameter in plant competitive ability. According to [11], RGR describes plant performance under different conditions. The RGR is a fundamental measure of dry matter production; a high RGR indicates an efficient resource acquisition by the plant [12]. RGR also varies according to the growth of plants. [13] potrayed RGR as one of the most important determinants of competitive outcome while Weed Growth Rate (WGR) is one of the factors for comparing competitive ability among weed species.

Majority of the world's cereal production comes from wheat, maize and rice whose yield is greatly affected by weeds. Maize is the third mostly cultivated grain with 138.5 million on hectare cultivation and 589.4 million tones production in the world after wheat and rice [12]. Maize is an alternative to nutritional malady in some countries where malnutrition is a huge challenge. Researchers on child and maternal health are encouraging the production of maize to fight against childhood nutritional deficiency diseases such as Kwashiorkor, Marasmus and Marasmic Kwashiorkor. In Nigeria, maize is of high importance as a main staple food crop and is the third most important food crop after cassava and yam [14].

In maize cultivation, an effective weed control is indispensable because of its low competitiveness in early growth stages. The objective of this study was to compare the weed growth indices to evaluate their effects in Maize yield in Lagos. The result obtained will give baseline information in developing an effective weed control mechanism.

II. Materials And Methods

Yellow (su) maize were grown in monoculture (10 crop plants) and also in mixtures with the weed species in the ratio of (10 crop plants : 15 individual weed species) as shown in Table 1on plots of 4 m^2 each in the Biological garden at University of Lagos. Four treatments were prepared each in six replicates in a randomized block design. The plants were watered twice a week with tap water.

Table 1: Distribution of Plants in mono and mixed cultures

Treatment	*Zea mays*
A (Monoculture)	10 plants
B (Mixed)	10 plants + 15 *C. lobatus*
C (Mixed)	10 plants + 15 *E. sonchifolia*
D (Mixed)	10 plants + 15 *S. anthelmia*

They were allowed to stabilize till the growth stage of 3 leaf (3V) when the first harvest was made. Subsequent harvests were made every two weeks at growth stages of 6 leaf (V6), 9 leaf (V9), 13 leaf (V13) and tasseling (VT) based on the phonological stages of maize development. On each harvest day, four plants from each treatment were randomly selected for assessment, 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 and some parameters such as Leaf area ratio (LAR), Net assimilation rate (NAR), Relative growth rate (RGR) and weed growth rate (WGR) were estimated for comparison.

$RGR = \frac{\ln W2 - \ln W1}{t2 - t1}$ (g/wk) (1)

WGR = RGR x MDW (Mean Dry Weight) (2)

Data were analyzed using analysis of variance. Further comparison of the treatments was carried out using LSD and Pearson's correlation coefficient at 0.05 probability level.

III. Results

3.1 Dry weight

Table 2 showed the results of the mean dry weight of *Z.. mays* grown in monoculture and in mixture with weed species. *Z.. mays* recorded its highest mean dry weights from the monoculture and the least form plants grown in mixture with *S. anthelmiaa* at all harvest periods (Tables 2).The mean dry weights of the monocultures vary significantly from those of the mixed cultures ($P < 0.05$).

3.2 Leaf Area (LA)

Tables 3 showed the mean LA of *Z.. mays* in mono and mixed cultures. Variations in the mean LA of *Z.. mays* followed the same pattern with those of their dry weights. Plants from the monoculture recorded the highest mean LA and those from crop – *S. anthelmia* grown in mixture the least at all harvest periods. Among the mixed cultured plants, those from mixture of crop-*E. sonchjfolia* had the highest mean LA at all harvest periods compared with others. This is an indication that the degree of competition was least in that treatment and highest in crop – *S. anthelmia* treatment. There is positive significant correlations in the mean LAs of the plants from all the treatments ($P < 0.05$).

3.3 LEAF AREA RATIO (LAR)

Table 4 showed the mean LAR of *Z.. mays* in mono and mixed cultures. Results showed that the plants experienced a decrease in their mean LAR values as the experiment progressed in all treatments except for crop – *C. lobatus* grown in mixture which showed a slight increase in their LAR values at the second sampling interval. There are significant differences between the LAR values of plants from the monoculture and those from the mixed cultures ($P < 0.05$).

3.4 Net Assimilation Rate (NAR)

Table 5 showed the mean NAR of plants from the mono and mixed cultures. Plants from the monoculture recorded the highest mean NAR and those from crop **-** *C. lobatus* mixture the least at all sampling intervals. Results showed that the NAR for plants from the monoculture are significantly higher than those of plants from the mixed cultures ($P < 0.05$).

3.5 Relative growth rate (RGR)

Tables 6 showed the mean RGR of *Z.. mays* from the mono and mixed cultures. There was an initial decrease in the mean RGR of *Z.. mays* between the first and second sampling intervals followed by a progressive increase for the monoculture. The mixed cultures on the other hand recorded increase in their RGR throughout the sampling periods. There are however significant differences between the RGR of *Z. mays* from the monoculture and those from the mixed cultures (P < 0.05).

3.6 Weeds Mean dry weight

Fig. 1 showed the mean dry weight of the weed species. There was an initial gradual increase in dry weight of the weed species followed by an exponential increase as the experiment progressed. The mean dry weight was highest for *C. lobatus*, followed by *E. sonchifolia* and lastly *S. anthelmia* throughout the course of the study (Fig. 1). There are significant differences in weed mean dry weights of the weed species (P<0.05).

3.7 Weeds relative growth rate

Fig. 2 showed the mean weed relative growth rate for the weed species. Generally, the mean weed RGR was highest shortly after seedling emergence and declined throughout the period of plant growth. *S. anthelmia* had the highest mean weed relative growth rate in all sampling intervals. There are significant differences in the patterns of variation in the mean RGR of the weed species throughout the growth period (P < 0.05).

3.8 Weeds growth rate (WGR)

C. lobatus had by far the highest WGR of all the weed species (Fig. 3). There was variation in the time to reach a peak of WGR among weed species. The maximum growth rate was attained at the forth sampling interval for *C. lobatus*, *E. sonchifolia* and at the third sampling interval for *S. anthelmia*. There are also significant differences in weed growth rates of the weed species (P<0.05)

Table 2: Mean dry weights (g) per plant of *Z.. mays* grown in mono and mixed cultures

Harvest period (two weeks intervals)	*Z.. mays* in monoculture	Dry weights of plants of *Z.. mays* in mixture			LSD
		Z... mays + *C.lobatus*	*Z. .mays* + *E.sonchifolia*	*Z.. mays* + *S.anthelmia*	(P < 0.05)
First	0.15±0.032	0.13±0.002	0.14±0.024	0.12±0.002	0.0286
Dry weight as % of monoculture	-	86.67	93.33	75.00	
% weght loss	-	13.33	6.67	16.67	
Second	0.30±0.006	0.20±0.030	0.23±0.016	0.14±0.004	0.0892
Dry weight as % of monoculture	-	66.67	76.67	46.67	
% weight loss	-	33.33	23.33	69.00	
Third	2.6±0.180	2.0±0.018	2.2±0.138	0.8±0.129	0.1129
Dry wejght as % of monoculture	-	76.92	84.62	30.77	
% weight loss	-	23.08	15.38	69.23	
Forth	36.0±0.404	13.6±0.058	3.8±0.240	2.2±0.118	0.4285
Dry weight as % of monoculture	-	37.78	10.56	6.11	
% weight loss	-	62.22	89.44	93.89	
Fifth	124.70±0.065	22.45±0.074	22.86±0.362	22.46±0.022	0.8670
Dry weight as % of monoculture	-	18.00	18.33	18.01	
% weight loss	-	82.00	81.67	81.99	

Table 3: Mean leaf area (cm^2) per plant of *Z... mays* grown in mono and mixed cultures

Harvest period (two weeks intervals)	*Z...mays* in monoculture	Mean LA of plants of *Z.. mays* in mixture			LSD (P<0.05)
		Z. . mays + C.lobatus	*Z. mays + E.sonchifolia*	*Z. .mays + S..anthelmia*	
First	1.02 ±0.01	0.76 ±0.12	0.92 ±0.02	0.60 ± 0.03	0.0436
LA as % of monoculture	-	74.50	90.20	58.82	
Second	2.11 ± 0.26	1.58 ± 0.17	2.02 ± 0.28	1.54±0.15	0.1855
LA as % of monoculture	-	74.88	95.73	72.98	
Third	5.85 ± 0.49	3.40 ±0.06	4.75 ± 0.30	3.16±0.03	1.3307
LA as % of monoculture	-	58.12	81.20	54.01	
Forth	21.99 ±0.10	12.09 ±0.11	13.57 ±0.02	11.74 ± 0.21	0.1542
LA as % of monoculture	-	54.98	61.71	53.39	
First	32.46 ± 2.4	17.50±0.36	18.30 ±0.10	17.04±0.15	0.3001
LA as % of monoculture	-	.53.91	56.38	52.50	

Table 4: Mean leaf area ratio (cm^2/g) per plant of *Z... mays* grown in mono and mixed cultures

Sampling intervals	*Z...mays* in monoculture	LAR of plants of *Z. mays*			LSD (P<0.05)
		Z.. mays + C. lobatus	*Z.. mays + E. sonchifolia*	*Z...mays + S.anthelmia*	
First	6.92 ± 0.033	4.57±0.260	3.80 ± 0.250	8.00 ± 0.250	0.8425
Second	4.78 ± 0.520	4.40 ±0.34	3.47 ± 0.420	7.48 ± 0.180	1.0540
Third	1.43 ± 0.240	1.29 ±0.42	2.87 ± 0.330	4.64 ± 0.260	0.4280
Forth	0.44 ± 0.150	0.83±0.170	2.19 ± 0.220	3.05 ± 0.130	0.7284

Table 5: Mean net assimilation rate ($g/cm^2/wk$) per plant of *Z. mays* grown in mono and mixed cultures

Sampling intervals	Z.. mays in monoculture	NAR of plants of *Z.. mays*			LSD (P<0.05)
		Z. mays + C. lobatus	*Z.. mays + E. sonchifolia*	*Z. mays + S.anthelmia*	
First	0.50 ± 0.004	0.02 ± 0.016	0.03 ± 0.001	0.04 ± 0.143	0.0013
Second	0.41 ± 0.015	0.30 ± 0.044	0.36 ± 0.004	0.38 ± 0.011	0.0146
Third	2.88 ± 0.012	1.47 ± 0.052	0.50 ± 0.004	1.75 ± 0.022	0.0007
Forth	9.95 ± 0.020	1.38 ± 0.036	3.13 ± 0.043	3.50 ± 0.178	0.0075

Table 6: Mean Relative Growth Rate (g/wk) per plant of *Z.. mays* grown in mono and mixed cultures

Sampling intervals	*Z... mays* in monoculture	RGR of plants of *Z.. mays*			LSD (P<0.05)
		Z.. mays + C. lobatus	*Z.. mays + . E. sonchifolia*	*Z... mays + S. anthelmia*	
First	3.46 ± 0.033	0.09 ± 0.260	0.11 ± 0.250	0.32 ± 0.250	0.8425
Second	1.96 ± 0.520	1.32 ± 0.340	1.25 ± 0.420	2.84 ± 0.180	1.0540
Third	4.12 ± 0.240	1.90 ± 0.420	1.44 ± 0.330	8.12 ± 0.260	0.4280
Forth	4.38 ± 0.150	2.15 ± 0.170	6.85 ± 0.220	10.68 ± 0.130	0.7284

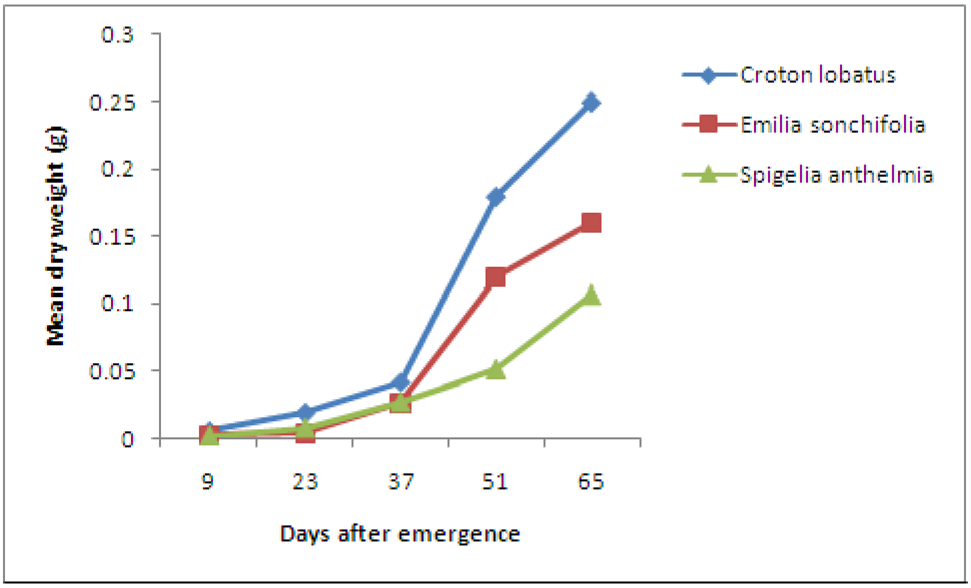

Fig. 1: Weeds Mean dry biomass during growing season

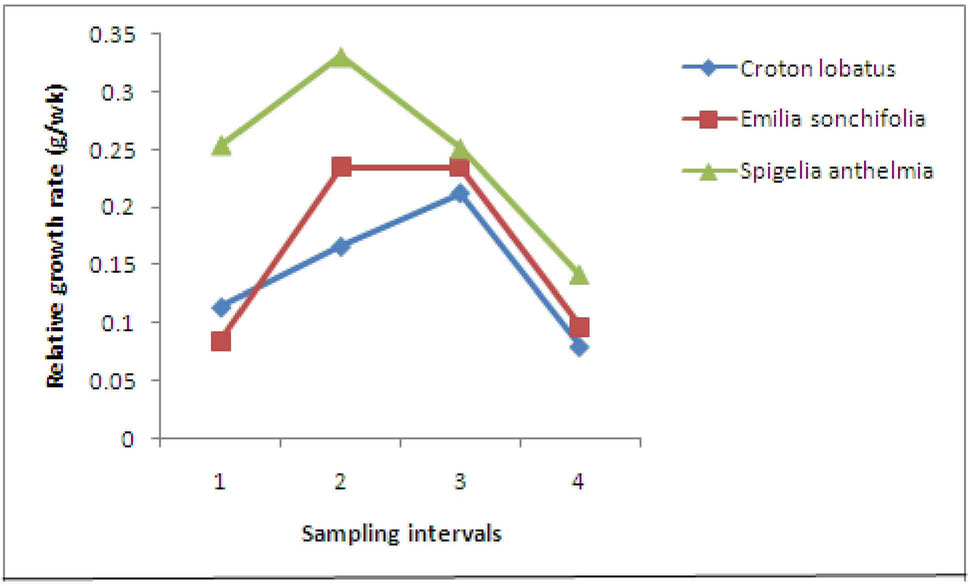

Fig. 2: Weeds relative growth rate during growing season

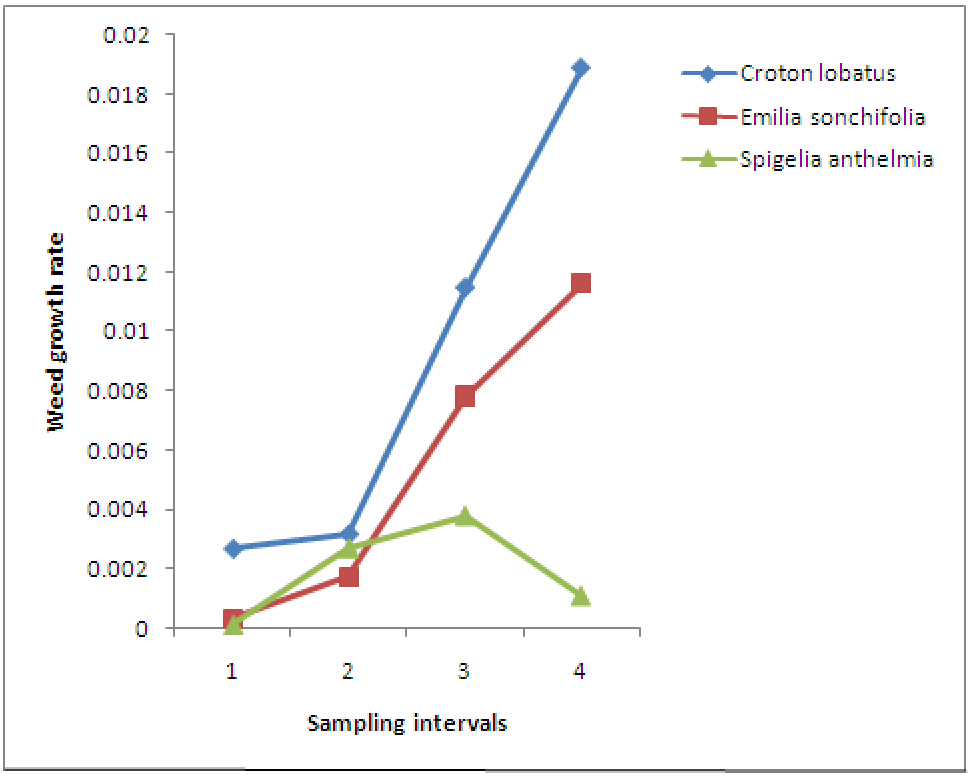

Fig. 3: Weeds growth rate during growing season

IV. Discussion

The lower mean dry weights from plants grown in mixed cultures shows that competition for essential nutrients reduced the growth of *Z.. mays*. The marked reduction in the dry weights of plants from plants **-** *S. anthelmia* mixture at all harvest periods is an indication that competition is most severe in that treatment. This is probably due to the production of allelochemicals by *S. anthelmia* which inhibits the plants' growth. This is in agreement with the findings of [15] that *Alternanthera philoxeroxeroides* inhibited the growth of *Eichornia crassipes.*

The variation of the mean dry weights of *Z.. mays* in the mixture is an indication that the degree of plant – weed interaction differ not only between weed species but also between crop plants. The higher percentage weight loss of *Z.. mays* at the early stage of the experiment confirmed the fact that weeds which emerged at the same time as the crop plant are more damaging at the early stage of their growth.

The lower mean dry weights, mean leaf areas and mean NAR obtained from plants grown in mixture with weeds shows that competition for essential nutrients reduced the yield components of the plants while the highest mean RGR from the crop- *Spigelia* mixture depicts severe competition. . This is in agreement with the findings of [16] that weeds cause severe losses to small scale farmers in developing countries.

The mean dry weight was highest for *C. lobatus*, followed by *E. sonchifolia* and lastly *S. anthelmia* throughout the course of the study (Fig. 1). This might be because of differences in weed competition mechanism and ability. *C. lobatus* is thus less competitive in comparison with *E. sonchifolia* or *S. anthelmia* while *S. anthelmia* is the most competitive of the three weeds. *C. lobatus* would therefore eestablish immediately and reach the flowering stage before experiencing any negative effects from more competitive weeds. This can be the mechanism of survival in the field for this species. The fact that *S. anthelmia* had the highest mean RGR at all sampling intervals is an indication that it is the most competitive of the weed species. This is in agreement with the findings of [13] that RGR is one of the most important determinants of competitive outcome.

V. Conclusion

It has been established that these weed species when present with *Z.. nays* will reduce their growth rate, the degree of reduction being higher at the early growth stage. *S. anthelmia* was found to have the greatest interactive effect on the crop plants. However, the knowledge gained from this work can be used to develop a good weed control mechanism in a maize field to ensure effective growth and increase crop production.

References

[1]. M. Aghaalikham and S. R. Yaghoobi, Critical period of Weed Control in winter canola (*Brassica napus* L.) in a Semi-Arid region. Pakistan Journal of Biological Sciences 11, 2008, 773-777.
[2]. S. Keramati, H. Pirdashti, M. A. Esmaili, A., Abbasian and M. Habibi,.The critical period of weed control in soybean (*Glycine max* L.) Merr.)in North of Iran conditions. Pak. J. Biol. Sci., 11, 2008, 463-467
[3]. F. C. Oad, M. H. Siddiqui, M.H. and U..A. Buriro, Growth and yield losses in wheat due to different weed densities. Asian J. Plant Sci., 6, 2007, 173- 176.
[4]. S. R. Yaghoobi, and K. Siyami, Effect of different periodical weed interference on yield and yield component in winter canola (*Brassica napus* L.). Asian J. Plant Science., 7, 2008, 413-416.
[5]. A. R. Javaid, N. R. Bajwa and T. Anjum, Comparative tolerance of six rice (*Oryza sativa* L.) genotypes to allelopathy of purple nutsedge (*Cyperus rotundus* L.). Allelopathy Journal 20(1), 2007, 157-166.
[6]. D. Isik, H. Mannan, B. Bukan, A. Oz and M. Ngouajiro, The critical period for weed control in corn in Turkey. Weed Technol., 20, 2006, 867- 872.
[7]. D. Pimentel, L. Lach, R. Zuniga and D. Morrison, Environmental and economic costs associated with non-indigenous species in the United States. Bioscience 50, 2000, 53–64.
[8]. G. R. Mohammadi, Growth parameters enhancing the competitive ability of corn (*Zea mays* L.) against weeds. Weed Biology Management., 7, 2007, 232-236.
[9]. H. Ni, K. Moody, R. P. Robles, E. C. Paller Jr., and J. S. Lales, .Oryza sativa plant traits conferring competitive ability against weeds. Weed Science., 48, 2000, 200-204
[10]. M. A. Baghestani, E. Zand, and S. Soufizadeh, Iranian winter wheat's (*Triticum aestivum* L.) Iterference with weeds. II. Growth analysis. Pakistan Journal of Weed Science Research 12, 2006, 131-144.
[11]. U. Karadavut, K. Kokten and Z. Kavurmaci,. . Comparison of relative growth rates in silage corn cultivars. Asian J. Anim. Vet. Adv., 5, 2010, 223-228.
[12]. A. Kohansal, and M. Mojab, The investigation of moisture stress on performance of weed and corn: Research and improvement Magazine, 2006.
[13]. G. Wang, M.E. McGiffen Jr. and J.D. Ehlers, Competition and growth of six cowpea (*Vigna unguiculata*) genotypes, sunflower (*Helianthus annuus*) and common purslane (*Portulaca oleracea*). Weed Science, 54, 2006, 954-960.
[14]. Anonymous. ONASA, Office National D'Appuila Securite National: Evaluation Dele Poduction Vivriere En. 2003.
[15]. G. N. Danalpal, Competitive Interaction between two weeds: Water hyacinth (*Eichhornia crassieis* (MART.) griseb). Abstracts of the 4th International Weed Science Congress, 2004.
[16]. L. Gianessi, Solving the Weed Problem in Africa would increase food production and Improve the lives of women and children.Abstracst of the 5th International Weed Science Congress, 2008, pp 333.