Genotype Effect on the Reaction of Groundnut to *Alectra vogelii* (Benth.) Infestation in a Sub-humid Environment

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Abstract : Field and screen house trials were conducted in 1999 and 2000 at Samaru in the northern Guinea savanna ecological zone of Nigeria to evaluate the reaction of 36 groundnut (*Arachis hypogaea* L.) genotypes to artificial inoculation with *Alectra vogelii* (Benth.).The field trial was conducted on a plot that was inoculated with about 24,000 *Alectra* seeds per each groundnut hill in the previous season. Every year, the trial plots were further inoculated with 2,700 *Alectra* seeds per hill and laid out in randomized complete block design(RCBD) with three replications. In the screen house, half of the experimental pots were inoculated with about 64,500 *Alectra* seeds per pot while the remaining half was used as un-inoculated control. Two out of the 36 groundnut genotypes screened ISG NIG 701 and SAMNUT-18, exhibited low pod yield reduction in the screen house and hosted low to moderate *Alectra* shoot number in both the field and screen house. These genotypes therefore appeared to be moderately resistant to *Alectra*. Two other genotypes, ISG NIG 174 and SAMNUT-11 which had very low pod yield reduction in the screen house and moderate to high *Alectra* shoot population in the screen house as well as the field could be regarded as being tolerant to *Alectra*. Groundnut genotypes, ISN NIG 858, ISG NIG 251, ISG NIG 826, ISG NIG 200B and ISG NIG 222 which had less pod yield reduction than ISG NIG 174 and SAMNUT-11 and supported moderate to high number of *Alectra* shoots both in the field and screen house were considered to be moderately tolerant to *Alectra*. Other groundnut genotypes supported high *Alectra* shoots in both the field and screen house and had high pod yield reduction in the screen house and were therefore highly susceptible to *Alectra* parasitism. [Journal of American Science 2010;6(10):644-651]. (ISSN: 1545-1003).

Key words: *Alectra vogelii*, Reaction, Resistance, Tolerance.

Introduction

Alectra vogelii (Benth), a root hemi-parasite of the family scrophulariaceae, is a stoutly-stemmed annual herb (Lind and Tallantire, 1962). It parasitizes on legumes such as cowpea, groundnut, bambara groundnut and soybean (Kureh *et al*., 1996; *Mabosa* and Lagoke, 1991). The scourge of *Alectra* is more prevalent in the northern and southern Guinea savanna ecological zone of West Africa (sub-humid region) and the yield reduction can be as high as 100% in severe cases (Emechebe *et al*., 1991; Alonge *et al*., 2002). *Alectra* has also been reported to be widespread in East and southern Africa (Singh *et al*., 2002). The parasite depletes the host of nutrients with resultant debilitating effect on the susceptible host plant. The damage is accentuated by the poor nutrient status of the soils of the West African savanna.

Groundnut *(Arachis hypogaea* L.) is one of the major oil seed crops in Nigeria. The crop is consumed mostly by local industries for the production of edible vegetable oil and groundnut cake for the livestock industry. Groundnut is also a ready source of vegetable protein to the populace. However the effect of *Alectra* on groundnut and other legumes could be devastating under high infestation (Mabosa and Lagoke, 1991). Despite the scourge of *Alectra* on groundnut and other legumes, relatively less work has been done on its control. Control of Alectra is difficult for peasant farmers as it produces large numbers of seed and up to 75% of crop damage could be done before it emerges from the soil (Singh, *et al*., 2002). Although different methods have been used for the control of parasitic weeds, the most economical and environmentally friendly method is host-plant resistance (El-Hiweris, 1987; Lane *et al*., 1991). While a number of improved, high yielding Striga/Alectraresistant cowpea genotypes have been developed and are fast becoming popular with farmers in West African savanna (Singh *et al*., 2002; Kamara *et al*., 2008), the same cannot be said for groundnut.

The bulk of the Nigerian groundnut production takes place in the sub-humid savanna but this zone is highly prone to *Alectra* infestation. This

study was therefore undertaken to screen some of the existing and ntroduced groundnut genotypes for their reaction to *Alectra* infestation in the northern Guinea savanna of Nigeria.

2. Materials and Methods

Field and screen house evaluations were done at the experimental farm of the Institute for Agricultural Research (IAR), Samaru (11° 11' N; 07° 38' E) in the northern Guinea savanna ecological zone of Nigeria. The field trials were conducted during the rainy seasons in 1999 and 2000 while the screen house trial was conducted in 2000. The soil of the area is broadly classified as alfisols. The soil of the experimental site was loam with pH of 5.8, available P 10.1 mg kg^{-1} and total nitrogen 0.2 g kg^{-1} soil. Thirty-six groundnut genotypes out of which 30 were from International Research Institute for Semi-Arid Tropics (1CRISAT) and six from IAR were screened. Fifteen of the genotypes are early maturing (90-110 days) while the remaining twenty-one are late maturing (130-145 days). The treatments were laid in randomized complete block design (RCBD) with three replications. Although the trial was conducted in a field that was naturally infested with *Alectra*, artificial inoculation with *Alectra* seeds (about 2,700 seeds per hill) was done to add to the pool of *Alectra* seeds in the soil. In both years, *Alectra* inoculation stock was prepared by thoroughly mixing 2g of *Alectra* seeds with 0.88kg of sand from which 5g was used to inoculate each planting hill just before sowing.

Sowing was done in the first week of July in 1999 and in mid-June in 2000. Two seeds were sown per hill at the spacing of 75cm by 25cm. Individual plot size was 9 m^2, comprising of four ridges, spaced 75 cm apart and of 3 m length. Phosphorus was applied by side placement of single super-phosphate at the rate of 22 kg P ha^{-1} two weeks after sowing (WAS). Hand weeding was done at 2, 5 and 8 WAS. Greater care was taken by hand pulling during the last two weeding to avoid tampering with the un-emerged and emerged *Alectra* shoots.

In the screen house trial, the 36 groundnut genotypes were sown in pots under *Alectra* inoculated and un-inoculated conditions . The experiment was arranged in randomized complete block design with three replications corresponding to pot size (26.3cm x 24.7cm; 21.6cm x 23.5cm; 20.0cm x 19.7cm) . The stock mixture used for inoculation was prepared by thoroughly mixing 100g of *Alectra* seeds with 1 .76kg of sand in a polythene bag. Each pot was inoculated using l0g of the *Alectra* stock mixture (about 24,000 *Alectra* seeds) further mixed with 0.77kg of soil taken from the pot and transferred back into the pot. The pots were then watered for two weeks to precondition the *Alectra* seeds before the sowing of groundnut. Four groundnut seeds were sown per pot in the first week of October, 2000 and thinned to two plants at 2WAS. The experimental pots were watered to field capacity. in the course of the research. Emerged shoots were counted weekly from the time the first emerged *Alectra* shoot was observed in the trial. In the field trial, pod yield was determined at maturity from a net plot area of 4.5 m^2 comprising the two inner rows of each plot. Pod yield as a percentage of the control was carried out in the screen house trial. Data were subjected to analysis of variance and treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

3. Results

In both the field and screen house, Alectra shoots emerged on all groundnut genotypes at 12 and 15 WAS (Tables 1 and 2). However, in the field, the groundnut genotypes varied significantly in their support for *Alectra* shoots in year 2000 and the combined analysis only (Table 1). At 12 and 15 WAS in year 2000 and the combined analysis, the genotypes that exhibited the lowest support for *Alectra* shoots were ISG NIG 174, SAMNUT-11, SAMNUT-14, ISG NIG 859, ISG NIG 701, ISG NIG 793, SAMNUT-18 and ISG NIG 513, while ISG NIG 128B hosted the highest number of *Alectra* shoots. Genotypes ISG NIG 174 and ISG NIG 859 gave significantly lower number of *Alectra* shoots than ISG NIG 790, ISG NIG 128B, SAMNUT-20 and ISG NIG *532*. The combined analysis indicated that ISG NIG 251 and ISG NIG 386 also hosted high number of *Alectra* shoot In the screen house, there were significant differences in the number of Alectra shoots hosted by the genotypes at I5WAS (Table 2). At this stage, ISG NIG 701 recorded the least *Alectra* shoot count, which was significantly lower than the high population hosted by SAMNUT-l0, 1SG NIG 13, ISG NIG 200B and ISG NIG 513. Other genotypes that also had fewer number of *Alectra* shoots than the latter four genotypes were SAMNUT-11, SAMNUT-14, ISG NIG 793, ISG NIG 784, ISG NIG 532, ISG NIG 199, ISG NIG 816, 1SG NIG 610, 1SG NIG 585, ISG NIG 253, ISG NIG 857B and 1SG NIG 251. The genotype ISG NIG 13 supported the highest number of *Alectra* shoots.

The genotypes differed significantly with respect to pod yield in both years and the combined analysis (Table 3). In both years, ISG NIG 790 and

ISG NIG 793 gave the highest pod yields. Averaged over the two years these genotypes yielded over 2.00 tonnes pod/ha. Genotypes that gave comparable yields with the highest yielder include SAMNUT-20, SAMNUT-11, SAMNUT-16, ISG NIG 611, ISG NIG 784, ISG NIG 826B, ISG NIG 13, ISG NIG 857B, ISG NIG 776 and ISG NIG 251, which are all late maturing. The early maturing genotypes produced relatively lower pod yields. In the screen house, when averaged over genotypes, *Alectra* infection resulted in 41% reduction in pod yield (Table 4). Under infection, the highest pod yielder was ISG NIG 199 followed by ISG NIG *859*, SAMNUT -11, ISG NIG 826, ISG N1G 953, ISG NIG 858, and ISG NIG200B and ISG NIG251in that order. All these genotype s produced up to 3.0g pod yield per pot and were comparable to ISG NIG 199. Genotype ISG NIG 814 failed to produce pods under Alectra infection while ISG NIG 386, ISG NIG *532*, ISG NIG 816, ISG NIG 776, ISG NIG 13, ISG NIG 784 and SAMNUT-20 had low (less than 1.0g) pod yields. The best pod yielder under uninfected condition was ISG NIG 598, which was at par with ISG NIG 200 and ISG NIG 199 only. The latter two genotypes, in turn, out-yielded ISG NIG 174, ISG NIG 814, ISG NIG 78, ISG NIG 784, ISG NIG 816 and ISG NIG 386. The percentage pod yield reduction showed that the genotypes 1SG NIG 814 had the highest pod yield reduction of 100% (Table 4). Other genotypes that recorded high percentage (84-88%) pod yield reduction were ISG NIG 13, ISG NIG 816 and ISG NIG 386. The least percentage (-42.8%) yield reduction was exhibited by 1SG NIG 174.

Table 1. Effect of genotype on the number *of Alectra* shoots in groundnut grown under *Alectra* infestation at Samaru in 1999 and 2000 rainy seasons

	Number of *Alectra* shoots/4.5m^2					
	12WAS			15WAS		
Genotype	1999	2000	1999/2000 Combined	1999	2000	1999/2000 combined
SAMNUT-l0	6.0	6.0cd	6.0c	7.0	12.7a-f	9.8a-e
ISG NIG 174	6.0	2.0d	4.0c	7.3	2.0f	2.7e
SAMNUT-20	11.0	10.7cd	10.8bc	21.7	19.7abc	20.7a
SAMNUT-16	6.7	11.7bcd	9.2c	7.0	11.0a-f	9.3a-e
SAMNUT-11	3.7	3.7d	3.7c	15.0	4.3def	9.7a-e
SAMNUT-14	9.0	3.0d	6.0c	7.0	2.7ef	4.8cde
ISGNIG 200	12.0	6.0cd	9.0c	11.7	8.7b-f	10.2a-e
ISG NIG 859	11.3	2.3d	6.8c	4.3	1.7f	3.0e
ISG NIG 790	15.7	19.6b	17.5ab	18.0	24.7a	21.3a
ISG NIG 701	*5.7*	3.7d	4.7c	9.3	4.0def	6.7b-e
ISG NIG 793	10.3	4.0d	7.2c	14.7	9.0b-f	11.8a-e
ISG NIG 826	5.7	10.3bcd	8.0c	3.7	18.3a-d	11.0a-e
ISG NIG 814	4.0	5.7cd	4.8c	5.0	9.0b-f	7.0b-e
ISG NIG 78	6.0	5.0cd	5.5c	7.3	5.3c-f	6.3b-e
ISG NIG 784	6.7	5.3cd	6.Oc	11.0	16.0a-f	13.7a-e
ISG NIG 532	2.3	10.0bcd	6.2c	3.0	18.0a-d	10.5a-e
SAMNUT-18	6.7	3.7d	5.2c	*5.0*	4.0def	4.5de
ISG NIG 199	9.0	5.3cd	7.2c	6.3	7.3b-f	6.8b-e
ISG NIG8I6	7.3	4.0d	*5.7c*	10.7	13.3a-f	12.0a-e
ISG NIG826B	15.3	4.4cd	10.3bc	21.7	11.0a-f	16.3a-d
ISG NIG610	5.0	4.7cd	4.8c	11.0	14.3a-f	12.7a-e
ISG NIG858	12.7	5.0cd	8.Sc	5.3	*9Th-f*	7.5b-e
ISG NIG253	8.3	4.3cd	6.3c	8.3	4.3def	6.3b-e
ISGNIG222	5.7	6.7bcd	6.2é	3.3	8.0b-f	5.7b-e
ISG NIG13	18.0	17.7bc	17.8ab	17.3	17.0a-f	17.2abc
ISG NIG 128B	4.3	34.3a	19.3a	15.7	20.3ab	18.0ab
ISG NIG598	5.3	5.0cd	5.2c	5.7	7.0b-f	6.3b-e

ISG NIG953	5.0	7.0bcd	6.0c	5.0	6.0b-f	5.5b-e
ISG NIG200B	7.7	8.3bcd	8.0c	7.0	5.3c-f	6.2b-e
ISG NIG857B	15.0	6.0cd	10.Sbc	18.7	13.7a-f	16.2a-d
ISG NIG533	8.7	5.3cd	7.0c	13.3	7.3b-f	10.3a-e
ISG NIG766	8.3	7.7bcd	8.0c	15.0	18.7a-f	16.8a-d
ISG NIG611	7.0	4.0d	5.5c	10.7	12.7a-f	11.7d-e
ISG NIG386	7.7	8.3bcd	8.0c	21.0	12.0a-f	16.3a-d
ISG NIG513	3.0	4.0d	3.5c	5.0	*7.7Th-f*	6.3b-e
ISG NIG251	9.3	4.7cd	7.0c	21.7	11.0a-f	16.3a-d
SE±	3.62	3.83	2.64	5.72	4.24	3.56

Means followed by the same letters in a column are not significantly different at 5% level of probability using Duncan Multiple Range Test.
WAS = Weeks after sowing.

Table 2: Influence of genotype on the number of *Alectra* shoots per pot of groundnut plants grown under artificial *Alectra* infestation at Samaru in October 2000.

Number of Alectra shoots per pot at

Genotype	I2WAS	I5WAS
SAMNUT-l0	21.3	*45.3ab*
ISG NIG174	20.7	28.0a-e
SAMNUT-20	11.7	13.7cde
SAMNUT-16	11.0	20.7bc
SAMNUT-Il	3.3	7.7de
SAMNUT-14	3.3	10.7de
ISG NIG 200	9.3	18.3b-e
ISG NIG859	10.0	15.7b-e
ISG NIG790	16.3	22.3b-e
ISG NIG701	3.0	2.7e
ISG NIG793	10.3	6.3de
ISG NIG826	11.7	14.7b-e
ISG NIG814	10.3	33.7a-e
ISG NIG78	13.0	27.3a-e
ISG NIG784	7.0	6.0de
ISG NIG532	6.3	8.0de
SAMNUT-18	8.0	18.7b-e
ISG NIG199	9.3	9.7de
ISG NIG816	5.3	8.7de
ISG NIG826B	6.3	14.7b-e
ISG NIG610	2.0	13.0de
ISG NIG858	5.0	8.0de
ISG NIG253	7.7	6.7de
ISG NIG222	8.3	19.0b-e
ISG NIG13	24.7	55.7a
ISG NIGI28B	5.0	21.0b-e
ISG NIG598	7.0	32.0a-e
ISG NIG953	11.3	13.7cde
ISG NIG200B	18.0	44.3abc
ISG NIG857B	6.3	7.3de
ISGNIG533	12.7	25.3b-e
ISG NIG766	9.0	17.7b-e
ISG NIG611	7.0	26.0b-e

ISG NIG386	7.7	21.7b-e
ISG NIG5I3	33.0	36.7a-d
ISG NIG25I	3.7	9.7de
SE±	5.37	8.94

Means followed by the same letter(s) in a column are not significantly different at *5%* level of probability using Duncan Multiple Range Test.
WAS = Weeks after Sowing.
ns = Not significant at *5%* level of probability.

Table 3.Pod yield of groundnut genotypes grown under *Alectra* infestation at Samaru in 1999 and 2000 rainy seasons.

	Pod yield (kg/ha)		
Genotype	1999	2000	1999/2000 combined
SAMNUT-l0	1180a-h	1922a-f	155lc-j
ISG NIG 174	926d-h	1109g.-k	1018k-n
SAMNUT-20	1630a	1961a-f	1769a-e
SAMNUT-16	1418a-d	2316ab	lS67abc
SAMNUT-11	1433a-d	1810a-h	1621a-h
SAMNUT-14	846fgh	846ijk	846Lmm
ISG NIG *200*	8l0fgh	7jk	794mn
ISG NIG 859	1242a-h	995ijk	1119j-n
ISG NIG 790	1625a	2462a	2044ab
ISG NIG701	738h	823jk	780mn
ISG NIG793	1698a	*2457a*	2078a
ISG NIG826	998c-h	l0S0h-k	1039k-n
ISG NIG814	1180c-b	1627b-c	1404c-k
ISG NIG78	899d-h	106Th-k	983k-n
ISG NIG784	1493abc	104a-e	1799a-c
ISG NIG532	845fgh	1438d-j	1141j-n
SAMNUT-18	1012b-h	475k	743n
ISG NIG199	1319a-f	1280f-j	1300f-i
ISG NIG816	864d-h	2236abc	1550e-j
ISG NIG826B	1405a-e	2273ab	1839a-d
ISG NIG610	988c-h	1450d-j	1219j-m
ISG NIG858	1020b-h	964ijk	992k-n
ISG NIG253	1193a-h	1345e-j	1269g-i
ISG NIG222	1163a-h	1265f-j	1214g-n
ISG NIG13	1224a-h	2290ab	*1757a-f*
ISG NIG128B	916d-h	1870a-g	193d-k
ISG NIG598	987c-h	1126g-k	1057k-n
ISG NIG953	756gh	9251jk	841lmn
ISG NIG200B	1049b-h	1228f-k	1138i-n
ISG NIG8578	1550ab	2138a-d	1844a-d
ISG N1G533	1263a-h	1475c-j	1369e-k
ISG NIG766	1325a-f	1970a-f	1647a-g
ISG NIG611	1555ab	2159a-d	1857a-d
ISG NIG386	1199a-h	1992a-f	1596b-i
ISG NIG513	1067b-h	1284f-j	1176h-n
ISG NIG251	1296a-g	2170a-d	1733a-f
SE±	156.9	228.4	138.6

Means followed by the same letter(s) in a column are not significantly different at 5% level of probability using Duncan Multiple Range Test.
ns significant at 5% level of probability.

Table 4. Pod yield per plant and percentage pod yield reduction of groundnut genotypes grown under artificial *Alectra* infestation in the screen house at Samaru, October 2000.

Pod yield/plant (g)			
infected	2.0b		Percentage
un-infected	3.4a		Pod yield
SE±	1.0		Reduction
	Infected	**Un-infected**	
SAMNUT-l0	1.6c-i	4.0b-f	61.3a-e
ISGNIG 174	2.3a-g	1.7gh	-42.8g
SAMNUT- 20	0.9f-i	3 .4b-g	*75.* 8abc
SAMNUT-16	l.0e-i	3.8b-g	69.7a-e
SAMNUT-11	3.5abc	3.2b-g	-22.9fg
SAMNUT-14	2.2b-g	3.Ib-h	31.3a-g
ISG NIG 2*00*	2.7a-f	4.7ab	36.0g.-f
ISG NIG 859	4.0ab	4.0b-f	-6.3d-g
ISGNIG 790	1.3d-i	3.9b-f	67. la-c
ISG NIG 701	2.9a-d	2.4c-h	-42.7g
ISG NIG 793	1.6c-i	3.5b-g	*59.0a-e*
ISG NIG 826	3.5abc	4.0b-f	14.2b-g
ISG NIG 814	0.0i	1.0h	l00.0a
ISG NIG 78	1.8c-i	3.7b-g	*51.0a-f*
ISG NIG 784	0.6g-i	2. Ic-h	70.8a-d
ISG NIG 532	0.3hi	2.lc-h	79.Iabc
SAMNUT-18	2.lb-h	3.lb-h	12.7b-g
ISG NIG 199	4.2a	4.5abc	4.8c-g
ISG NIG 816	0.3hi	2.2dh	86.0ab
ISG NIG 826B	1.0e-i	3.2b-g	75.4abc
ISG NIG 610	1.6c-i	2.6b-h	33.9a-f
ISG NIG 858	3.la-d	3.0b-h	-3.ld-g
ISG NIG 253	2.5a-f	4.3bcd	42.2a-f
ISG NIG 222	2.7a-f	3.5b-g	21.4b-g
ISG NIG 13	0.6g-i	3.9b-f	88.2ab
ISG NIG 128B	2.9a-d	4.2b-e	30.8a-g
ISG NIG 598	2.8a-e	6.4a	59.7a-e
ISG NIG 953	3.2a-d	3.9b-f	16.8a-e
ISG NIG 200B	3.0a-d	3.9b-f	13.6b-g
ISG NIG 857B	1 .4d-i	4.0b-f	64.9a-e
ISG NIG 533	1.3d-i	3.5b-g	*55.7a-e*
ISG NIG 766	0.5g.-i	3.2b-g	78.6abc
ISG NIG 611	1.8c-i	4.lb-f	53.6a-f
ISG NIG 386	0.2i	1.9fgli	84.9ab
ISG NIG 513	3.0a-d	3.0b-h	-7.5efg
SE_{-}^{+}	0.54	0.63	22.3

Means followed by the same letter(s) in a column are not significantly different at *5%* level of probability using Duncan Multiple Range Test.

4. Discussions

This field and screen house study showed that groundnut genotypes differed in their reaction to *Alectra* parasitism, which had marked effect on their performance. Among the genotypes tested, ISG NIG 701 and SAMNUT- 18 exhibited moderate resistance to *Alectra* both in the field and the screen house This was demonstrated by their having low pod yield reduction in the screen house, and low to moderate shoot number in the screen house as well as the field. The low pod yield reduction implies that *Alectra* parasitism was not able toeffect significant yield

reduction in these genotypes. Low *Alectra* shoot number has been associated with resistance to *Alectra* in cowpea (Magani, 1994) and soybeans (Kureh *et* al., 1996). The moderate resistance in these groundnut genotypes might have been achieved through low production of germination stimulant which is one of the resistance mechanism advocated by some authors (El-Hiweris, 1987; Obilana, 1987, Ramaiah, 1978, Ramaiah, 1991). The low production of germination stimulant signifies less chemical available that could induce *Alectra* seed germination consequently Low parasitism and its effect.

The other group of genotypes that exhibited very low podyield reduction in spite of hosting high number *of Alectra* shoots can be considered as tolerant cultivars. Mussell (1980) defined tolerance as the ability to produce good crops despite the insult of pathogen. The genotypes that fell into this category were ISG NIG 174 and SAMNUT-11. While the genotype ISG NIG 174 had moderate number of *Alectra* shoots in the field, it hosted high number of *Alectra* shoots in the screen house. Kim (1997) noted that variations occur in the field with respect to parasitic weed infection. This may account for the difference observed in the *Alectra* support of this genotype in the field and the screen house. Nevertheless, since it had very low yield reduction despite high infestation in the screen house, therefore it can be considered as being tolerant to *Alectra.* The other genotype SAMNUT-11 appeared to support low to moderate *Alectra* shoot number at the early growth stage but high density at later stage, especially in the field. Its ability to sustain high yield in spite of the high *Alectra* infestation marks it out as a tolerant genotype. Low *Alectra* damage in tolerant soybean cultivars has been reported by Kureh and Alabi (2003). Tolerance can be considered as a type of horizontal resistance which is polygenic in contrast to vertical resistance which is monogenic (Kim, 1997). The horizontal resistance allows for the co-existence of the host and the parasite and it is more sustainable than vertical resistance which breaks down faster with time. Since the tolerant genotypes can produce high yield in spite of high parasitism, it implies they have to be very efficient in the production of assimilates to support the parasites and still have enough to give high yields. According to MuselI (1980), such genotypes are able to achieve this by judiciously allocating minerals, energy and food resources for the production of valuable output despite being infested.

The genotypes ISG NIG 858, ISG NIG 251, ISG NIG 826, ISG NIG 200B and 1SG NIG 222 also had low pod yield reduction, but to a lesser extent compared to the aforementioned genotypes. They supported moderate to high number *of Alectra* shoots both in the field and the screen house. Therefore, they may be considered as being moderately tolerant to *Alectra.* Other genotypes ISG N1G 199, 1SG NIG 953, ISG NIG 128B, and SAMNUT-14 showed inconsistent support for *Alectra* shoots. The 22 genotypes which had high pod yield reduction (over 30%) could be regarded as being susceptible. The reaction syndrome displayed by these susceptible cultivars was that of chlorosis, scorching and premature defoliation. Similar chlorotic symptoms have been reported on cowpea by Magani (1994). The resultant chlorosis could be due to chlorophyll degradation in susceptible host as suggested by Knuston (1979). Furthermore, the premature defoliation may possibly be attributed to elevated level of abscisic acid as observed in *Striga* infected sorghum by Stewart (1987). Thus reduction in photosynthetic site might be responsible for the yield reduction in susceptible genotypes. The negative effect of *Alectra* parasitism in depleting the host plant of assimilates was reflected in depressed pod number and pod yield per pot in the screen house. Similar observations were reported on cowpea by Magani (1994) and Alonge *et al* (2002).

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References

1 Lind, E.M. and Tallantire, A.C. (1962). Some common flowering plants of Uganda, Oxford University Press London. 1962:.134.
2 Kureh, I., Gupta, U.S., Lagoke, S.T.O.; Olugbemi, **L.B.** and Berner, D.K.. Reaction of soyabean cultivars to *AlectrA vogelii* in the northern Guinea savanna of Nigeria. *Striga* Newsletter of Pan-Africa striga
Control Network. September, 1996 (7):76.
3 Mabosa, S. and Lagoke, S.'I.O. . *Alectra* vogelii attacks bambara groundnut in Zimbabwe. *Striga* Newsletter of Pan-Africa. Striga Control Network. March, 1991 (2): 11
4 Emechebe, A.M., Singh,
.B,Leleji,O.I.,Atokple,D.K.and Audu, J.K. Cowpea

Striga problems and research in Nigeria. in: Kim S.K (ed)

5 Alonge, S.O. Tehatchoua, D.T. and Musa, S.D. (2002). Effect *of Alectra vogelil* on theunutrient composition of cowpea varieties. *Nigerian Journal of Weed Science. 15: 31-37.*

6 Singh, B.B. Breeding cowpea varieties forresistance to *Striga gesnerioides* and *Alectra vogelii*. pages 154-166. In Fatokun, C.A., S.A.Tarawali, B.B.Singh, P.M.Kormawaand M. Tamo (editors).2002. Challenges and opportunities for enhancing
sustainable cowpea production. IITA, Ibadan, Nigeria 2002**.**

7 El-Hiweris, S.O. Nature of Resistance to *Striga hermonthica.* Parasitism in some sorghum vulgare (Pers) cultivars. *Weed Research,11987*,127:305-311.

8 Lane, J. A.; Bailey, J.S.; and (Terry, P.J (1991). An in-vitro growth system for studying The parasitism of cowpea *(Vigna unguiculata)* by *Srtiga gesnerioides* Abstract 40 (12) 1991)

9 Kamara, A.Y., Chikoye, D., Ekeleme, F., Omoigui,L.O.and Dugje, I.Y. (2008). Field performance of improved cowpea varieties under conditions of natural infestation by the parasitic weed *Striga gesneroides*. *International Journal of Pest Management*, 54: 189-195.

10 Duncan, B.B. Multiple Range Test and Multiple F-test. Biometrics.195511:142.

11 Magani, E. I. Effects of Fertilizers and herbicides on the reaction of cowpea *(Vigna unguiculata)* varieties to *Alectra* vogelii (Benth). Doctor of Philosophy Thesis: Department of Agronomy, Ahmadu Bello University, Zaria. 1994,. 133-138.

12 Obilana, A.T. . Breeding Cowpea for *Striga* resistance in: Musselman, L.J. (Ed). Parasitic Weed in Agriculture CRC Press, Boca Raton, Florida, 1987, 243-253.

13 Ramaiah, K. V. . *Striga* resistance work at 1CR1SAT. A paper presented at *Striga* Workshop at Khartoum, November,1978.

14 Ramaiah, K. V. . Breeding for *Striga* resistance sorghum and millet. In: Kim, S.K. (Ed). Combating Striga in Africa. Proceedings of International Workshop held in Ibadan, Nigeria, 22 - 24th August, 1988, PP. *75-80.*
Stewart, G.R. (1987). Physiological biochemistry of *Striga.* In: Mussdman, L.J. (Ed). Parasitic Weeds In Agriculture, Vol. I. *Striga* Press, Boca Raton, Florida, *1991*,. 77-88.

15 Musell, H. . Tolerance to Disease. In: Horsfall, J. and Cowling, E. B. (Ed). How plant defend themselves. an Advanced Treatise Vol.V. Academic Press, New York.
1980:. *39-52.*

16. Kim **S.**K **.**Horizontal resistance, misunderstanding
,approach and importance. In: Kim, S.K., Robinson, K
Atkinson, V.O., Adetimirin ,C.and Salle, G. (ed). Combating striga parasitic weeds through horizontal resistance . Proceedings of the International workshop on horizontal resistance for controlling parasitic weeds held at Hotel President World Centre**,** Brussel ,Belgium.1997:35-53.s

17 Kureh, 1. and Alabi, S.O. . The parasitic angiosperm *Alectra vogelli (Berth)* can influence the growth and nodulation of host soybean *('Glycine Ln) merril Crop protection* 22 (2003) 36 1-367.

18 Knutson, D.M.. How Parasitic seeds plants induce disease in other plants. In: Horsfall, J.G. and Cowling, F.B. (Ed). How Pathogens induce disease in Plant Disease, An advanced treatise Vol. IV Academic Press, New York, 1997. 293-312.

18Stewart G.r.1987). Physiological biochemistry of *triga*. in: Musselman L.J (ED). Parasitic Weeds in Agriculture vol. I. striga CRC Press, Boca Raton Florida pp. 77 – 88.

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