REACTION OF COWPEA VARIETIES TO ALECTRA VOGELII (BENTH.) IN NORTHERN GUINEA SAVANNAH OF NIGERIA

MAGANI[1*] I.E; S.T.O. LAGOKE[2] AND A.M. EMECHEBE[3]

[1] Department of Crop Protection and Environmental Sciences, Federal University of Agriculture, P.M.B 2373, Makurdi, Nigeria. m.enochistifanus@yahoo.com
[2] University of Agriculture, Abeokuta, Nigeria
[3] International Institute of Tropical Agriculture, Ibadan, Nigeria.

ABSTRACT
In field trials conducted at Samaru (11° 11[1] 07° 36'E) in 2003 and 2004 wet seasons in Northern Guinea Savannah of Nigeria, Variety B301 and derivatives of its crosses with IT84S 2246-4 (IT90K-59 and IT90K-76 did not support Alectra emergence. Varieties IT89KD-245-1 and IT89KD 245, both of which are derivatives of B301 and local variety Kananado supported low emergency of Alectra. Inspite of high infestation by Alectra, and very low pod number, Kano 1696 produced acceptable grain yield of 830 kg/ha. Cowpea varieties IT82D-849 and SUVITA-2 known to be resistant to Striga gesnerioides, exhibited moderate susceptibility to Alectra. Both TVX3236 and SAMPEA-7 supported high Alectra infection with consequent high susceptibility to the parasite. All the varieties tested including B301 had lower grain yield than VITA-3.

KEYWORDS: Cowpea, Alectra vogelii Resistance/Tolerance Guinea Savannah.

INTRODUCTION
Alectra vogelii (Benth.) a hemi-parasitic plant of the family Scrophulariaceae derives its water, nutrients and some of its manufactured food from the host plants through root connection. It is a major constraint to the production of cowpea, groundnut and soybean in Sub-Saharan regions of Africa (Aggarwal, 1985; Lagoke, 1989 and Emechebe, et al 1991). Its presence in a field can result in complete devastation of cowpea crop, and possible abandonment of cowpea production under high infestation (Lagoke, 1989). Alectra appears to be more destructive in the Northern Guinea and Sudan agro-ecologies, because of marginal nutrient status of the soils and unreliable rainfall (Emechebe et al 1991. Although attack by Alectra is less dramatic than that of Striga, total yield loss is not uncommon in fields heavily infested by these parasites when susceptible varieties of cowpea are planted (Lagoke, 1989; Atokple et al 1993; Singh et al.; 1993). The constant weeding advocated by Olunuga and Akonbundu (1980) has been found ineffective because of intensive labour requirements, re emergence of Alectra (Emechebe et at., 1983) and the severe crop damage done by the subterranean Alectra prior to its emergence (Press and Stewart, 1987). Emphasis on control of Alectra in cowpea has been placed mainly on host plant resistance (Aggarwal, 1985; Emechebe et al., 1988; Atokple, 1989) however, complete reliance on host plant resistance is not advisable; rather a strategy that combines Alectra resistant cultivars with appropriate complementary agronomic practices has been advocated (Ramaiah, 1984, Lagoke, 1990).

Although considerable work has been done on various control methods for parasitic weeds, Alectra control in cowpea has received relatively little attention. The purpose of this study was to screen cowpea varieties for their reaction to Alectra.

MATERIALS AND METHODS
Experimental Materials
The materials used in these studies included 18 cowpea lines with details viz:

a. B301- This is a local land race from Botswana that is late maturing but photoperiod insensitive. The seeds are rather small, creamy in colour with smooth testa. It has cross-resistance to all strains of cowpea

Striga and Alectra.

b. **IT82D - 849 -** It is early maturing and photoperiod insensitive with erect plant architecture. It is known to be resistant to Striga, however, it is highly susceptible to Alectra.

c. **IT81D 994 -** It is late maturing and photoperiod sensitive. The seeds are rough textured and white in colour with black eyes. It is moderately resistant to Striga but highly resistant to Alectra.

d. **SUVITA - 2 -** It originates from Burkina Faso, medium maturing and photoperiod insensitive. The seeds are brown with rough seed coat. It has high resistance to Striga only in Burkina Faso, however, highly susceptible to Alectra.

e. **IT84S 2246 4 -** It is photoperiod insensitive and susceptible to both Striga and Alectra. The medium sized are brown in colour with rough testa.

f. **IT90K 59 and IT90K - 76 -** They are photoperiod insensitive, early maturing, medium sized seeds are brown in colour with rough testa. They are crosses between B301 and IT84S 2246 4.

g. **TVX 3236 -** It medium maturing, photoperiod insensitive that is susceptible to both Striga and Alectra. The medium size seeds are white cream eye.

h. **IT81D - 985 -** It is late maturing and photoperiod sensitive. The medium sized seeds are rough and white in colour. It is moderately resistant to both Striga and Alectra.

i. **VITA - 3 -** It is photoperiod insensitive and medium maturing. It is semi erect growth with most of the straight pods above the canopy. The seeds are large and red in colour with smooth testa.

j. **IT89KD 245 1 and IT89KD - 245 -** They are derivatives of B301 and local variety kananodo. They are photoperiod sensititive, the rough textured, large sized seeds are white in colour.

k. **IT86D - 843 -** It is medium maturing and the medium sized seeds are rough textured and white in colour.

l. **TN121 80 and TN93 - 80 -** They originates from INRAN Niger Republic. They are late maturing and moderately resistant to Striga. The seeds are white with rough testa.

m. **SAMPEA - 7 -** It is photoperiod insensitive, early maturing, the medium sized seeds are rough textured and brown in colour. It is highly susceptible to both Striga and Alectra.

n. **Kano 1969 -** It is photoperiod sensitive, that is late maturing. The large sized seeds are rough textured and white in black eye spot.

Description of Experimental Sites

Field experiments were conducted in 2003 and 2004 wet seasons at Samaru (11° $11'^{N}$ 7° $36'^{E}$) in the Northern Guinea Savannah agro-ecology of Nigeria to evaluate cowpea varieties for their reaction to Alectra. The site used for the 2003 trial was naturally and heavily infested with Alectra. In 2004, the field was divided into two blocks; one block was artificially inoculated with about 1600 Alectra seeds per hill two weeks before crop planting while the second block was not inoculated but planted with same varieties evaluated in the first block. Alectra seed/sand inoculum was prepared by mixing Alectra seeds and sieved sand (< 180 pm particle size) in the ratio of 1:30 to obtain the stock that was used in the inoculation in the field. The mixture was shaken thoroughly in an air-filled polythene bag for 5 minutes to ensure a uniform distribution of Alectra seeds in the sand/seed stock. The 18 cowpea varieties were planted out in a randomized complete block design in the field

naturally infested by Alectra in 2003 and in both inoculated and Alectra free blocks in 2004 and replicated three times. The gross and net plot sizes were $9m^2$ and $4.5m^2$ (4 and 2 ridges) all of 3m long, respectively. Planting was done at an intra row spacing of 30cm which gave 88, 889 plants/ha. Application of 20 kg N/ha and 54 kg P_2O_5 was done after the emergence of cowpea. Weed control was achieved by the application of Galex plus Gramoxone pre emergence a day after planting and followed by supplementary hoe weeding at 3WAS. Fungal diseases were controlled by the application of Benlate and Dithane M_{45}, at the product rate of 0.6kg plus 2.5kg/ha, thrice weekly commencing from 4WAS. Cymbush 10EC and Perferkthion 40EC were each applied fortnightly at the rate of 0.75 litre/ha each as tank mixture beginning from 6WAS until harvest to control various categories of insect pests.

Date collected included number of days to Alectra emergence, Alectra shoot count, number of pods/plot and cowpea grain yield/ha. Also, data on crop vigour score was collected using a scale of 0 10; where 0 = completely killed plants and 10 = most vigours plants; while crop damage score was taken using a scale of (1 5), where 1 = normal crop plant growth, no chlorosis, no blotching, no leaf scorching and 5 = total leaf scorching or/and obviously stunted or dead plants. Treatments means were compared using Duncan Multiple Range Test (Duncan, 1955). Coefficient of correlation (r) between cowpea yield and other parameters were also determined.

RESULTS AND DISCUSSION

Generally, the yields of 2003 trial were lower than that of 2004. This could be because in 2004 under artificial Alectra infestation, the Alectra seed concentration was not high enough to cause serious yield reduction as the case of natural but heavily infested situation of 2003.

In all the trials, variety B301 and the derivatives of crosses with IT84S 2264-4 (IT90k 59 and IT90k-76) did not support the emergence of Alectra. The varieties also produced cowpea grain yields that were comparable to the maximum in 2003 and significantly higher than the least in the two years under Alectra infection. Line B301, a local variety, which was initially identified for resistance to Alectra vogelii in Botswana has since been observed to exhibit combined resistance to various strains of Alectra and Striga in Africa, including Nigeria (Riches, 1987; Emechebe and Singh 1989). However, Emechebe and Singh (1989) have reported that the other two sources of resistance to Striga gesnerioides (SUVITA^{-2} and IT82D-849) are susceptible to Alectra. Resistance to Striga in the genotype B301 has been reported to be controlled by one dominant gene, while that of Alectra by two dominant genes (Singh and Emechebe, 1990[a]; 1990[b]; Atokple et al; 1993). This then indicates there are differences in mechanism of resistance and the genes controlling resistance to these parasitic weeds in different varieties. Lane and Bailey (1991) and Lane et al (1991) reported that in B301, actual stimulation and germination of the Striga seeds and the formation of haustoria occurs but anatomical studies shows that the haustorium remains in the endodermis and fail to develop any further possibly because of antibiosis.

Table 1: Reaction of cowpea varieties to Alectra at Tasha Zomo, 2003 wet season

Varieties	Number of days to First Alectra	Number of host plant infected with Alectra/ $4.5m^2$ 9 WAS	Alectra count/ $4.5m^2$ 9 WAS	Crop vigour score at 9 WAS	Crop damage score on crop plant 9 WAS
IT84S-2246-4	49	10.3 abc	36.7 ab	7.3 bcd	4.3 ab
Kano 1696	51	11.0 ab	37.7 ab	6.7 cd	4.3 ab
IT89KD-245-1	64	2.3 efg	4.7 d	8.7 abc	2.0 d-g
TVX 3236	49	7.7 a-d	26.3 bc	9.0 ab	2.7 b-f
IT90K-59	-	0.0 g	0.0 d	9.7 a	1.0 g
IT90K-76	-	0.0 g	0.0 d	9.7 a	1.7 efg
IT86D-534	71	0.3g	0.7 d	8.7 abc	2.7 b-g
IT89KD-245	56	2.3 efg	6.3 d	9.0 ab	2.3 c-g
IT82D-849	50	9.3 a-d	51.0 a	3.3 e	5.0 a
B 301	-	0.0g	0.0 d	9.7 a	1.0 g
IT81D-985	56	2.3 efg	4.7 d	8.3 a-d	2.0 efg
IT81D-994	58	1.3 fg	1.7 d	9.3 a-d	1.3 fg
IT86D-843	59	5.0 def	10.7 cd	9.0 ab	3.0 b-f
TN 93-80	55	6.3 cde	14.3 cd	7.7 a-d	4.0 abc
TN 121-80	49	7.3 bcd	13.7 cd	8.0 a-d	3.0 b-f
VITA 3	54	9.3 a-d	37.0 d	6.3 d	3.3 a-e
SUVITA 2	52	5.7 def	11.7 cd	7.3 bcd	3.7 a-d
SAMPEA-7	47	12.0 a	41.3 ab	6.3 d	4.0 abc
S.E	10.66	1.40	16.49	1.95	1.55

Table2: Performance of cowpea varieties under artificial Alectra infestation at Samaru 2004 wet season

Varieties	Number of plants Infected with Alectra/$4.5m^2$ 9 WAS	Alectra count 9 WAS[1]	Number of days to first emergence Alectra	Crop damaged score on 9 WAS
IT84S-2246-4	2.0 def	7.3 b	40 bc	1.3 cd
Kano 1696	3.7 b-e	12.3 b	39 bc	1.7 bcd
IT89KD-245-1	1.7 ef	6.3 b	42 bc	1.3 cd
TVX 3236	8.7 a	49.3 a	37 c	2.3 abc
IT90K-59	0.0 f	0.0 b	-	1.0 d
IT90K-76	0.0 f	0.0 b	-	1.0 d
IT86D-534	1.3 ef	2.0 b	50 a	1.0 d
IT89KD-245	1.7 ef	1.7 b	50 a	1.0 d
IT82D-849	2.7 b-f	6.0 b	43 abc	2.7 ab
B 301	0.0 f	0.0 b	-	1.0 d
IT81D-985	2.3 c-f	6.0 b	46 ab	1.3 cd
IT81D-994	1.3 ef	3.3 b	44 abc	1.0 d
IT86D-843	2.7 b-f	4.0 b	51 a	1.3 cd
TN 93-80	5.7 abc	13.0 b	38 bc	2.3 abc
TN 121-80	2.0 def	4.3 b	41 bc	1.7 bcd
VITA 3	3.0 b-f	6.7 b	39 bc	2.3 abc
SUVITA 2	6.0 ab	35.7 a	36 c	3.0 ad
SAMPEA 7	5.3 bcd	34.0 a	38 bc	2.0 a-d
S.E +	1.06	6.67	2.57	0.39

1 Weeks after sowing

Means followed by the same letter(s) are not significantly different at 5% level of Probability (DMRT)

However, from this study, it is apparent that the varieties B301, IT90K-59 and IT90K-76 are not completely immuned from the parasite since important aspect of crop growth as well crop yields were interfered with in these resistant varieties. The fact that no Alectra emergence occurred in 1T90K-59 and IT90K76 further indicates the compatibility of relevant genes in the two parents i.e B301 and IT84S-2246-4. In contrast, IT89KD 245-1 and IT89KD-245, both of which are derivatives of B301 and local variety Kananado still supported low emergence of Alectra. The varieties still produced cowpea grain yields that were comparable to the maximum in 2003 and significantly higher than the least in the two years. Variety IT86D-534 presents an interesting and useful reaction to Alectra. Inspite of support for Alectra infection in all trials, it did not suffer any reduction in cowpea grain yield in 2004. The variety was observed to delay Alectra emergence and possible attack. The delay in Alectra might be the mechanism of tolerance, which enables it to produce adequate grain yield under infection, in spite of moderate yield potentials. Possible delay in the production of adequate stimulant or/and high production of germination/haustorial inhibitor factor might be suggested as being responsible for the reaction of variety to Alectra (Berner et al 1993). Kano 1696 produced low pod number, but acceptable grain yield in 2003 and low reduction in 2004 in spite of high and moderate infestation, respectively. This may be attributed to tolerance reaction, which it does through reduction in pod number but compensated for in seed size, which consequently increases the grain yield of the crop. Since it is late maturing, it would still produce adequate photosynthetic apparatus for the production of assimilates for grain filling at the later stage of life-cycle in spite of the initial adverse effect of Alectra infection. VITA-3 exhibited a high degree of tolerance in this study since it combines high yield with tolerance. It could therefore be used to improve the genetic base of the varieties being developed for Alectra tolerance/resistance. Both TV_x3236 and SAMPEA-7, the two recommended varieties in Northern Guinea and Sudan Savannah supported high Alectra infection with consequent high susceptibility to the parasite.

Table 3: Performance of cowpea varieties under artificial Alectra infestation at Samaru, 2004 wet season

Varieties	Crop vigour at Infection Infected	Un-infected	9 WAS[1] Means
IT84S-2246-4	6.1 g-f	6.5 d-j	6.3 b
Kano 1696	5.8 ig	7.6 abc	6.7 b
IT89KD-245-1	6.7 c-I	5.9 hij	6.3 b
TVX 3236	5.5 jk	7.0 b-g	6.3 b
IT90K-59	7.0 b-g	8.0 a	7.5 a
IT90K-76	6.9 b-h	7.7 ab	7.3 ab
IT86D-534	7.0 b-g	7.4 a-e	7.2 ab
IT89KD-245	6.8 b-I	7.5 a-d	7.1 ab
IT82D-849	5.9 hij	6.2 f-j	6.1 b
B 301	7.2 a-f	8.0 a	7.6 a
IT81D-985	6.6 c-i	6.8 b-a	6.7 b
IT81D-994	6.7 c-i	7.5 a-d	7.1 ab
IT86D-843	6.8 b-i	7.8 ab	7.3 ab
TN 93-80	6.2 f-j	6.2 f-j	6.2 b
TN 121-80	6.2 b-h	6.4 e-j	6.3 b
VITA 3	6.9 b-h	7.7 ab	7.3 ab
SUVITA 2	5.9 hij	4.7 k	5.3 c
SAMPEA 7	5.9 hij	6.5 d-j	6.2 b
(Int.) S.E	0.31	(v) S.E	0.22
Mean	6.5b	6.9a	
(I) S.E	0.07	6.9a	

Weeks after sowing

(Int.) = Interaction, (V) = variety, (I) = Infection

Table 4: Reaction of cowpea varieties to Alectra at Tasha Zomo, 2003 wet season

Varieties	Stand count At harvest	Weight of pods	Number of pods/plot(Kg/ha) (Kg/ha)	Grain yield
IT84S-2246-4	19 abc	540 bc	282 cd	378 bc
Kano 1696	19 abc	1324 a	256 cd	894 ab
IT89KD-245-1	19 abc	1354 a	374 abc	1099 a
TVX 3236	16 bcd	829 ab	364 abc	664 abc
IT90K-59	19 abc	1142 a	435 abc	974 a
IT90K-76	18 abc	1142 a	541 ab	981 a
IT860-534	17 abc	902 ab	315 ab	648 abc
IT89KD-245	20 ab	1271 a	297 bcd	987 a
IT82D-849	13 d	238 c	88 d	161 c
B 301	18 abc	1229 a	612 a	860 ab
IT81D-985	20 ab	1064 ab	272 cd	821 ab
IT81D-994	18 abc	1013 ab	304 bcd	821 ab
IT86D-843	21 a	918 ab	259 cd	650 abc
TN 93-80	19 abc	1482 a	598 a	1122 a
TN 121-80	19 abc	918 ab	418 abc	714 ab
VITA 3	19 abc	1036 ab	207 cd	777 ab
SUVITA 2	15 cd	818 ab	244 bc	643 abc
SAMPEA-7	19 abc	804 ab	321 bc	624 abc
S.E	1.20	201.0	76.7	156.15

Means followed by the same letter (s) are not significantly different at 5% level of probability (DMRT)

Table 5: Effect of Alectra inoculation on days to flowering, stand count and weight of 1000 grain of cowpea varieties at Samaru, 2004 wet season

Treatments	Number days to crop flowering	Stand count at harvest	Weight of 1000 grains (g)
Infection (I)			
Infected	48 b	21 b	188.1 b
Un-infected	49 a	23 a	191.4 a
S.E	0.29	0.29	2.72
Variety (V)			
IT84S-2246-4	48 bcd	19 d	180.0 efg
Kano 1696	64 a	22 bc	224.2 abc
IT89KD-245-1	50 b	20 cd	213.3 a-d
TVX3236	50 b	20 cd	131.7 i
IT90K-59	47 cde	23 ab	170.0 gh
IT90K-76	44 fg	23 ab	166.7 gh
IT86D-534	45 efg	23 ab	196.7 def
IT89KD-245	49 bc	21 bcd	230.0 a
IT82D-849	48 bcd	21 bcd	121.7 j
B 301	47 cde	25 a	121.7 d-g
IT81D-985	45 efg	21 bcd	228.3 ab
IT81D-994	46 c-f	21 bcd	205.0 b-e
IT86D-843	42 g	23 ab	190.0 d-g
TN 93-80	50 b	23 ab	171.7 fgh
TN 121-80	49 bc	22 bc	151.7 hi
VITA 3	50 b	22 bc	238.3 a
SUVITA 2	50 b	23 ab	205.0 b-e
SAMPEA 7	47 cde	21 bcd	199.8 cde
S.E	0.86	0.88	8.17
Interactions			
I x V	N.S	N.S	N.S

Means followed by the same letter(s) are not significantly different at 5% level of Probability (DMRT)

Table 6: Interaction of cowpea variety and Alectra on number of pods of cowpea at Samaru, 2004

	Number of pods/plot Infection		
Varieties	**Infection**	**Un-infected**	**Mean**
IT845-2246-4	252 ijk	251 ijk	251 fg
Kano 1696	562 e-f	840 a	701 a
IT89KD-245-1	459 efg	938 a	699 a
TVX 3236	410 e-i	483 e-g	447 b-e
IT90K-59	521 b-g	666 bc	594 abc
IT90K-76	405 e-i	688 b	547 a-d
IT86D-534	461 efg	473 d-g	467 b-e
IT89KD-245	225 kji	440 e-h	333 efg
IT82D-849	353	364 g-j	361 ef
B 301	548 b-g	662	308 ab
IT81D	384 f-j	462 efg	423 cde
IT81D-994	538 b-g	366 b-g	452 b-e
IT86D-843	268 h-k	525 c-g	397 def
TN 93-80	452 efg	515 b-g	483 b-e
TN 121-80	375 f-j	494 b-g	434 cde
VITA 3	640 bcd	507 c-g	574 abc
SUVITA 2	183 Ki	217 j-k	200 g
SAMPEA 7	595 b-e	529 b-g	562 a-g
(Int.) S.E	74.54	(V) S.E	52.69
Mean	424 b	524 a	

(I) S.E 17.59

Means followed by the same letter(s) within a treatment group in the marginal means and within the first order of interactions are not different statistically by DMRT at 5% level

(Int.) = Interaction, (V) = variety, (I) = Infection

Table 7: Interaction of cowpea variety and Alectra on weight of pods of cowpea at Samaru 2004 wet season

	Weight of pods/plots^2 Infection		(Kg/ha)
Varieties	**Infected**	**Un-infected**	**Mean**
IT84S-2246-4	860 J-M	1160 i-1	1020 fg
Kano 1696	1420 hij	2420 b-e	1930 bc
IT89KD-245-1	1110 jkl	2690 a-d	1910 bc
TVX 3236	730 j-m	2760 abc	1760 cd
IT90K-59	2190 c-g	2330 b-f	2270 ab
IT90K-76	2070 efg	2530 a-e	2310 a
IT86D-534	1360 h-k	1310 h-l	1360 de
IT89KD-245	760 km	2270 c-g	1510 de
IT82D-849	620 m	870 j-m	760 g
B 301	1710 ghi	3090 a	2390 a
IT81D-985	790 klm	2190 c-g	1510 de
IT81D-994	870 j-m	2130 d-g	1490 de
IT86D-843	790 klm	2110 d-g	1490 de
TN 93-80	840 j-m	2110 d-g	1310 ef
TN 121-80	760 klm	980 j-m	870 g
VITA 3	2190 c-g	2890 ab	2530 a

SUVITA 2	290 m	1090 jkl	760 g
SAMPEA 7	1110 jkl	2390 b-e	1760 cd
(Int.) S	180	(V) S.E	130.0
Mean	1160 b	2070 a	
(I)	S.E 40.0		

Means followed by the same letter (s) within a treatment group in the marginal means and within the first order of interactions are not different statistically by DMRT at 5% level

(Int.) = Interaction, (V) = variety, (I) = Infection

Table 8: Interaction of cowpea variety and Alectra on grain yield and % yield reduction at Samaru, 2004 season

Varieties	Grain yield (Kg/ha) Infection Infected	Un-infected	Mean	Reduction in grain yield due to Alectra %
IT84S-2246-4	541 i-m	765 h-k	653 fg	29.3
Kano 1696	830 g-I	1066 e-h	948 def	22.1
IT89KD-245-1	708 h-l	1679 ab	1194 cd	57.8
TVX 3236	237 m	1570 abc	904 def	84.9
IT90k-59	1011 e-h	1715 a	1363 bc	41.1
IT90K-76	1006 e-h	1794 a	1400 bc	43.9
IT86D-534	950 e-I	953 e-I	952 de	0.4
IT89KD-245	475 j-m	1534 a-d	1004 de	69.1
IT82D-849	211 m	327 lm	269 h	35.5
B 301	1032 e-h	1919 a	1476 b	46.3
IT81D-985	478 j-m	1335 b-e	907 def	64.2
IT81D-994	570 i-m	1206 c-g	888 ef	52.7
IT86D-843	586 j-m	1269 b-f	877 ef	61.7
TN 93-80	461 j-m	1127 d-h	794 efg	59.1
TN 121-80	398 klm	748 h-l	573 g	46.7
VITA 3	1934 a	1804 a	1869 a	-7.2
SUVITA 2	188 m	852 f-j	520 gh	77.9
SAMPEA 7	747 h-l	1370 b-e	1058 de	45.5
(Int.) S.E	132.60	(V) S.E.	193.78	
Mean	681 b	1280 a		
	(I) S.E. 31.26			

Means followed by the same letter(s) within a treatment group in the marginal means and within the first order of interactions are not different statistically by DMRT at 5% level

(Int.) = Interaction, (V) = Variety, (I) = Infection

The negative correlations between cowpea grain yield and Alectra shoot count, number of plants infected, days to Alectra emergence and crop damage symptom score in the two trials (Tables 9 and 10) indicated that Alectra

parasitism reduced cowpea grain yield seriously. Similar observation has been reported (Atokple et al., 1991). The positive correlation observed between grain yield and weight of pods revealed this as an important yield component and determinant of cowpea grain yield. There was stronger relationship between cowpea grain yield and Alectra parameters at 9WAS than other stages of crop growth. This could probably be explained by the fact that maximum Alectra emergence occurred at 9WAS which probably cause serious damage at the crop. Subsequent emergence are either less damaging on the crop. In addition many of the earlier emerged shoots of Alectra senesce and die off after 9WAS and escape assessment.

Table 9: Correlation between cowpea grain yield and various parameters in the screening of cowpea varieties for Alectra tolerance at Tasha Zomo, 2003 wet season

	1	2	3	4	5	6	7	8	9	10	11
1	1.0										
2	-0.35**	1.0									
3	-0.34*	0.90**	1.0								
4	-0.35**	0.88**	0.76**	1.0							
5	-0.41**	0.83**	0.86**	0.85**	1.0						
6	-0.39**	0.86**	0.77**	0.93**	0.85**	1.0					
7	-0.37**	0.84**	0.87**	0.80**	0.95**	0.82**	1.0				
8	-0.96**	-0.33*	-0.31*	-0.36**	-0.36**	-0.35**	1.0				
9	-0.10	0.38**	0.30*	0.35**	0.50**	0.29*	-0.08	1.0			
10	-0.53**	-0.68**	-0.63**	-0.77**	-0.70**	-0.61**	-0.61	-39**	0.59**	1.0	
11	0.42**	-0.26	-0.34*	-0.18	-0.26**	-0.24	-0.37**	0.43**	-0.03	-0.24	1.0

1	Grain yield	8	Weight of pods
2	Number of plants infected at 8 WAS	9	Number of days to Alectra emergence
3	Alectra count at 8 WAS	10	Crop damage symptom score at 9 WAS
4	Number of plants infected at 9 WAS	11	Crop stand count at harvest
5	Alectra count at 9 WAS	*	Significant at 5% of probability (r = 0.27)
6	Number of plants infected at harvest	*	Significant at 1% level of probability (r = 0.35)
7	Alectra count at harvest		

Table 10: Correlation between grain yield and various parameters under Alectra infestation in the screening of cowpea varieties for Alectra resistance/toleance, at Samaru 2004 wet season

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.0												
2	-0.29*	1.0											
3	-0.25*	0.86**	1.0										
4	-0.32*	0.90*	0.79**	1.0									
5	-0.52*	0.85**	0.87**	0.87	1.0								
6	-0.30*	0.88**	0.78**	0.97	0.89**	1.0							
7	-0.26	0.84**	0.85**	0.87*	0.98**	0.84	1.0						
8	-0.17	0.71**	0.73**	0.80**	0.89**	0.82**	0.87	1.0					
9	-0.14	0.63**	0.86**	0.71**	0.86**	0.73**	0.89**	0.88**	1.0				
10	-0.86**	-0.37**	-0.24	-0.39**	-0.31*	-0.37**	-0.27*	-0.22	-0.13	1.0			

11	-0.35**	0.17	0.08	0.25	0.09	0.21	0.09	0.09	0.03	-0.63**	1.0	
12	-0.18	-0.63*	0.55**	0.69**	0.61**	0.73**	0.61**	0.61**	0.45**	-0.34**	0.11	1.2
13	0.26	-0.19	-0.18	-0.21	-0.24	-0.24	-0.26	-0.24	-0.24	0.36**	-0.38**	-0.24	1.0

1	Grain yield	9	Alectra count at harvest
2	Number of plants infected at 8 WAS	10	Weight of pods
3	Alectra count at 8 WAS	11	Number of days to Alectra emergence
4	Number of plants infected at 9 WAS	12	Crop damage symptom score at 9 WAS
5	Alectra count at 9 WAS	13	Crop stand count at harvest
6	Number of Plants infected at 10 WAS	I	= Significant at 5% levels of probability (r = 0.27)
7	Alectra count of 10 WAS	II	= Significant at 1% level of probability (r = 0.35)
8	Number of plants infected at harvest		

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