Striga Research in Sorghum at ICRISAT Center

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ABSTRACT

Information on current progress in refinement of screening techniques, identification of resistant germplasm and breeding lines, and crop loss assessment due to *Striga* attack is presented. A new lab-cum-pot steel mesh roll technique which permits interaction of stimulants with soil was developed and found effective in differentiating the low- from high-stimulant producing sorghum lines. The results correlated well with the results from field screening in breeding lines for *Striga* resistance. In the *Striga*-sick plot, significant increase in *Striga* incidence was achieved using an improved package of practices. An annual grain yield loss due to *Striga* of 53000 tons has been estimated in hybrid production in India, and at ICRISAT Center grain yield losses of up to 49% have been recorded. Resistant germplasm and breeding lines identified at ICRISAT Center have been listed. Future research should emphasize development of single plant selection procedures in early-segregating generations, and exploitation of mechanisms of *Striga* resistance other than low-stimulant production.

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INTRODUCTION

The parasitic weed *Striga* (white flowered, *Striga asiatica* L. Kuntze) is recognized as major problem on sorghum in parts of Africa and India (ICSU, 1984). A breeding program to develop *Striga*-resistant varieties, initiated in 1975 at ICRISAT Center, has resulted in a number of resistant varieties (ICRISAT, 1981 to 1988). These varieties have already entered various national and international sorghum breeding programs. Some of these varieties have also been reported resistant to *S. asiatica* and *S. forbesii* found in parts of southern Africa (ICRISAT, 1988). Work until 1983 has been reported at *Striga* workshops held at Ouagadougou in 1981, and at Dakar in 1983 (Vasudeva Rao et al. 1983, and Vasudeva Rao 1985a). The later research at ICRISAT Center has been pursuant on some of the recommendations of these workshops to refine screening techniques, develop reliable *Striga*-sick fields, and assess crop losses, in addition to identifying of resistant genetic material. The progress made is described in this paper.

SCREENING TECHNIQUE

Screening, both in laboratory and in the field, has been found useful to identify *Striga* resistance in sorghum. However, the existing laboratory screening (double-pot technique) is reported to have poor correlation with field results (Vasudeva Rao et al. 1983). The field screening suffers from lack of uniform and reliable levels of *Striga* infestation.

Steel Mesh Roll Technique

Laboratory conditions often affect the results because environmental conditions are different from the field whereas the conditions in pot technique are considered closer to the field. To complement the advantages of laboratory and pot conditions, a laboratory-cum-pot steel mesh roll technique has been developed at ICRISAT Center. The technique uses double filter paper, enclosing preconditioned *Striga* seeds, sandwiched in glass fiber filter paper discs rolled in a steel mesh. This steel mesh roll is kept in a 1:1 mixture of sand and clay soil, filled in a 12.5 cm diameter plastic growers pot, wherein the test genotype is grown. The pots are maintained in the ambient environmental conditions and watered regularly. Two weeks after seedling emergence, the steel mesh roll is removed from the pot. The sandwiches of glass fiber filter paper discs are carefully opened in the laboratory, and the percent germinated *Striga* is calculated, using a microscope.

The technique has been tested over a series of monthly experiments in 1986/87 and 1987/88 at ICRISAT Center. In each experiment, five sorghum cultivar treatments, comprising of two field-susceptible, high-stimulant producing cultivars, CSH 1 and Swarna; two field-resistant, low-stimulant producing cultivars, 555 and Framida; and a field-resistant, high-stimulant producing cultivar, N 13, were compared along with a control (without sorghum seeds) treatment. Each treatment was represented by 24 pots so that four pots were available for each observation at 6, 8, 10, 12, 14, and 16 days after seedling emergence. The experiment was conducted in a randomized complete block design with four replications, and the data computed using factorial analysis. Significant differences were observed among the high- and low-stimulant producing cultivars in both 1986/87 and 1987/88 (Table 1). The percent *Striga* germination was lower in 1987/88 than in 1986/87, but did not affect the differences among the cultivars. The results further indicated that about 14 days of host seedling growth after emergence (Fig. 1), and the months of June to November, both favored the differentiation of low- from high-stimulant cultivars (Fig. 2). Thus, the high-stimulant producing cultivars (CSH 1, Swarna, and N 13) could be differentiated from low-stimulant producing cultivars (555 and Framida).

Correlation coefficients were calculated to see if there was any improvement in correspondence of screening results between steel mesh roll technique (SMR) and the double-pot technique (DPT) to that of the field technique (FLD) (Table 2). Two sets, one of breeding lines and another of germplasm lines, were screened, using the steel mesh roll technique, the double-pot technique, and the field technique. The *Striga* reaction in the field was obtained using the observation nursery stage of the three-stage testing procedure (Vasudeva Rao, 1985b). For breeding lines, a significant correlation coefficient was obtained for results between SMR and FLD and between SMR and DPT. On the other hand, for germplasm lines, the correlation coefficient between SMR and FLD alone was significant. However, the correlation coefficients between the results of DPT and FLD were nonsignificant for both breeding and germplasm lines. The correlation of screening results from SMR to that of FLD had improved, perhaps because the host-root exudates stimulated the *Striga* seed germination in SMR after interaction with the soil medium, whereas no such opportunity existed in DPT.

Development of *Striga*-sick Plot

Although guidelines useful to develop *Striga*-sick field have been listed earlier (Vasudeva Rao, 1985b), these were supplemented by providing factors known to favor *Striga* incidence, and a field study done. The cultural practices examined, are:

1. Use of a low fertility field with good surface drainage.
2. Least tillage operations, preferably rotovating soil to a depth of 10-15 cm only.
3. Uniformly distribute at least 1-year old *S. asiatica* seeds, @ 1.5 kg ha^{-1}, in the field about 3 months before sowing the host crop.
4. Leaving the field fallow until sowing of the host crop.
5. Presowing irrigation (perfo-system), such that the field remains wet continuously for 10-12 days prior to sowing.
6. Immediately after, sow the host crop (sorghum) on ridges, 0.6 m apart, about 1 month ahead of the normal planting time in the rainy season.
7. No fertilizer application.
8. Thinning operations completed within 10 days, and weeding within 25 days, after seedling emergence.
9. Avoid intercultivation and other machinery operations in the later crop season.

The field study was conducted during rainy seasons 1985, 1986, and 1987. During 1985, the field was managed following standard cultural practices with the natural *Striga* seed infestation in soil. In 1986 and 1987, it was managed following the practices listed above. The field was sown on 22 May in 1986 and on 15 May in 1987, using a *Striga* susceptible sorghum hybrid CSH 1, in 4-row plots of 2.25 m row length and 0.6 m row-to-row spacing, with 0.75 m alleyways. The numbers of emerged *Striga* plants (*Striga* count) per plot were recorded. *Striga* incidence increased as was evident from the *Striga* count in 1985 to 1987 (Table 3). The frequency distribution of number of plots revealed that in 1986 fewer plots were without *Striga* than in 1985, and in 1987 no plot was without *Striga*; the infestation level per plot had also increased (Fig. 3). This was also indicated by the expression of host-plant symptoms such as stunted growth, leaf wilting, delayed flowering, reduced plant height, and loss in grain yield. In the portion of the field where *Striga* seed was not infested, however, CSH 1 had no *Striga* and/or stress symptoms. Thus, the package of practices studied did result in regular increased levels of *Striga* infestation in the field.

IDENTIFICATION OF RESISTANCE

At ICRISAT Center, the sorghum germplasm collection has been screened to identify sources of resistance, and some of these sources utilized in the development of *Striga*-resistant breeding lines.

Resistant source lines. To date, 15057 sorghum lines have been screened by the double-pot technique, and 672 low-stimulant producing lines identified. These lines were tested in the *Striga*-sick field across locations, and 80 lines were found to be resistant (Table 4). Among these and other field-resistant lines, based on resistance mechanism other than low-stimulant production, which entered the parentage in the crossing program, were; IS 2221, IS 4202, IS 5106, IS 5218, IS 7471, IS 9830, IS 9985, IS 18475 (555), IS 8744 (Framida), IS 18331 (N 13), IS 18339 (NJ 1515), and IS 18520 (Serena). However, IS 18475 and IS 8744 were the parents in many of the advance breeding lines.

Breeding approach. Encouraging results were obtained from the modified pedigree breeding program, by exploiting the resistant source parents in a range of crosses. Considerable number of potential resistance-breeding material was generated. The early-segregating generations (F_2 and F_3) usually were grown in a *Striga*-infested field, and single plants selected for their desirable agronomic traits and normal growth. Because of difficulties in assessing *Striga* resistance on an individual plant basis (for reasons implicit in the underground nature of *Striga* attack), selection was based on progenies in the later generations. Progenies exhibiting lower *Striga* count were identified, and individual plants within the selected progenies were selected with desirable agronomic traits and no *Striga* attack symptoms. These selected plants were bulked to form a new progeny for further testing. The magnitude of genetic gain from such selection was certainly low, but not discouraging. In view of this, the approach has been not to reject too many progenies in the early generations, which were tested over locations where *Striga* appearance had been more likely during most years. The entry was selected in the field, when the *Striga* count (emerged *Striga* plants/plot on the susceptible checks was high enough to effect plant symptoms on the host plant, such as stunted growth, delayed flowering, and reduced grain yield. Additionally, the entry should support less than 10% *Striga* count of the adjacent check in all the replications across locations (Vasudeva Rao, 1985b). *Striga* counts, supplemented by host plant symptoms including yield loss estimates, were successfully used in advancing the lines in multilocation trials.

Resistant breeding lines. Efforts were made to incorporate *Striga* resistance into an agronomically elite background. Forty-eight breeding lines with *Striga* resistance, in relatively acceptable and exploitable genetic background, were developed until 1987 (Table 5). The lines were repeatedly tested in the laboratory and in available sick-field conditions, across locations and were observed to support fewer *Striga* plants than the susceptible check (CSH 1, Swarna). The lines worthy of considerable use in the breeding program are ICSV 114, ICSV 115, ICSV 145, ICSV 146, ICSV 153,

ICSV 193, ICSV 421, ICSV 655, ICSV 676, and ICSV 677. ICSV 145 has been already recommended for cultivation in the Striga-endemic areas of India in 1987 and accepted for registration in Crop Science (Vasudeva Rao and Vaidya et al., in press).

CROP LOSS ASSESSMENT

Crop yield losses have been known in sorghum, wherever the fields were plagued by Striga spp. to the extent that farmers even abandon growing of sorghum for several years. More seriously, Striga is continually invading areas that had not been previously infested. There have been reports on yield loss estimates, based on area and production statistics, of the ecological zones where cereal production may be seriously reduced by Striga. However, specific experiments have not been conducted to determine these yield loss estimates. Using the multilocational Striga trials data from 1981 to 1983, crop yield losses in India were estimated by the regression approach on CSH 1, a Striga susceptible sorghum hybrid. Assuming a loss of 10% in the sorghum hybrid crop due to Striga, losses of about 53000 tons of sorghum grain yield, worth about 4.9 million US dollars, had been predicted (Vasudeva Rao et al., in press). In another comparative study on CSH 1, under Striga-infested and non-infested field conditions in 1987, grain yield reduced by 49% in the Striga-infested condition (ICRISAT, 1988).

FUTURE NEEDS IN BREEDING RESEARCH

Though workable screening techniques to identify Striga-resistant lines have been developed, breeders still need a method to pick up resistant single plants in the early-segregating generations to do the selection more precisely. The improved, *Striga*-resistant breeding lines are based on the low-stimulant production mechanism of resistance. Also, the available potential in *Striga*-resistant breeding material is the result of segregants from low-stimulant into high-stimulant lines or low-stimulant into low-stimulant lines. But the level of resistance achievable through such crosses, by itself, may not be enough. Directed efforts are needed to find exploitable source lines with other mechanisms of resistance. The indirect approach to combine genes for different mechanisms of resistance into a common background may be to constitute a population, involving diverse sources and improved resistant lines, using standard random mating procedures. Later, the recurrent selection procedure may be employed to recombine and reconstitute the progressive cycles and extract stable *Striga*-resistant derivatives. More studies on genetics of resistance may further help in reorienting the breeding methodology for *Striga* resistance. To circumvent the increasing need for higher grain yields, efforts may be initiated also to develop *Striga*-resistant hybrids.

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Table 1. Mean percent *Striga* germination on susceptible and resistant sorghum cultivars at different stages of host seedling growth after emergence.

Year	Months	Cultivar	Host seedling age (days)						
			6	8	10	12	14	16	Mean
1986/87	Jun-Nov	CSH 1	52.5	86.9	85.3	84.2	82.8	80.7	78.[illegible]
		Swarna	48.1	78.6	84.5	79.2	76.4	80.0	74.[illegible]
		N 13	43.5	71.8	85.9	79.0	79.8	79.5	73.[illegible]
		555	1.4	1.3	0.8	1.4	1.3	1.5	1.[illegible]
		Framida	1.9	0.7	0.8	1.3	1.2	1.7	1.[illegible]
		Control	0.0	0.3	0.2	0.0	0.0	0.3	0.1
		Mean	24.5	39.9	42.9	40.8	40.2	40.6	
		SED of means							
		Cultivars	±1.04						
		Host age	±1.04						
		Cultivar x host age	±2.55						
		CV%	19						
	Dec-May	CSH 1	2.4	2.3	15.9	12.2	20.2	28.4	13.5
		Swarna	2.3	9.8	23.1	28.5	21.3	21.6	17.
		N 13	3.1	16.4	14.8	23.2	15.7	15.8	14.8
		555	0.0	0.2	0.2	2.4	1.2	2.0	1.0
		Framida	0.1	0.5	0.0	0.3	0.6	0.3	0.3
		Control	0.0	0.1	0.0	0.1	0.1	0.1	0.0
		Mean	1.3	4.9	9.0	11.1	9.8	11.4	
		SED of means							
		Cultivars	±1.21						
		Host age	±1.21						
		Cultivar x host age	±2.96						
		CV%	106						

Table 1 (contd.)

Year	Months	Cultivar	Host seedling age (days)						
			6	8	10	12	14	16	Mean
1987/88	Jun-Nov	CSH 1	16.4	28.3	36.0	37.0	51.7	53.8	37.0
		Swarna	13.4	32.8	38.4	33.3	56.7	62.9	39.6
		N 13	11.3	23.3	33.1	47.2	49.4	56.5	36.8
		555	0.4	0.2	0.5	4.0	0.4	0.4	1.0
		Framida	0.7	0.3	0.9	0.0	0.2	0.5	0.4
		Control	0.2	0.2	0.0	0.0	0.0	0.0	0.0
		Mean	7.1	14.2	18.1	20.2	26.4	29.0	
		SED of means							
		Cultivars	±0.87						
		Host age	±0.87						
		Cultivar x host age	±2.12						
		CV%	41						
	Dec-Feb	CSH 1	0.0	20.2	27.0	37.0	43.4	43.2	28.5
		Swarna	0.0	17.6	29.3	38.5	49.9	47.1	30.4
		N 13	5.9	18.9	48.3	44.2	48.0	49.5	35.8
		555	0.1	0.3	0.4	0.5	0.6	0.5	0.4
		Framida	0.0	0.0	0.4	0.4	0.5	0.3	0.3
		Control	0.0	0.0	0.0	0.3	0.2	0.0	0.1
		Mean	1.0	9.5	17.6	20.1	23.7	23.4	
		SED of means							
		Cultivars	±1.91						
		Host age	±1.91						
		Cultivar x host age	±4.68						
		CV%	66						

Table 2. Correlation coefficient among the screening techniques.

Genetic material	Lines tested	DPT and FLD	SMR and FLD	DPT and SMR
Germplasm material	72	0.09	0.44**	0.14
Breeding material	20	0.17	0.69**	0.46*

DPT = Double-pot technique; FLD = Field technique; SMR = Steel mesh roll technique; * Significant at $p < 0.05$; ** Significant at $p < 0.01$.

Table 3. Field incidence of *Striga*, ICRISAT Center, rainy seasons 1985, 1986, and 1987.

Year	Cultural practices	*Striga* count[1] Mean	Range
1985	Standard	15.66	0-103
1986	Recommended	53.60	0-680
1987	Recommended	296.62	28-1887

1. Emerged *Striga* count in 2.10 m area.

Table 4. *Striga*-resistant germplasm lines.[1]

S.No.	IS No.	Origin	Taxonomic classification	Time to flower (days)	Plant height (cm)	Plant color	Grain color
1	2221	USA	Guinea-kafir	66	130	Tan	White
2	2261	Sudan	Kafir-caudatum	54	220	Pigmented	"
3	2643	India	Durra	67	180	Tan	"
4	3366	USA	Bicolor	67	180	"	"
5	3675	USA	Kafir-durra	61	220	"	"
6	4270	India	Durra	60	150	"	"
7	4415	India	Durra	63	140	"	"
8	4419	India	Durra	60	100	"	Yellow
9	4969	India	Durra	57	210	"	White
10	6331	India	Guinea-caudatum	56	200	"	Brown
11	6041	India	Durra-bicolor	47	210	"	Reddish brown
12	6723	Burkina Faso	Durra-caudatum	60	260	"	"
13	7015	Sudan	Caudatum-bicolor	60	220	Tan	White
14	7079	Sudan	Guinea-caudatum	50	150	Pigmented	Brown
15	7091	C. Africa	Caudatum	56	280	"	"
16	7329	Nigeria	Durra-caudatum	67	200	Tan	White
17	7334	Nigeria	Durra-caudatum	57	170	"	"
18	7343	Nigeria	Durra-caudatum	56	180	Pigmented	"
19	7436	Nigeria	Guinea-bicolor	56	200	Tan	"
20	7471	Nigeria	Guinea	61	250	"	Straw
21	7730	Nigeria	Guinea	68	270	Pigmented	White
22	7732	Nigeria	Guinea-bicolor	61	270	"	"
23	7734	Nigeria	Guinea	60	220	"	"
24	7773	Nigeria	Guinea	67	250	"	"
25	7821	Nigeria	Guinea	57	230	"	"
26	8222	Uganda	Caudatum-bicolor	61	260	Tan	Purple
27	8556	Chad	Caudatum	55	140	Pigmented	Brown
28	8560	Chad	Caudatum	60	100	"	"
29	8563	Chad	Caudatum	57	180	"	Light brown
30	8744	S. Africa	Caudatum	56	155	"	Red
31	8785	Kenya	Caudatum	56	140	"	Brown
32	9569	S. Africa	Caudatum	56	160	"	Red
33	9830	Sudan	Caudatum	50	190	"	White
34	9832	Sudan	Caudatum	56	190	"	Red
35	9934	Sudan	Caudatum	55	190	"	White

S.No.	IS No.	Origin	Taxonomic classification	Time to flower (days)	Plant height (cm)	Plant color	Grain color
36	9985	Sudan	Durra	75	165	"	Yellow
37	10107	Burkina Faso	Guinea-caudatum	60	260	"	Red
38	10139	Burkina Faso	Caudatum-bicolor	60	250	"	Grey
39	10158	Burkina Faso	Guinea	58	230	Tan	White
40	10162	Burkina Faso	Guinea	58	250	"	"
41	10187	Burkina Faso	Guinea-caudatum	60	250	Pigmented	Red
42	10234	C. Africa	Guinea-caudatum	57	140	"	"
43	10306	USA	Durra-caudatum	56	100	"	White
44	10319	Nigeria	Guinea-durra	61	110	Tan	"
45	10336	Nigeria	Durra-caudatum	61	130	Pigmented	Yellow
46	10529	USA	Kafir-caudatum	60	85	"	White
47	10699	Nigeria	Durra-caudatum	61	120	"	Yellow
48	10700	Nigeria	Guinea	60	220	Tan	White
59	10726	USA	Guinea	61	240	"	"
50	10775	Chad	Guinea	56	200	Pigmented	"
51	10776	Chad	Guinea-caudatum	61	230	Tan	"
52	10778	Chad	Caudatum	60	240	"	"
53	10833	Chad	Guinea	56	230	"	"
54	10834	Chad	Guinea	56	260	Pigmented	Light red
55	10835	Chad	Guinea	57	200	Tan	Grey
56	10836	Chad	Guinea-caudatum	61	240	"	Chalky white
57	10838	Chad	Guinea-bicolor	57	260	"	White
58	10839	Chad	Guinea-bicolor	55	200	Pigmented	"
59	10869	Australia	Guinea	54	210	"	Light red
60	10875	Nigeria	Guinea	56	230	"	White
61	10883	Nigeria	Guinea-caudatum	61	260	"	Brown
62	10921	USA	Durra-caudatum	61	80	"	White
63	10922	USA	Durra-caudatum	57	100	Tan	Chalky
64	10927	USA	Durra-caudatum	56	80	Pigmented	"
65	10931	USA	Durra-caudatum	58	105	"	White
66	10932	USA	Durra-caudatum	59	110	"	"
67	10933	USA	Durra-caudatum	56	80	"	"
68	10934	USA	Durra-caudatum	61	130	Tan	"
69	12605	Nigeria	Durra-bicolor	57	230	"	"
70	14844	Cameroun	Caudatum	57	210	"	Straw
71	15823	Cameroun	Caudatum	55	200	Pigmented	Light red
72	15867	Cameroun	Guinea-caudatum	56	230	"	White
73	16005	Cameroun	Guinea-bicolor	58	230	Tan	"
74	16127	Cameroun	Guinea-bicolor	60	250	Pigmented	"
75	16184	Cameroun	Caudatum	56	190	"	Light brown

S.No.	IS No.	Origin	Taxonomic classification	Time to flower (days)	Plant height (cm)	Plant color	Grain color
76	16185	Cameroun	Caudatum	55	190	"	Reddish brown
77	16437	Cameroun	Caudatum	63	180	"	"
78	16661	Cameroun	Guinea	60	240	"	Light re
79	18475	India	Durra	62	110	Tan	Straw
80	18717	India	--	78	170	"	Straw

1. Lines which showed emerged *Striga* count as < 10% of the adjacent susceptibl check at the available level of *Striga* infestation in field.

Table 5. *Striga*-resistant breeding lines.[1]

S.No.	ICSV no.	Pedigree	Time to 50% flowering (days)	Plant height (cm)
1.	ICSV 113	(148 x 555)-1-2	64	129
2.	114	[SRN 4841 x (WABC x P 3)-3]-7-3	68	219
3.	115	(555 x 168)-19-2-7	65	134
4.	145	(555 x 168)-1-1	66	250
5.	146	(555 x 168)-16	59	156
6.	147	(555 x GPR 168)-23-2-2-3-2	64	143
7.	152	(N 13 x 269)-5-2	67	238
8.	153	(555 x GPR 168)-23-1-2	70	239
9.	169	(Framida x 3691)-1-1-3	76	140
10.	171	(148 x Framida)-36-2	74	155
11.	172	(555 x Awash 1050)-2-2-1	85	134
12.	173	(SRN 4841 x SPV 104)-17-1	64	230
13.	191	(20/75)-1-1-1-2-1	65	200
14.	192	(Framida x 148)-21-2-1-4-1	65	150
15.	193	(148 x Framida)-39-2-4-1-2-1	66	183
16.	418	(148 x 555)-1-2-2-1	65	165
17.	419	(148 x 555)-Bulk-1	67	110
18.	420	(148 x 555)-Bulk-4-1-3	68	165
19.	421	(148 x 555)-Bulk-1-1-1	68	160
20.	422	(20/75)-1-1-3-2-2	62	130
21.	423	(Framida x IS 3691)-1-2-1	73	140
22.	424	(Framida x IS 3691)-9-1-3-4-3	71	190
23.	655	(20/75)-1-1-5-1	63	190
24.	656	(20/75)-1-1-2-2-1-2-2	63	145
25.	657	(GPR 148 x Framida)-1-2-4-1	67	132
26.	658	(555 x GPR 168)-23-1	66	240
27.	659	(GPR 148 x 555)-6K	63	205
28.	660	(GPR 148 x 555)-33-1-3	65	197
29.	661	(Framida x GPR 168)-9-2-3-1	68	170
30.	662	(Framida x 9-60)-5-4-1	79	250
31.	663	[555 x (PD 3-1-11 x CSV 4)-29-3]-5-2-1-1	76	187
32.	664	(555 x Awash 1050)-2-2	80	145
33.	665	(SRN 4841 x SPV 104)-17	63	255
34.	666	(555 x GPR 168)-1-1	60	156
35.	667	(Framida x GPR 148)-21-2-2-4	61	157

S.No.	ICSV No.	Pedigree	Time to 50% flowering (days)	Plant height (cm)
36.	669	(N 13 x 2KX 6)-1-2-1-2	67	192
37.	671	(20/75)-1-1-2-2-1-1	66	158
38.	672	(Framida x IS 3692)-7-2-1-2-2-1-5	76	136
39.	673	(GPR 148 x Framida)-2-1	64	144
40.	674	(GPR 148 x Framida)-3-3-1	73	141
41.	675	(GPR 148 x Framida)-2-1-2-2-1	72	155
42.	676	(GPR 148 x 555)-29-3-2-1-1	67	130
43.	677	(GPR 148 x 555)-33-1-3-1-1-1	66	167
44.	678	[555 x (IS 146 x CSV 4)-6]-22-2-1-1	68	170
45.	679	[SRN 4841 x (WABC x P 3)-3]-7-3-5-1-1	66	178
46.	697	(555 x 168)-23-1-1-1-2	71	214
47.	760	(148 x 555)-29-3-2-2	71	151
48.	761	(148 x Framida)-2-1-2-3-1	67	214

1. Lines which showed emerged *Striga* count as < 10% of the adjacent susceptible check at the available level of *Striga* infestation in field.

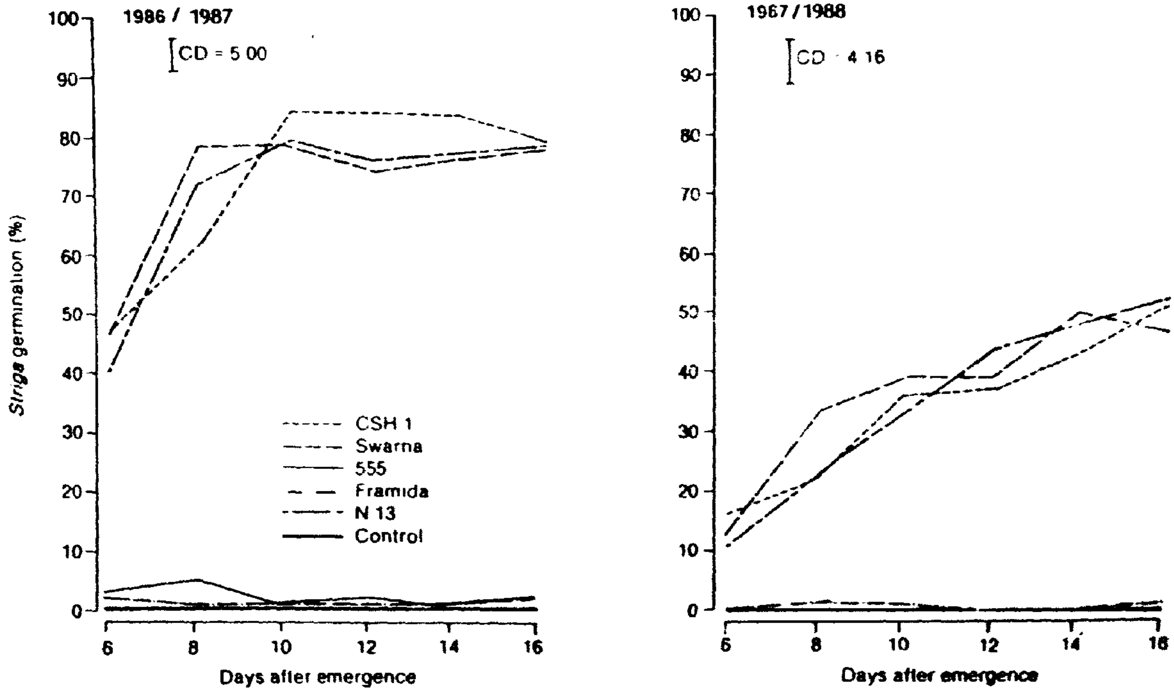

Figure 1. **Percent *Striga* germination at increasing host-seedling age of susceptible and resistant sorghum cultivars, during June to November each year.**

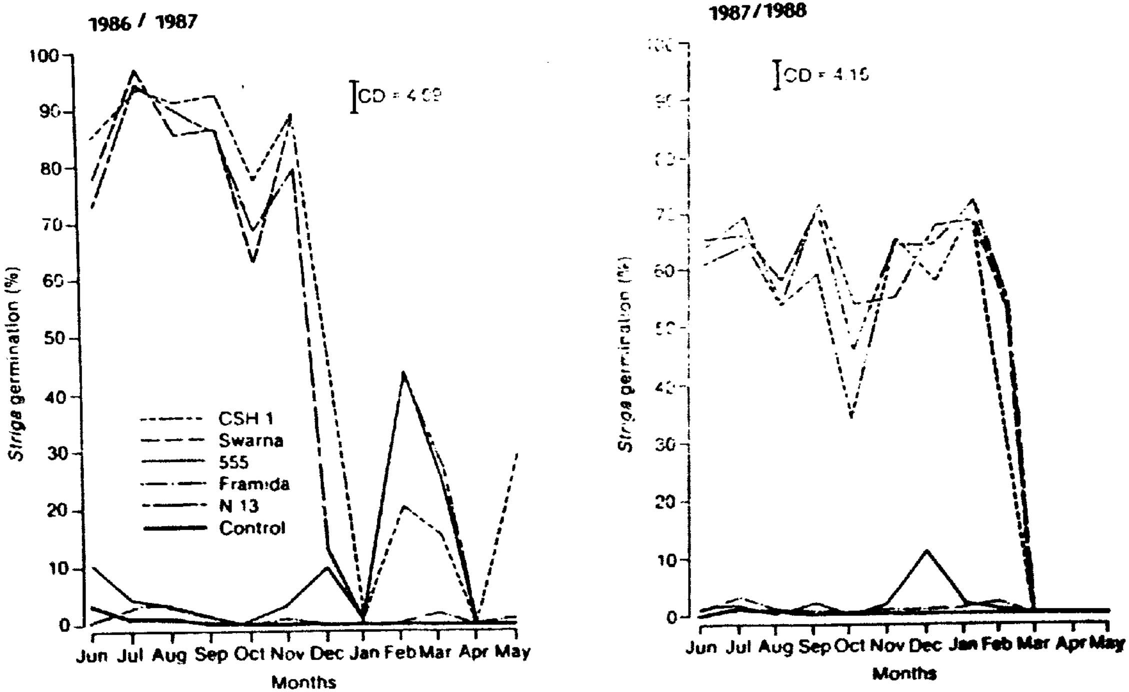

Figure 2. *Striga* germination (%), by month, in susceptible and resistant sorghum cultivars at two weeks after emergence.

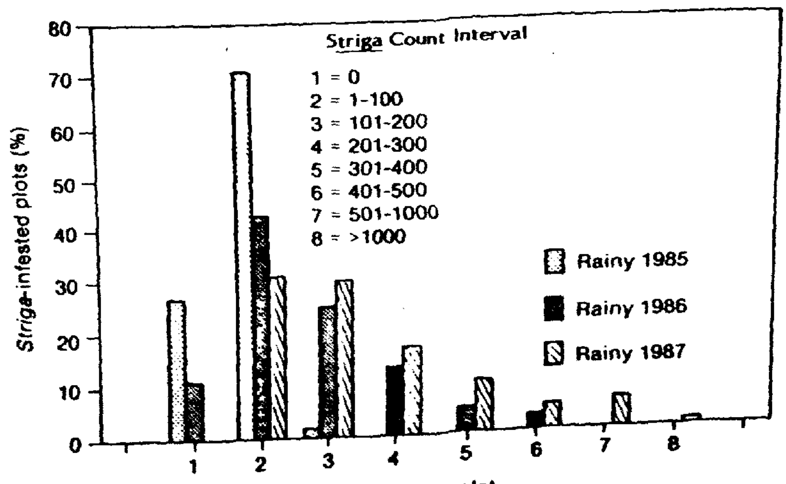

Figure 3. Frequency distribution of Striga-infested plots in the field.