Combating Striga in Africa

Proceedings of the International Workshop
organized by

International Institute of Tropical Agriculture (IITA)
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
International Development Research Centre (IDRC)

22 - 24 August 1988
Ibadan, Nigeria

S. K. Kim
EDITOR

International Institute of Tropical Agriculture

About IITA

The goal of the International Institute of Tropical Agriculture (IITA) is to increase the productivity of key food crops and to develop sustainable agricultural systems that can replace bush fallow, or slash-and-burn, cultivation in the humid and subhumid tropics. Crop improvement programs focus on cassava, maize, plantain, cowpea, soybean, and yam. Research findings are shared through international cooperation programs, which include training, information, and germplasm exchange activities.

IITA was founded in 1967. The Federal Government of Nigeria provided a land grant of 1,000 hectares at Ibadan, for a headquarters and experimental farm site, and the Rockefeller and Ford foundations provided financial support. IITA is governed by an international Board of Trustees. The staff includes around 180 scientists and professionals from about 40 countries, who work at the Ibadan campus and at selected locations in many countries of sub-Saharan Africa.

IITA is one of 16 nonprofit, international agricultural research centers currently supported by the Consultative Group on International Agricultural Research (CGIAR). Established in 1971, CGIAR is an association of about 50 countries, international and regional organizations, and private foundations. The World Bank, the Food and Agriculture Organization of the United Nations (FAO), and the United Nations Development Programme (UNDP) are cosponsors of this effort.

Correct citation

Kim, S. K. (ed). 1991. Combating Striga in Africa. Proceedings, International Workshop organized by IITA, ICRISAT and IDRC, 22-24 August 1988. IITA, Ibadan, Nigeria. 151 pp.

Oyo Road, PMB 5320
Ibadan, Nigeria

Telex: 31159 or 31417 TROPIB NIG
Cable: TROPFOUND IKEJA
Telephone: (234-22) 400300-400318

ISBN 978 131 070 7

Progress in Breeding Resistance to *Striga asiatica* in Sorghum at the ICRISAT Center

P. K. VAIDYA[1], B. RAGHAVENDER[1] AND S. Z. MUKURU[2]

Information on current progress in the refinement of screening techniques, identification of resistant germplasm and breeding lines, and assessment of crop losses due to striga attack is presented. A new laboratory-cum-pot steel mesh roll technique which permits interaction of stimulants with soil was developed and found effective in differentiating low from high stimulant-producing sorghum lines. Results correlated well with those from field screening of breeding lines for striga-resistance. In the development of a striga sick plot a significant increase in striga incidence was achieved using an appropriate package of practices. It has been estimated that striga causes an annual yield loss of 53 000 tonnes in hybrid production in India, and at ICRISAT Center yield losses of up to 49 percent have been recorded. Resistant germplasm and breeding lines identified at ICRISAT Center are 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.

The parasitic weed striga (white-flowered, *Striga asiatica* (L.) Kuntze) is recognized as a major problem on sorghum in parts of Africa and India (ICSU 1984). A breeding program, initiated in 1975 at ICRISAT Center, has resulted in a number of striga-resistant varieties (ICRISAT 1981-1988). 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 carried out up to 1983 has been presented in striga workshops held at Ouagadougou in 1981 (Vasudeva Rao et al. 1983) and at Dakar in 1983 (Vasudeva Rao 1985a). Pursuant to some of the recommendations of these workshops, later research at the ICRISAT Center has sought to refine screening techniques, develop reliable striga-sick fields and assess crop losses, in addition to identifying resistant genetic material. Progess is described in this paper.

Screening technique

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

Steel mesh roll technique

Laboratory conditions produce results which differ from those in the field because environmental conditions are markedly different. Conditions in pot techniques, however, are considered to be closer to those in the field. To combine the advantages of laboratory and pot conditions, a laboratory-cum-pot steel mesh roll technique has been developed at ICRISAT Center. It uses double filter paper enclosing 30-50 preconditioned striga seeds, sandwiched between glass-fiber filter paper discs rolled in steel mesh. This steel mesh roll

1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh 502 324, India.
2. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), P O Box 30786, Nairobi, Kenya.

is placed in a 1:1 mixture of sand and clay soil in a 12.5cm diameter plastic pot, in which the test genotype is grown. The pot is exposed to the ambient environmental conditions and watered regularly. Two weeks after seedling emergence, the steel mesh roll is removed from the pot. The sandwich of glass-fiber filter paper discs is opened in the laboratory and the percentage of germinated striga seed is determined, by counting 4-5 microscopic fields (4x X 10). Each treatment (genotype) is replicated eight times.

The technique was tested in a series of monthly experiments in 1986/87 and 1987/88 at ICRISAT Center. In each experiment, five sorghum cultivars (two field-susceptible, high-stimulant-producing cultivars, CHS 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 treatment (no striga seeds). 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 complete randomized-block design with four replications.

Significant differences were observed between the high- and low-stimulant-producing cultivars in all test periods. Striga germination was lower in 1987/88 than in 1986/87, but this did not affect the pronounced differences between resistant and susceptible cultivars. The results further indicated that at about 14 days after emergence of the host (figure 1), and also, during the months of June to November (figure 2), the separation of the high- from the low-stimulant-producing cultivars was favored.

Correlations between the steel mesh roll technique (SMR), the double-pot technique (DPT), and the field technique (FLD) were obtained by screening a set of breeding lines and another of germplasm lines. Striga reaction in the field was evaluated using the observation nursery stage of the three-stage testing procedure (Vasudeva Rao 1985b). For breeding lines, significant correlations were obtained between SMR and both FLD and DPT, while for germplasm lines only the correlation between SMR and FLD was significant (table 1). The correlation of FLD with SMR was greater than that with DPT 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 a striga-sick plot

Guidelines useful for the development of a striga-sick field (Vasudeva Rao 1985b) were used in a field study that included additional factors believed to favor striga incidence. These factors were:

1. Using a low fertility field with good surface drainage.
2. Using tillage, preferably rotovating soil to a depth of only 10-15cm.
3. Uniformly distributing at least one-year-old *S. asiatica* seed, at 1.5kg ha^{-1} in the field about 3 months before sowing the host crop.
4. Leaving the field fallow until sowing the host crop.
5. Irrigating (perfo-system) so that the field remains wet continuously for 10-12 days prior to sowing.
6. Immediately following irrigation, sowing the host crop (sorghum) on ridges 0.6m apart, about 1 month ahead of the normal planting time in the rainy season.
7. Not applying fertilizer.
8. Completing thinning operations within 10 days, and weeding within 25 days, after seedling emergence.
9. Avoiding intercultivation and other machinery operations in the latter part of the crop season.

The trial was conducted during the rainy seasons of 1985, 1986, and 1987. During 1985, the field was managed following standard cultural practices with natural infestation of striga seed in the soil. In 1986 and 1987, striga seeds were added artificially to three-quarters of the field, which was then 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 2.25m row length and 0.6m row-to-row spacing, with 0.75m alleyways, giving a plot of $2.1m^2$. The number of emerged striga plants (striga count) per plot was recorded. Striga incidence increased from 1985 to 1987 (table

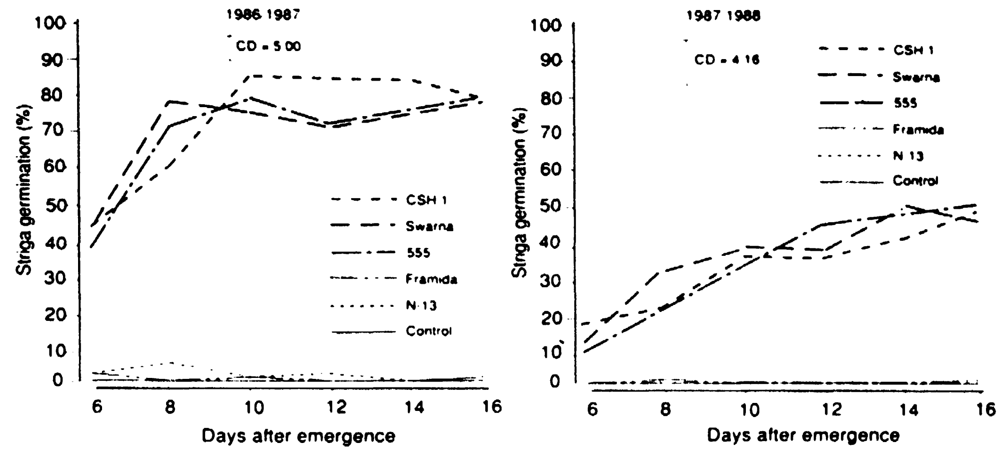

Figure 1. Percent striga germination at increasing host-seedling age of susceptible and resistant sorghum cultivars during June to November of 1986/87 and 1987/88.

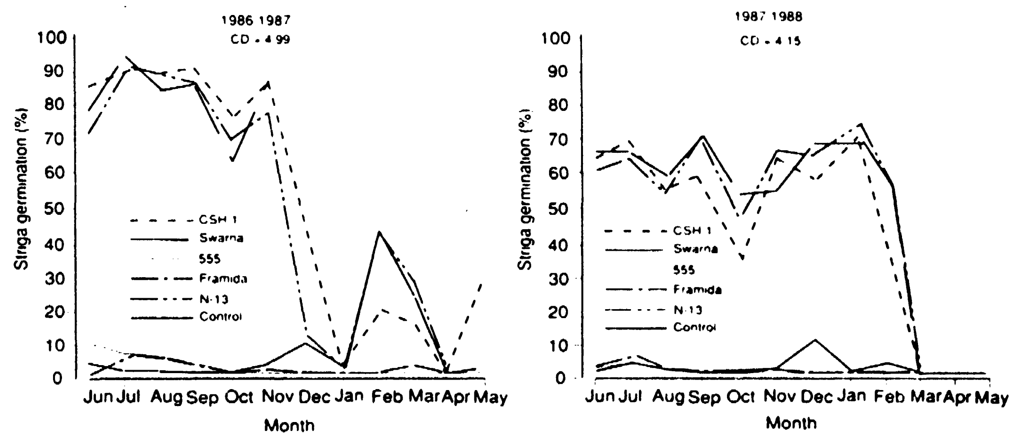

Figure 2. Percent striga germination, by month, in susceptible and resistant sorghum cultivars at two weeks after emergence.

Table 1. Correlation coefficients among three screening techniques

Genetic material	Lines tested	Screening technique comparisons [a]		
		DPT vs FLD	SMR vs FLD	DPT vs SMR
Germplasm material	72	0.09	0.44[b]	0.14
Breeding material	20	0.17	0.69[b]	0.46[c]

Notes: *a* DPT = double-pot technique; FLD = field technique; SMR = steel mesh roll technique

b Statistically significant at $P < 0.01$

c Statistically significant at $P < 0.05$

2). The frequency distribution of the counts (figure 3) reveals that in 1986 fewer plots were without striga than in 1985, and in 1987 no plot was without striga, the infestation level having thus increased. This was also indicated by the expression of host plant symptoms such as stunted growth, leaf wilting, delayed flowering, reduced plant height and yield loss. In a portion of the field where striga seed had not been applied, however, CSH 1 had no striga and/or stress symptoms. Thus, the recommended package of practices studied did result in 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 have been utilized in the development of striga-resistant breeding lines.

Sources of resistance

To date, 15 057 sorghum lines have been screened by the double-pot technique, and 672 low-stimulant-producing lines identified. These lines were tested in striga-sick fields in several locations, and 80 lines were found to be resistant (Appendix 1). Among these and other field-resistant lines, based on a 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 advanced breeding lines.

Breeding approach

Encouraging results were obtained from the pedigree breeding program by exploiting re-

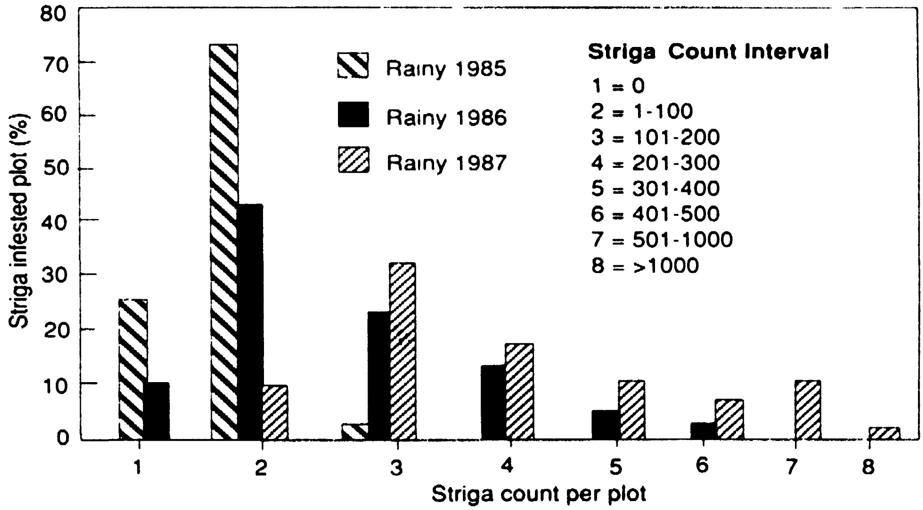

Figure 3. Frequency distribution of striga-infested plots in the field.

Table 2. Field incidence of striga, ICRISAT Center, rainy seasons 1985, 1986, and 1987 (plots 2.1m² in area)

Year	Cultural practices	Emergent striga count: Mean (no. per m²)	Emergent striga count: Range (no. per m²)
1985	Standard	7	0-49
1986	Recommended	26	0-325
1987	Recommended	142	13-903

sistant parents in a range of crosses. A considerable amount of potential resistance breeding material was generated. The early-segregating generations (F_2 and F_3) were usually 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 (because of the underground nature of striga attack), selection was based on progenies in the later generations. Progenies exhibiting lower striga counts were identified, and individual plants among their parents with desirable agronomic traits and no striga attack symptoms were selected. These selected plants were bulked to form a new population for further testing. The 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 several locations where striga was likely to appear during most years. An entry was selected in the field when striga parasitism on the susceptible checks was severe enough to result in symptoms such as stunted growth, delayed flowering, and reduced yield. Additionally, the entry should support less than 10 percent of the striga count of the adjacent check in all replications across locations (Vasudeva Rao 1985b). Striga counts, supplemented by host symptoms, including yield loss estimates, were successfully used in advancing the lines in multilocational 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 backgrounds, were developed up to 1987 (Appendix 2). The lines were repeatedly tested in the laboratory and in the field across locations where striga-sick conditions were available, and were observed to support fewer striga plants than the susceptible checks (CSH 1, Swarna). The lines worthy of considerable use in the breeding program are ICSV 114, 115, 145, 146, 153, 193,421, 655, 676, and 677. ICSV 145 was recommended for cultivation in the striga-endemic areas of India in 1987 (Vasudeva Rao et al. 1989a).

Crop loss assessment

Crop yield losses occur in sorghum wherever the fields are plagued by striga, to the extent that farmers may even abandon the growing of sorghum for several years. More seriously, striga is continually invading areas that had not previously been infested. Yield loss estimates, based on area and production statistics, have been made for the ecological zones where cereal production may be seriously reduced by striga. However, few experiments have been conducted to determine yield losses.

Using data from multilocational trials (1981-83) in India for CSH 1, a striga-susceptible sorghum hybrid, grain yield was regressed on striga count. Estimates of yield loss in the rainy season ranged from 9 to 28 percent (mean 17 percent). Assuming only 10 percent of the hybrid sorghum crop area to be infested at the levels in the trials, losses were estimated to be about 53 000 tonnes of sorghum grain per year, worth about US $4.9 million (Vasudeva Rao et al. 1989b). In 1987, in another field study on CSH 1, grain yield was reduced by 49 percent under striga-infested conditions compared with noninfested conditions (ICRISAT 1988).

Future needs in resistance breeding

Though workable screening techniques to identify striga-resistant lines have been developed, breeders still need a method to detect single resistant plants in early-segregating generations to make selection more precise. The improved striga-resistant breeding lines produced so far are based on the resistance mechanism of low stimulant production. 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. However, the level of resistance achievable through such crosses, by itself, may not be enough. Efforts are needed to find exploitable source lines with other mechanisms of resistance. An indirect approach to inserting genes for different mechanisms of resistance into a common background may be to produce 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 through progressive cycles and extract stable striga-resistant derivatives. More studies on the genetics of resistance may help further in reorienting the breeding methodology for striga-resistance. To satisfy the increasing need for higher yields, efforts should be initiated to develop striga-resistant hybrids.

Acknowledgment

Assistance in computing by Mr A. J. Reddy, Research Associate, ICRISAT, is appreciated.

References

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1981. Annual report 1979-80. ICRISAT, Patancheru, A. P. 502 324, India. 304 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1982. Annual report 1981. ICRISAT, Patancheru, A. P. 502 324, India. 364 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1983. Annual report 1982. ICRISAT Patancheru, A.P. 502 324, India. 416 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1984. Annual report 1983. ICRISAT, Patancheru, A.P. 502 324, India. 371 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1985. Annual report 1984. ICRISAT, Patancheru, A. P. 502 324, India. 376 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1986. Annual report 1985. ICRISAT, Patancheru, A.P. 502 324, India. 379 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1987. Annual report 1986. ICRISAT, Patancheru, A.P. 502 324, India. 367 pp.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1988. Annual report 1987. ICRISAT, Patancheru, A.P. 502 324, India. 390 pp.

ICSU (International Council of Scientific Unions). 1984. Striga: biology and control. Papers presented at a Workshop on the Biology and Control of Striga, 14-17 November 1983, Dakar, Senegal. ICSU Press, Paris/IDRC, Ottawa.

Vasudeva Rao, M.J. 1985a. Patterns of resistance to *Striga asiatica* in sorghum and millets, with special reference to Asia. Pages 93-112, *in*: Striga: biology and control. Papers presented at a Workshop on the Biology and Control of Striga, 14-17 Nov 1983, Dakar, Senegal. ICSU Press, Paris/IDRC, Ottawa.

Vasudeva Rao, M.J. 1985b. Technique for screening sorghums for resistance to striga. Information Bulletin No. 20. ICRISAT, Patancheru, A.P. 502 324, India.

Vasudeva Rao, M. J., V. L. Chidley, K.V. Ramaiah and L. R. House. 1983. Breeding sorghum with resistance to *Striga asiatica* (L.) Kuntze at ICRISAT Center. Pages 61-76, *in*: Proceedings of the Second International Workshop on Striga, 5-8 October 1981. IDRC/ICRISAT, Ouagadougou, Burkina Faso. ICRISAT, Patancheru, A.P. 502 324, India.

Vasudeva Rao M.J., P.K. Vaidya, V.L. Chidley, S.Z. Mukuru and L. R. House. 1989a. Registration of 'ICVS 145' *Striga asiatica*-resistant sorghum cultivar. Crop Science (in press).

Vasudeva Rao, M.J., V.L. Chidley and L.R. House. 1989b. Estimates of grain yield loss caused in sorghum (*Sorghum bicolor* L. Moench) by *Striga asiatica* Kuntze obtained using the regression approach. *in*: Agriculture, ecosystems, and environment (in press).

Appendix 1. Eighty striga-resistant germplasm lines[a]

IS No.	Origin	Classification	Time to flowering (days)	Plant height (cm)	Plant color[b]	Grain color[c]
2221	USA	guinea-kafir	66	130	T	W
2261	Sudan	kafir-caudatum	54	220	P	W
2643	India	durra	67	180	T	W
3366	USA	bicolor	67	180	T	W
3675	USA	kafir-durra	61	220	T	W
4270	India	durra	60	150	T	W
4415	India	durra	63	140	T	W
4419	India	durra	60	100	T	Y
4969	India	durra	57	210	T	W
6331	India	guinea-caudatum	56	200	T	B
6041	India	durra-bicolor	47	210	T	BR
6723	Burkina Faso	durra-caudatum	60	260	T	BR
7015	Sudan	caudatum-bicolor	60	220	T	W
7079	Sudan	guinea-caudatum	50	150	P	B
7091	C. Africa	caudatum	56	280	P	B
7329	Nigeria	durra-caudatum	67	200	T	W
7334	Nigeria	durra-caudatum	57	170	T	W
7343	Nigeria	durra-caudatum	56	180	P	W
7436	Nigeria	guinea-bicolor	56	200	T	W
7471	Nigeria	guinea	61	250	T	S
7730	Nigeria	guinea	68	270	P	W
7732	Nigeria	guinea-bicolor	61	270	P	W
7734	Nigeria	guinea	60	220	P	W
7773	Nigeria	guinea	67	250	P	W
7821	Nigeria	guinea	57	230	P	W
8222	Uganda	caudatum-bicolor	61	260	T	P
8556	Chad	caudatum	55	140	P	B
8560	Chad	caudatum	60	100	P	B
8563	Chad	caudatum	57	180	P	BL
8744	S. Africa	caudatum	56	155	P	R
8785	Kenya	caudatum	56	140	P	B
9569	S. Africa	caudatum	56	160	P	R
9830	Sudan	caudatum	50	190	P	W
9832	Sudan	caudatum	56	190	P	R
9934	Sudan	caudatum	55	190	P	W
9985	Sudan	durra	75	165	P	Y
10107	Burkina Faso	guinea-caudatum	60	260	P	R
10139	Burkina Faso	caudatum-bicolor	60	250	P	G
10158	Burkina Faso	guinea	58	230	T	W
10162	Burkina Faso	guinea	58	250	T	W
10187	Burkina Faso	guinea-caudatum	60	250	P	R
10234	C. Africa	guinea-caudatum	57	140	P	R
10306	USA	durra-caudatum	56	100	P	W
10319	Nigeria	guinea-durra	61	110	T	W
10336	Nigeria	durra-caudatum	61	130	P	Y

Appendix 1. (continued)

IS No.	Origin	Classification	Time to flowering (days)	Plant height (cm)	Plant color[b]	Grain color[c]
10529	USA	kafir-caudatum	60	85	P	W
10699	Nigeria	durra-caudatum	61	120	P	Y
10700	Nigeria	guinea	60	220	T	W
10726	USA	guinea	61	240	T	W
10775	Chad	guinea	56	200	P	W
10776	Chad	guinea-caudatum	61	230	T	W
10778	Chad	caudatum	60	240	T	W
10833	Chad	guinea	56	230	T	W
10834	Chad	guinea	56	260	P	RL
10835	Chad	guinea	57	200	T	G
10836	Chad	guinea-caudatum	61	240	T	C
10838	Chad	guinea-bicolor	57	260	T	W
10839	Chad	guinea-bicolor	55	200	P	W
10869	Australia	guinea	54	210	P	RL
10875	Nigeria	guinea	56	230	P	W
10883	Nigeria	guinea-caudatum	61	260	P	B
10921	USA	durra-caudatum	61	80	P	W
10922	USA	durra-caudatum	57	100	T	C
10927	USA	durra-caudatum	56	80	P	C
10931	USA	durra-caudatum	58	105	P	W
10932	USA	durra-caudatum	59	110	P	W
10933	USA	durra-caudatum	56	80	P	W
10934	USA	durra-caudatum	61	130	T	W
12605	Nigeria	durra-bicolor	57	230	T	W
14844	Cameroon	caudatum	57	210	T	S
15823	Cameroon	caudatum	55	200	P	RL
15867	Cameroon	guinea-caudatum	56	230	P	W
16005	Cameroon	guinea-bicolor	58	230	T	W
16005	Cameroon	guinea-bicolor	60	250	P	W
16184	Cameroon	caudatum	56	190	P	BL
16185	Cameroon	caudatum	55	190	P	RB
16437	Cameroon	caudatum	63	180	P	RB
16661	Cameroon	guinea	60	240	P	RL
18475	India	durra	62	110	T	S
18717	India	-	78	170	T	S

Notes: *a* Lines which showed emerged striga count as < 10% of the adjacent susceptible check at the available level of striga infestation in the field

b Plant color: P = pigmented; T = tan

c Grain color: B = brown; BL = light brown; BR = reddish brown; C = chalky; G = gray; P = purple; R = red; RL = light red; S = straw-colored; W = white; Y = yellow

Appendix 2. Forty-eight striga-resistant breeding lines (striga count < 10% of adjacent susceptible check in field)

ICSV No.	Pedigree	Time to 50% flowering (days)	Plant height (cm)
113	(148 x 555)-1-2	64	129
114	[SRN 4841 x (WABC x P 3)-3]-7-3	68	219
115	(555 x 168)-19-2-7	65	134
145	(555 x 168)-1-1	66	250
146	(555 x 168)-16	59	156
147	(555 x GPR 168)-23-2-2-3-2	64	143
152	(N-13 x 269)-5-2	67	238
153	(555 x GPR 168)-23-1-2	70	239
169	(Framida x 3691)-1-1-3	76	140
171	(148 x Framida)-36-2	74	155
172	(555 x Awash 1050)-2-2-1	85	134
173	(SRN 4841 x SPV 104)-17-1	64	230
191	(20/75)-1-1-1-2-1	65	200
192	(Framida x 148)-21-2-1-4-1	65	150
193	(148 x Framida)-39-2-4-1-2-1	66	183
418	(148 x 555)-1-2-2-1	65	165
419	(148 x 555)-Bulk-1	67	110
420	(148 x 555)-Bulk-4-1-3	68	165
421	(148 x 555)-Bulk-1-1-1	68	160
422	(20/75)-1-1-3-2-2	62	130
423	(Framida x IS 3691)-1-2-1	73	140
424	(Framida x IS 3691)-9-1-3-4-3	71	190
655	(20/75)-1-1-5-1	63	190
656	(20/75)-1-1-2-2-1-2-2	63	145
657	(GPR 148 x Framida)-1-2-4-1	67	132
658	(555 x GPR)-23-1	66	240
659	(GPR 148 x 555)-6K	63	205
660	(GPR 148 x 555)-33-1-3	65	197
661	(Framida x GPR 168)-9-2-3-1	68	170
662	(Framida x 9-60)-5-4-1	79	250
663	[555 x (PD 3-1-11 x CSV 4)-29-3]-5-2-1-1	76	187
664	(555 x Awash 1050)-2-2	80	145
665	(SRN 4841 x SPV 104)-17	63	255
666	(555 x GPR 168)-1-1	60	156
667	(Framida x GPR 148)-21-2-2-4	61	157
669	(N-13 x 2KX 6)-1-2-1-2	67	192
671	(20/75)-1-1-2-2-1-1	66	158
672	(Framida x IS 3692)-7-2-1-2-2-1-5	76	136
673	(GPR 148 x Framida)-2-1	64	144
674	(GPR 148 x Framida)-3-3-1	73	141
675	(GPR 148 x Framida)-2-1-2-2-1	72	155
676	(GPR 148 x 555)-29-3-2-1-1	67	130
677	(GPR 148 x 555)-33-1-3-1-1-1	66	167
678	[555 x (IS 146 x CSV 4)-6]-22-2-1-1	68	170
679	[SRN 4841 x (WABC x P 3)-3]-7-3-5-1-1	66	178
697	(555 x 168)-23-1-1-1-2	71	214
760	(148 x 555)-29-3-2-2	71	151
761	(148 x Framida)-2-1-2-3-1	67	214