STRIGA

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CANADA

PATTERNS OF RESISTANCE TO STRIGA ASIATICA IN SORGHUM AND MILLETS, WITH SPECIAL REFERENCE TO ASIA

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INTRODUCTION

Striga, an old world root parasite of cereals and legumes, has attracted much attention of late, as a causative agent for serious losses in crop production in the semi-arid tropics. There are three general options available for its control : a) genetic (using resistant varieties); b) agronomic (using cultural manipulation and chemicals); and c) biological (using insect pests and pathogens). The genetic option appears to be economically the most viable because a resistant variety that can avert the subterranean damage by Striga is a non-cost input for the farmer. In this paper the distribution and nature of the Striga problem in different Asian countries is briefly described, with special reference to sorghum and pearl millet.

1. Striga in Asia

Striga is reported to occur in almost all sorghum-growing semi-arid parts of Asia, including India, Pakistan, China, Japan, Indonesia, Thailand and Burma. Striga is a serious problem in India and certain parts of Pakistan on sorghum and pearl millet. In other countries, Striga is a recognized yield reducer on crops such as maize (Thailand), sugarcane (Australia), and rice (Burma, Indonesia, Thailand). In addition to being a major problem on sorghum and pearl millet in restricted areas in India, Striga is also a problem on sugarcane, maize, rice and minor millets.

There are at least two morphotypes of S. asiatica occurring in Asia. White-flowered S. asiatica is reported from India, Pakistan and Burma, and a yellow-flowered variety is reported from Thailand and Indonesia. There are also reports of yellow-flowered types of S. asiatica in the Malnad tract of Karnataka state in India (Hosmani, 1978). There could be some implications of this with reference to host reactions and consequently on breeding of resistance lines.

2. Striga in India

In India, which has the largest area under sorghum in Asia, Striga was a problem with marginal economic implications for traditional farmers using local cultivars. The problem has, however, grown in magnitude since the introduction of hybrids, as all the released hybrids are highly susceptible. In several places sorghum cultivation has been abandoned because of Striga after some years of hybrid cultivation (House & V. Rao, 1982). Under traditional farming systems using local varieties, some Striga seed is always present in the soil because most local varieties are tolerant and yield well in spite of Striga infestations. Even though some local cultivars have evolved resistance because of their cohabitation with Striga over centuries, they are not immune. Consequently, when susceptible hybrids are introduced, the level of Striga infestation in the soil, which hitherto remained low, increases considerably. However, a few years are required to build up economically-damaging Striga levels, so hybrids were accepted in the initial years of introduction when their yields were good in spite of Striga. The problem assumes economic proportions only after a few years of continuous hybrid cultivation in the same field. Consequently, the Striga problem has followed the spread of the hybrids. The gravity of the problem was strongly stressed by a working group meeting of scientists from the Indian Council of Agricultural Research (ICAR) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) at the ICRISAT Centre, Patancheru in September-October 1982. This meeting also recommended an increase in the research thrust to counter this increasingly severe problem on sorghum in India and to define the future research strategy on Striga in the region. In addition to S. asiatica, S. densiflora and S. euphrasioides occur in India. S. densiflora is a recognized problem in the post-rainy season sorghums in parts of Karnataka and Maharashtra states. In view of its increasing importance, the working group meeting recommended additional research input on S. densiflora.

In the Asian region pearl millet is grown to a large extent only in India. Striga is recognized as a serious problem in Gujarat and Rajasthan states in Sikar, Jhunjhunun, Nagour and Alwar districts. Striga is also reported to damage pearl millet in Andhra Pradesh in south India (Sivaramakrishnaiah et al, 1968). In the pearl millet growing regions of India, Striga is more serious on the relatively lighter types of soils, this is also true for sorghum.

Striga is also reported to cause damage to upland rice in Nellore district, Andhra Pradesh state (G. Rao et al, 1953), on the Malabar Coast, Tamil Nadu state (Uttaman, 1949), and in Quillon district, Kerala state (K. Karunakaran, personal communication). S. asiatica and S. euphrasioides are reported as causing the damage. Losses of 80-90% are reported (Uttaman, 1950).

Of late, Striga has also been reported to cause damage to sunflower in Tamil Nadu and Karnataka States (N.M. Prasad, personal communication). The species involved is presumed to be S. asiatica, but detailed studies are required to verify this.

3. Striga in Thailand

Teerawatsakul (1975) reported that in Thailand, Striga occurred before 1974 on wild plants in uncultivated areas. However, in 1974, it was first noticed attacking maize at Nam Yuen, Ubon Ratchathani, where maize cultivation was extensive. Nearly 7,000 hectares is infested with Striga in this area. It was named 'Yah Jew' (a tiny weed) and 'Yan Maemod' (witchweed). Furthermore, Teerawatsakul and Kanjanajirawong (1977) reported that Striga attacks field maize cv 'Suwan 1', sorghum cv 'Late Hegari', sugarcane and sweet corn.

4. Striga in Indonesia

Pancho and Mangoesoekardjo (1975) recorded S. asiatica as a parasite of rice. They reported that it caused an estimated 50-60% yield reduction in upland rice.

5. Striga in Pakistan

Mohyuddin et al (1965) reported that S. asiatica and S. euphrasioides attack sorghum in West Pakistan. The white-flowered S. asiatica is also a serious problem on sorghum in Deraghazi Khan district in Punjab State (M. Ali Bajwa, personal communication)

6. Striga in Burma

Aubert (1910) and McKerral (1912) recorded the white-flowered S. asiatica as a problem constantly threatening the cultivation of sorghum.

CURRENT RESEARCH PROGRAMMES ON STRIGA IN ASIA

Research on Striga has been sporadic throughout the world. Among the various Asian countries where Striga is a menace, only India has on-going Striga research programmes. A strong research project is located at the ICRISAT Centre, Hyderabad. The All India Coordinated Sorghum Improvement has coordinated Striga resistance trials and agronomic trials, and some of the Indian universities also have limited programmes on Striga control.

PATTERNS OF RESISTANCE TO STRIGA - SORGHUM

1. Past Efforts in Asia

India is the only country in the world other than South Africa, where work on breeding for Striga resistance in sorghum was initiated as early as the 1930s. Hosmani (1978) reviewed the past Indian work on resistance breeding activities in sorghum. Several varieties were reported resistant to S. asiatica by different workers (Table 1). Most Striga research efforts in the past had short-term objectives and were not adequately sustained. The progress in breeding for Striga resistance in the past was slow. Possible reasons are the absence of long-term support, both fiscal and physical to sustain the continuity of research efforts; the absence of immunity to Striga in sorghum, coupled with the lack of valid field screening techniques, which resulted in the terms 'resistant' and 'tolerant' being used indiscriminately. Follow-up studies of early reports have not been able to confirm the results mainly due to the absence of a reliable screening methodology.

2. Screening for Resistance Mechanisms

Two approaches were adopted by past researchers : screening for the individual mechanism which confers resistance to the host; or screening for field resistance. Three resistance mechanisms have been identified in sorghum : low stimulant production; mechanical barriers (anti-haustorial factors); and antibiosis factors. At the ICRISAT Centre, nearly 15,000 germplasm accessions have been screened for their capacity to stimulate the germination of S. asiatica from the Patancheru area, and 640 low stimulant accessions have been identified. Only N 13, a high stimulant and a highly stable field resistant line has been identified as having mechanical barriers. Little work has been carried out on the third mechanism although it is indicated to exist (Saunders, 1933).

The usefulness of low stimulant production as a prediction of the field resistance of sorghum lines has often been questioned. Initial efforts to correlate Striga numbers in the field and stimulant production indicated a low, but positive correlation. Further studies have lead to the following conclusions (V. Rao et al, 1982a) :

i. the proportion of field resistant line among low stimulant lines is higher than that among the high stimulant lines;

ii. simple correlation coefficients between Striga numbers and stimulant production obtained from different trials were positive and at some locations and trials very high - indicating that stimulant production could be a useful indicator of field reaction (Table 2).

GENETICS OF STRIGA RESISTANCE

1. Inheritance of Low Stimulant Production

The first report on inheritance of low stimulant production was from the ICRISAT Centre (ICRISAT, 1978). It indicated that a single recessive gene, 'sal', controlled stimulant production. Further analysis indicated that the character was also amenable to quantitative genetic variance (V. Rao et al, 1983a). Shinde and Kulkarni (1982) in a 7-parent complete diallel, while confirming the higher additive gene action for this character, also reported reciprocal differences indicating maternal effects. IS 2221, S 1841 and SPV 86 were reported to be good combiners for low stimulant production.

2. Inheritance of Field Resistance

Studies on the inheritance of field resistance are plagued by two main difficulties, the absence of a field technique that assures a uniformly high level of Striga challenge for each host plant and the interpretation of data based on a single external manifestation (emerged Striga counts) of reaction which is the result of actions and interactions of one or more resistance mechanisms, each of which are likely to be controlled by different genes. Chandrasekharan and Parthasarathy (1953) reported that Striga resistance was dominant while Narasimhamurthy and Sivaramakrishnaiah (1963) reported that the nature of inheritance varied with the parents involved in a cross. 23-4, N 13 and NJ 1515 in their crosses showed dominant resistance and in crosses with IS 6942 there was partial dominance. A preliminary study at ICRISAT using line x tester analysis has indicated that susceptibility is dominant over resistance (V. Rao et al, 1983). Shinde and Kulkarni (1982), using a 7-parent diallel, reported that field resistance was controlled by both additive and non-additive gene actions with a preponderance of additive gene action, and suggested that pedigree selection was effective for field resistance.

There is no work on the inheritance of mechanisms other than low stimulant production.

TRANSFER OF RESISTANCE

Concerted efforts have been made since work began at ICRISAT to identify stable resistant lines by multi-locational testing. Although there is no absolute resistance or immunity to S. asiatica there are stable low susceptible lines such as N 13, 555, IS 2203, IS 4202, IS 7471 and IS 9985 (V. Rao et el, 1983). Crosses are made every year among resistance lines and between resistant lines and high yielding susceptible lines. The absence of reliable single plot screening techniques to differentiate resistant and susceptible plants in the segregating generation is a major drawback. However, the segregating generations are grown and advanced in Striga-sick fields. The best looking plants are selected and once they attain some uniformity, they are processed through a three-stage screening (see below). The best advance generation progenies are being identified as SAR (S. asiatica resistant) lines. SAR 1, 2, 10 and 16 are lines with good levels of Striga resistance that have moderate yield levels even under the most severe Striga infestations (Table 3). SAR 1 and 2 are currently undergoing farmers' field testing in Manarashtra State.

Breeding for Stable Resistance

Striga is a versatile parasite capable of adapting to different hosts and different environments in a short time. There are different levels of organization within the genus Striga, i.e., with reference to differences between species, morphotypes within a species, and host-specific races within a morphotype. Taxonomically-distinct species like S. asiatica, S. densiflora and S. euphrasioides coexist in India. Variations in morphological characters among plants of S. asiatica existing in the same field have been noticed (V. Rao et al, 1983). Recent observations near Anantapur, Andhra Pradesh state, indicated that in a restricted area, Striga attacks pearl millet. From cross inoculation tests, using Striga from sorghum and pearl millet collected in the same area, it has been found that pearl millet-Striga parasitized both sorghum and pearl millet, while the sorghum-Striga could only parasitize sorghum (Table 4).

These observations point to the necessity to breed for 'stable' resistance, i.e., resistance of the host across different Striga spp., morphotypes and host-specific races.

The stability of resistance with reference to Striga pressures, as expressed in the number of emerged Striga plants per unit area has also been studied at ICRISAT. Data from an advanced Striga resistance trial conducted at five locations in India using a checkerboard layout was used to plot the number of emerged Striga plants in test entries against the positional check average (average of four check plots surrounding each test entry plot). Three representative varieties were studied (Figure 1). N 13, a very stable variety, held its resistance even at the highest pressure recorded, while SRN 4841, a moderately resistant variety held its resistance under low Striga pressure, but became susceptible at higher pressures. T233B, a susceptible variety, showed high Striga counts even at low pressures. It was found that a graphical approach using the multi-location checkerboard layout data is a very useful way to identify varieties with stable resistance (Gilliver et al, 1983).

In addition to breeding stable resistant varieties, it is important to protect the products of breeding, i.e., the Striga-resistant varieties, from losing their resistance. In the past, excellent resistant varieties such as 'Radar' failed to maintain resistance apparently due to outcrossing (Grobbelaar, 1952). At present, there are no specific procedures for monitoring the seed production of varieties bred for specific resistance. Stringent seed production procedures may have to be developed to avoid the breakdown of resistance due to mutation, outcrossing or other reasons. This procedure will become even more crucial when Striga-resistant sorghum hybrids are developed.

PATTERNS OF RESISTANCE TO STRIGA - PEARL MILLET

Breeding for Striga resistance in pearl millet has received much less research input than sorghum. Consequently, very little information is available on patterns of resistance. However, since pearl millet and Striga have coexisted for a long time, it is to be expected that resistance to Striga exists in the host and a concerted effort to identify resistant lines would be worthwhile.

Sivaramakrishnaiah et al (1968) screened six pearl millet hybrids and their parental lines against Striga near Anantapur and reported that TIF23A was highly resistant and that this resistance was transmitted to its hybrids. Mathur and Bhargava (1971) studied the resistance of 19 hybrids (with TIF23A as the female), 12 inbreds, 14 established lines, HB1 and TIF23A as checks in pots at Jaipur, Rajasthan state. They also notices that TIF23A is highly resistant. Among the 12 Durgapura inbreds (DB series) tested in crosses with TIF23A, only six hybrids were resistant.

Obviously much work is still required on screening pearl millet for Striga resistance.

SCREENING METHODOLOGY

Lack of proper screening methodology has hindered significant progress in Striga resistance breeding activities in the past. The main problems to be countered are variability in infestations as measured by the emerged Striga counts from year to year and variability from spot to spot in the field in any one year. The emerged Striga count is an unknown percentage of the subterranean Striga numbers. Major efforts at the ICRISAT Centre have been directed to solving the latter problem. A 'three-stage' screening methodology specifically suited to Striga-resistance breeding activities (Figure 2) has been developed (V. Rao et al, 1982b). The three stages are :

Stage 1 - Observation Nursery. This consists of a single replication of a large number of breeding lines with a frequently-repeated (one in five plots) susceptible check. A minimum of two rows of each entry are grown and susceptible lines are rejected based on Striga counts relative to the closest check.

Stage 2 - Preliminary screening. The entries, advanced from Stage 1, are tested at more than one location in three row plots and repeated at least three times with checks arranged in such a way that every test entry plot will have one check adjacent to it (Figure 2). Striga counts are determined on the central row of each plot. Trials are classified as all-zero, some-zero or no-zero based on Striga emergence in the susceptible check plots. In the all-zero trial, where Striga has not appeared in the susceptible check, trial data may be used for yield evaluations. In the some-zero trials, where Striga has appeared in some parts ot the trial and not in other parts, data may be analyzed using a 'single-unit comparison' system (V. Rao et al, 1983), wherein comparison between test entries are limited to a unit of eight plots with the susceptible check being in the centre. In the non-zero trials, where Striga appears in all check plots, the reactions of test entries are computed as Striga counts percent of the susceptible check, in the same unit. Data are then analyzed as per the experimental design.

Stage III - Advanced screening. Resistant entries from Stage II are tested in five row plots arranged in such a way that every test entry plot is surrounded by susceptible check plots on four sides, giving the field a checkerboard appearance (hence the name). This layout provides a useful opportunity to estimate grain yields from replicated test entry plots in Striga-sick fields, and at the same time to monitor, estimate and use the information in Striga infestations in the susceptible check plots which are regularly interspersed in the experimental area for assessing the variability of Striga infestation. Statistical procedures involve either plot assessment, co-variance analysis or a graphical approach (Gilliver et al, 1983).

The three-stage screening methodology is fully operational at the ICRISAT Centre and has been found quite useful in identifying resistant lines. The checkerboard layout has been adopted by the All India Sorghum Improvement Project in their multilocation coordinated Striga trial.

Farmers' field testing. A procedure which involves sowing of resistant and susceptible lines in alternate strips (Figure 3) has also been developed to test resistant lines in farmers' fields. The length and width of each strip is variable. The alternate strips are very convenient for use in farmers' fields and very convincing when Striga is seen on either side of resistant strips. Data on Striga counts and yields may be collected from two to five random samples from each strip.

FUTURE RESEARCH PRIORITIES

1. The current research input on Striga is grossly inadequate, and is not commensurate with the magnitude of the problem. It requires not only a concerted effort on the part of each organization involved in Striga research, but also strong international coordination between organizations so that there is more effective research to control this menace across crops, species, morphotypes and host-specific strains.

2. A very strong input is requires on breeding for resistance, not only in sorghum and pearl millet, but also in other crops which host Striga. Breeding programmes can produce results only if there is a well-established network of testing centres located in places where the different species and morphotypes occur.

3. More effort is required to understand the mechanisms conferring resistance to the host and their action and interactions between themselves and with the environment.

4. Intensified effort is required to develop more efficient methods for screening single plants for resistance. This will help speed up progress in breeding. Field screening methodology needs to be improved to obtain reliable *Striga* infestations year after year. Studies are required on the management of *Striga*-sick fields.

5. More studies are required on the biology of *Striga* to determine the biochemical interactions involved between the parasite and its hosts.

6. Systematic surveys are required in the Asian countries to locate *Striga* 'hot-spots', to identify the species and morphotypes occurring and to understand the host range and magnitude of the problem.

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Table 1 : Varieties reported to be resistant to Striga asiatica from India

Variety	Place	Reference	Remarks
Bilichigan	Temburni Maharashtra	Gadgil(1933)	Selection from Maldandi
Mudinandyal Burma K.K. Burma Y.K. Agikodal Malleswar	Poona Maharashtra	Jenkins(1944)	Resistant in pot tests
S.versicolor S.purpureosericeum S.nitidum	Poona Maharashta	Deodikar(1951)	
AS 4003(Boganhilo) AS 4693(Bilichigan) CO-7 CO-11 CO-20(AS 9028)	Coimbatore Tamil Nadu	Sivaraman(1952)	
N 13(Culture 109)	Nandyal Andhra Pradesh	Nagur et al(1962)	Selection from local 'Patchajonna'
BH 4-1-4	Bailhongal Karnataka	Kajjari et al(1967)	Also resistant to SDM
BO-1	Akola Maharashtra	Anonymous(1979)	Selection from local NJ-156
PS-13 PJ-16K Khedi 2-2-10	Parbhani Maharashtra	Chopde et al(1973)	

Table 2 : Simple correlation coefficients between low stimulant production and field reaction to *Striga asiatica*

Season	Trial No.	No. of entries	Location	'r' Value	Remarks
Rainy '81	53	13	Akola	0.91**	Checkerboard layout
			Bhavanisagar	0.65**	" " " "
			Bijapur	0.34	" " " "
Rainy '82	71	15	Akola	0.85**	" " " "
			Bijapur	0.70**	" " " "
			Indore	0.86**	" " " "
			Parbhani	0.57	" " " "
			Patancheru	0.85**	" " " "
Rainy '82	72	78	Akola	0.51**	Preliminary Stage
			Bijapur	0.36**	Screening
			Parbhani	0.58**	" " " "
			Patancheru	0.47**	" " " "
Rainy '82	73	54	Akola	0.32*	" " " "
			Bijapur	0.28*	" " " "
			Patancheru	0.023	" " " "
Rainy '82	74	20	Akola	0.27	" " " "
			Bijapur	0.39	" " " "
			Patancheru	0.56**	" " " "

Table 3: *Striga* reaction (SR)[1] and grain yield (kg/ha) of 15 breeding lines and 5 source lines in multilocation testing (checkerboard layout, rainy season 1982)

Origin	Pedigree	Patancheru		Akola		Indore		Parbhani		Bijapur		Average	
		SR	Gr.Yd.	SR	Gr.Yd.	SR	Gr.yd.	SR	Gr.Yd.	SR	Gr.Yd.	SR	Gr.Yd.
SAR-1	(555x168)-1-1	0.1	3967	4.2	2281	0.2	1543	5.7	2250	1.4	2130	1.9	2434
SAR-2	(555x168)-16	0.5	3367	3.9	2593	1.3	1605	10.2	1958	1.8	2120	3.0	2328
SAR-5	(148x555)-1-2	0.7	3956	3.6	2474	12.4	988	6.2	1958	2.6	1527	4.2	2180
SAR-6	(148x555)-33-1-3	0.2	3678	3.2	2178	1.0	2130	13.3	2450	0.5	1814	3.0	2450
SAR-9	[SRN-4841x(WABC xP-3)]-7-3	1.1	4844	1.5	1074	4.9	2346	4.0	2083	12.8	1425	4.1	2354
SAR-10	[555x(PDxCS-3541) -29-3]-5-2-1	0.5	4111	1.1	2578	0.6	2625	6.8	2625	0.8	2166	1.7	2562
SAR-11	(555xAwash-1050) -2-2	2.2	1556	5.7	1785	11.1	818	11.5	1667	3.9	1731	6.0	1511
SAR-12	(SRN-4841xSPV-104)-17	4.1	3500	5.3	1044	8.8	2160	9.3	2208	8.3	1129	7.1	2008
SAR-13	(555x168)-1[illegible]	0.8	4600	1.7	2267	1.1	1728	5.6	1958	2.1	1601	2.0	2439
SAR-14	(Framida x148)-21 -2-2-4	0.3	4367	4.7	1067	13.0	710	3.8	2125	1.7	1296	3.9	1913
SAR-15	(555x168)-23 -2-2-3-2	0.8	4211	5.0	2400	4.6	1759	28.6	1708	1.3	2138	6.9	2443
SAR-16	(555x168)-19-2-7	0.8	4344	5.2	2700	18.2	664	8.7	2450	2.3	1500	6.4	2331

Table 3 (cont.)

Origin	Pedigree	Patancheru		Akola		Indore		Parbhani		Bijapur		Average	
		SR	Gr.Yd.	SR	Gr.Yd.	SR	Gr.yd.	SR	Gr.Yd.	SR	Gr.Yd.	SR	Gr.Yd.
SAR-17	(N-13x269)-5-2	3.2	2656	10.3	2207	10.1	864	2.6	2000	6.2	1712	5.7	1887
SAR-18	(N-13x2KX6)-1-2 -1-2	3.2	4211	20.9	1674	4.2	988	9.9	2083	11.7	1129	8.7	2017
T-233B	T-233B	128.1	2356	141.3	1659	156.9	710	31.1	1874	23.5	777	85.6	1475
N613	N-13	0.1	1288	0.3	2192	1.1	771	2.9	1374	0.8	2851	0.9	1695
555	555	4.9	1166	10.3	2533	10.3	1033	4.0	1708	1.2	2148	5.2	1717
SRN-4841	SRN-4841	11.4	2211	6.8	-	10.3	1280	11.0	458	22.7	1231	10.5	1036
IS-4202	IS-4202	0.2	1688	3.8	2222	1.4	1975	4.3	1916	2.9	861	2.1	1732
IS-7471	IS-7471	0.8	-	12.9	-	25.5	-	9.5	-	0.9	1638	8.4	327
CSH-1[2]	Mean	230	4041	67	1307	222	1471	36	2131	501	804		
(Susceptible	Min	82		7		4		13		189			
control)	Max	434		380		1047		101		817			
	'r' bet^n Striga counts and yield/plot		-0.43**		-0.49**		-0.57**		-0.39*		-0.32*		
	R^2		0.18		0.24		0.33		0.15		0.10		

1 : SR of test entries expressed as emerged *Striga* counts percent of positional check value, averaged over two replications

2 : SR of CSH-1 expressed as number of emerged *Striga*/M^2 averaged over 40 CSH-1 plots in the checkerboard

Gr. Yd : Grain Yield

Table 4 : Cross-infection of *Striga asiatica* from sorghum and pearl millet hosts

Test host	Number of *Striga* plants/flats	
	Sorghum *Striga*	Pearl Millet *Striga*
Sorghum (Cv. Swarna)	169	15
Pearl millet (IPS551)	0	27

Kharif 1981; 75-day counts; wooden flats; average of three repeats

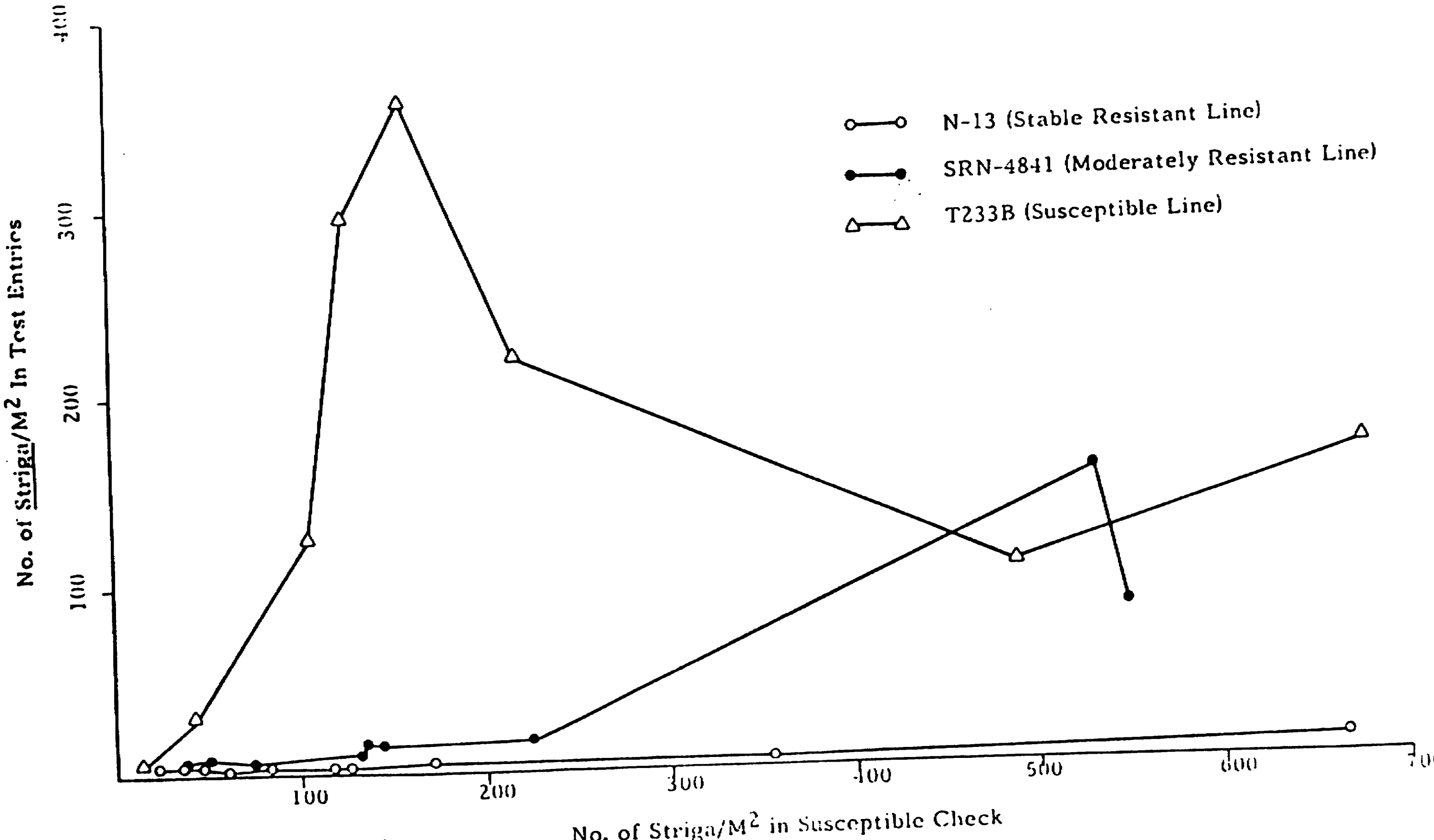


Figure 1 : Association between <u>Striga</u> numbers in test entries and the <u>Striga</u> intensity in the soil measured by the number of <u>Striga</u> with a susceptible check (Gilliver et al, 1983)

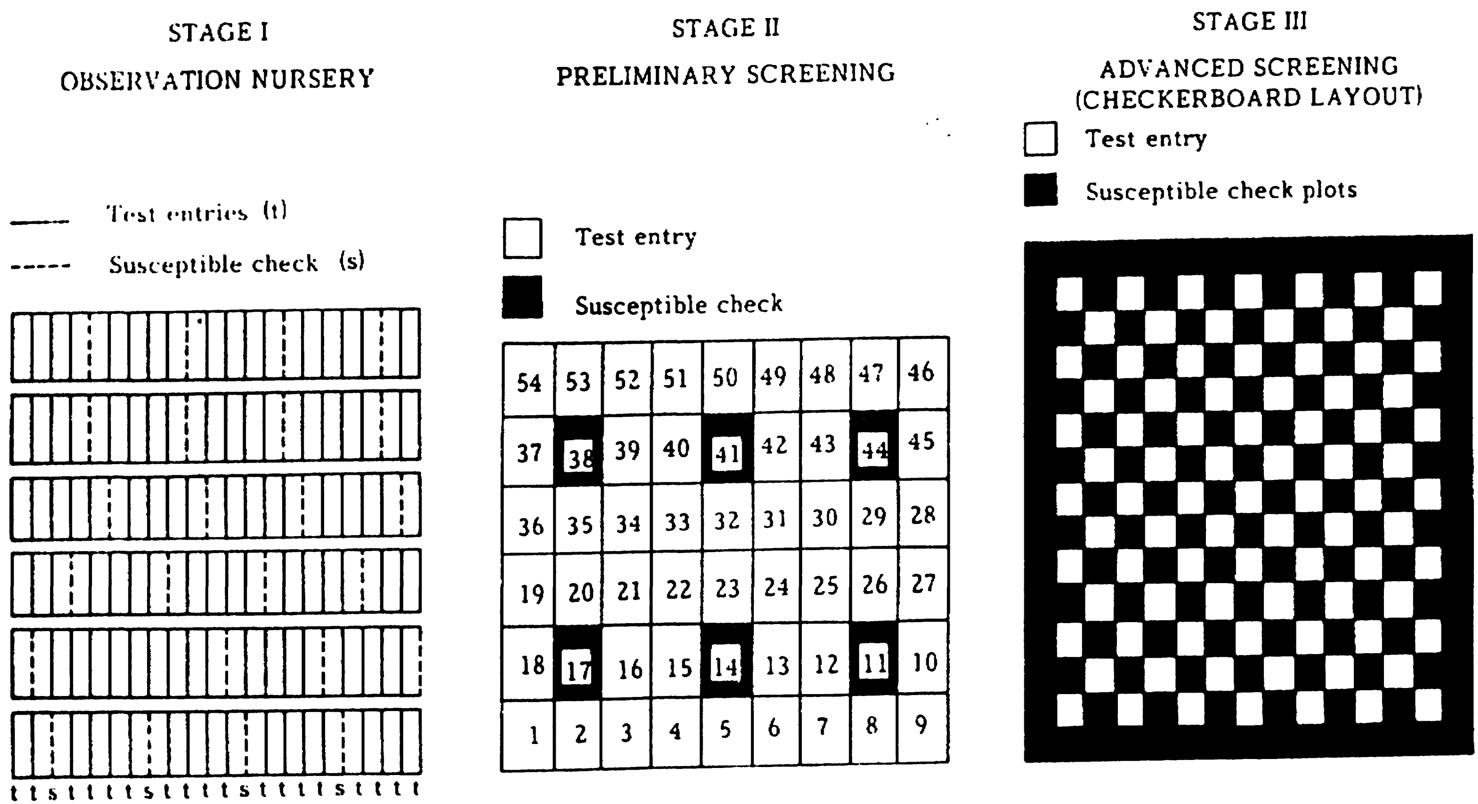
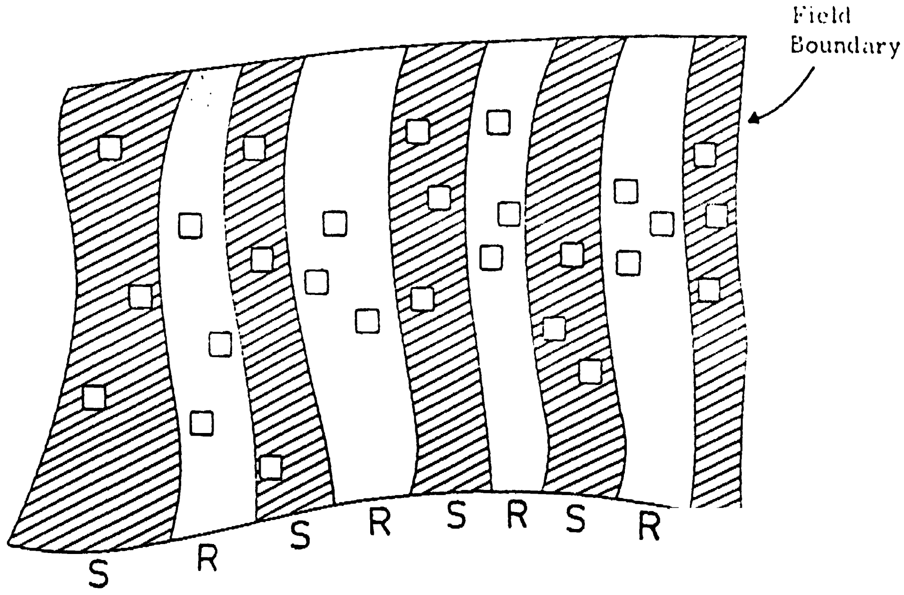


Figure 2 : A three-stage screening methodology for Striga resistance breeding in sorghum (Rao, M.J.Vasudeva et al, 1983)



S = Susceptible check

R = Resistant varieties

☐ = Sample area for *Striga* counts and yield estimation

Figure 3 : **Farmers' field testing of *Striga* resistant varieties in alternate strips**

Slide 1 : A resistant line of sorghum bred at the ICRISAT Centre, Hyderabad, India, shows much less Striga compared to a mat of Striga present on the susceptible hybrid (at left)

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