See page 14 for
Immediate future priorities
according to Shetty
ICRISAT
Samaru

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IC.ISAT/SAFGRAD OAU/STRC JP 31 Programme at Nigeria

The ICRISAT/SAFGRAD Programme at Samaru, Nigeria was initiated in July 1980 with the appointment of the Sorghum Breeder, Dr. N.G.P. Rao, followed by the Agronomist, Dr. M.B. Boling, in September but neither of these scientists could take up residence in Samaru as the incorporation of the agreement between SAFGRAD OAU/STRC and the Nigerian Government was delayed until October, 1980.

The SAFGRAD Programme finally got started in February, 1981, with the arrival of the complete team including the Entomologist, Dr. J.H. MacFarlane. The problems were compounded in June, 1981 with the Agronomist, Dr. Boling, resigned and this position was not filled until February, 1983, with the appointment of Dr. S.V.R. Shetty. The Sorghum Breeder, Dr. Rao, resigned in June, 1983, after 2 complete cropping seasons at Samaru although his programme was continued with yield trial evaluation during the 1983 cropping season under the guidance of Dr. S.V.R. Shetty. The current SAFGRAD team consists of the Agronomist and the Entomologist.

Sorghum Breeding Programme

The primary objective of this programme is to breed suitable cultivars of sorghum that could lead towards development of production systems of higher levels of yield performance and stability across a range of environments.

1980

In this first season and since the breeder could not take up residence in Nigeria efforts were directed towards develop-

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ing a basis for a regional programme. Two preliminary yield trials and a breeding nursery were planted in a number of locations in the region. Compared to Hyderabad, India, flowering was delayed at most locations. The yield data from two locations showed that the hybrids CSH-1, CSH-5, CSH-6 and CSH-9 and the varieties SPV-126, SPV-245, SPV-312, SPV-313, SPV-315 and SPV-470 gave higher yields. SPV-315 was particularly good from the point of view of plant and disease aspect and offers scope for selection in the region. The breeding nursery was planted at Soluba, Mali and Samaru, Nigeria. Data on flowering and the entries were visually rated. The entries SPV-301, SPV-312, selection of SPV-314, SPV-315, SPV-342 and some selections in segregating generations of the crosses SPV-104xCS 3541 and SPV-104x168 were generally good.

<u>1981</u>

In the current season over 1000 lines of exotic sorghum lines were grown at Samaru to determine their adaptability to the West African zones.

All the material from the germplasm collection at Hyderabad were susceptible to grey leaf spot and none of this material could be used for direct adaptation.

A number of entries in the other adaptation trials showed a low number of dead hearts, shoot fly and stem borer. The entries were SPV-220, SS-81-SPV-315-4-3, SS-81-SPV-315-4-2, SS-81-SPV-315-3-1, SR-80-SPV-142, SS-81-SPV-338-1-1. The leaf damage due to stem borer was also assessed but this type of damage has no relation to dead hearts or stalk tunnelling and is essentially useless for estimating stem borer susceptibility.

The incidence of dead hearts, 35 days after planting, increase with an increase in nitrogen fertilizer and decreased as plant population increased.

Most of the introduced sorghum lines were susceptible to leaf diseases and especially anthracnose (Table 1). The hybrids were highly susceptible to anthracnose. Many of the leaf diseases developed after flowering and grain formation.

Two commercial hybrids, CSH-5 and CSH-6, and two improved varieties, SPV-221 and SPV-245, were sown in 1/4 to 1/2 hectare plots at six locations as part of the adaptation trials. Data obtained indicate potential yields up to 3.4 tons per hectare at populations of 60,000-90,000 plants per hectare. CSH-5 and CSH-6 were relatively free from diseases, SPV-245 showed some anthracnose in Samaru; SPV-221 exhibited lodging and some long smut besides anthracnose.

The major lesson from these bulk plot studies is that improved cultivars developed elsewhere do have a potential both in drier areas and as short season late planted crops in wet areas. If suitable cultivars exhibiting resistance to prevalent pest and diverse problems are chosen and grown under optimal population and reasonable management, yields could be much higher. They could also furnish the basis for the design and development of different cropping systems.

The experimental material for selection of suitable cultivars combining yield with insect and disease resistance, adaptability, etc., comprised of:

1. Selections made at Samaru from advanced breeding materials

Table 1. Entries which exhibited general resistance to the prevalent diseases at Samaru in 1981.

Experiment	Entries which exhibit general resistance to prevalent diseases at Samaru
Trial 1	SPV Nos. 99, 220
Trial 2	SPV Nos. 126, 301, 312, 313, 315, 316, M. 90411
Trial 3	Entries 41, 42, 49, 64 (Selections of SPV 314; have traces of Anthracnose)
	Entries 66, 67, 68, 69, 70, 71, 72, 75 (Selections from SPV 315)
Trial 4	SPV Nos. 218, 229, 266, 298, 303, 338, 342, 355 entry 892-1-2
Trial 5	Entries 143, 144, 149 (Selections from SPV 104x CS3541). 151 (SPV 104x168)
Trial 7	SPV Nos. 290, S. 461, M39281, M96095
Trial 9	Entries 2 (A6141), 11 (A. 6170), 13 (A6175)
Trial 10	Entries 2 (A6121), 6 (A 3666), 15 (A 7045), 17 (A62213), 18 (A62675)
Trial 11	Entries 2 (M 9281), 17 (A 6001), 22 (A 6286)
Trial 12	Entries 23 (296AxA.964), 25 (296AxCS3541)
Trial 13	Entries 7 (2219AxMR716), 18 (2219AxA546)
Nursery	CSV 4, CSV 5, SPV Nos. 113, 141, 156, 255, 258, 259, 260, 265, 292, 302, 305, 307, 308, 311, 321, 325, 338, 388; H163, H166; M90411, M91019, Sepon 103.2, SPV 103-11-1, Ethiopian Gambella 1107 and 12089; Sudan GSA 737, 738, 766, 917 and 932 and Collection IS 8245; N.547 and 555 (SPV 104xCS3541); SP62; 2219A, 2077A (traces Anthracnose), 296A and 323A.
Checks	CSH5, CSH6, (traces of sooty), CSH9.

Note: Most of them have some oval leaf spotting towards maturity.

during 1980 rainy season and 1981 off-season.

2. Selections made at Samaru from segregating crosses during 1980-81 rainy season and off-season.
3. Experimental varieties and hybrids obtained from the ICRISAT and Indian breeding programmes.
4. Some male and female parents of released commerical hybrids.
5. Breeding materials from Sidan Ethiopia and Mali.

No plant protection measures were resorted to and selection was under unprotected conditions. Based on critical evaluation and integrated performance, 50 cultivars have been selected for yield evaluation during 1982 at various locations. A list of the selected materials is presented in (Table 2) and they will be critically evaluated in yield trials in different regions.

In addition a number of selections have been retained for growing in the breeding nursery. The F_1S of several hand crosses were grown. Selections were also made in early segregating generations of crosses.

An examination of the pedigrees of selected lines reveal that CS-3541, 148/168, SC-108, SB-1066, UCHV-2 and SPV-104 were the most common parents entering into crop combination of selected lines. A crossing programme has now been chalked out with selected local materials and some of the presently identified adapted types.

Rainfall gradually decreases from Southern Guinea Savannah to the Sahel of Northern latitudes in West Africa. Sorghum yields are low and uncertain in all regions the

Table 2. Promising sorghum line which combine yield, agronomic desirability and tolerance to pests and diseases identified by ICRISAT/SAFGRAD Sorghum Breeding Programme in 1981.

S. No.	Pedigree	Plant Type	Selected
1.	SPV-126	(Tall mutant of CS 3541)	rainy and summer seasons
2.	Row-131	(SPV 314; SB 1066xUCHV 2)	"
3.	SPV-220	(148x512A)	"
4.	SPV-221-1	(148x512A)	"
5.	SPV-255-1	(IS 3687xAispuri)	"
6.	SPV-265-2	(148x53)	
7.	SPV-266	(148xFR632)	"
8.	SPV-290	(CS3541xUCHV 2)	"
9.	SPV-298-1	(CS3541xIS3924)	"
10.	SPV-301	(CS3541xSB 1066)	"
11.	SPV-389	(IS 12611xSC 108-3)	"
12.	SPV-312	(CS 3541xUCHV 2)	"
13.	SPV-313	(SB 1066xUCHV	"
14.	SPV-314-2-1	(SB 1066xUCHUV 2)	"
15.	SPV-314-2-2	"	"
16.	SPV-314-10-1	"	"
17.	SPV-314-12-1-1	"	"
18.	SPV-315	"	"
19.	SPV-315-4-2	"	"
20.	SPV-315-4-1	"	"
21.	SPV-315-3-3	"	"
22.	SPV-315-5	"	"
23.	SPV-315-4-4	"	"
24.	SPV-321	(CS3560xCS3541)	rainy Season
25.	SPV-338-1-2	(148x298003)	"
26.	SPV-342	(SPV 29xIS2954)	rainy and summer seasons
27.	SPV-388	(SC 108-4-8xCS3541)	rainy season
28.	N-555-1	(SPV 104xCS3541)	"
29.	N-556-2	(SPV 104xCS3541)	"
30.	N-559-1	(SPV 104x168/148)	"
31.	80R-A6291	(UCHV 2 x Bulk y55)	"

Table 2. (Contd.)

32.	80R-A6213	(S 8927xUS1R-139)	rainy season
33.	A62866286	UCHV 2 x Bulk y55)	"
34.	Sepon 103-2	(of Samaru '80 nursery)	"
35.	M 91019-6	-	rainy and summer seasons
36.	M 90411	-	"
37.	M 36170	(E35-1xTam 428)	rainy season
38.	H. 166	(IS6948xCS3541)	"
39.	SF 62		"
40.	Ethiopian 12089		"
41.	GSA 766		"
42.	GSA 932		"
43.	470		"
44.	N 547	(SPV 104xCS3541)	"
45.	SPV-315-5	(SB 1066xUCHV 2)	rainy and summer seasons at Kano
46.	SPV-301-1	(CS3541xSB1066)	"
47.	M 36411	(IS-12645CxCS3542) xE351)x Group 3	"
48.	M 36037	(SC 108-4-8xCS3541)	"
49.	M 39281	(SC 108-4-8xCS3541)	"
50.	D. 82066	V2M 2BxSPV 104)	"

uncertainty factor being more towards the Northern Latitudes. Present day cultivars and cultivation methods are largely traditional. There is need to enhance and stablize yield in all latitudes.

The duration of the cultivars is much longer compared to the duration of the effective rainy season rendering them vulnerable to rainfall fluctuations. Hence it is necessary to readjust the critical periods of growth together with the amount and distribution of dry matter to suit the assured periods of rainfall.

It is always not necessary to orient the breeding objectives to the traditional zones and traditional maturities. In higher rainfall areas it is more effective to grow a short season sorghum crop towards the latter part of the rainy season. There are already effort in this direction, but suitable cultivars are yet to be developed. Such adjustments in cropping would provide greater opportunities for manipulation and development of productive cropping systems.

Adaptation of cultivars, those particularly developed in tropics, might provide a rapid means of bring about productivity changes with built in stability, but in so doing the pest and disease reaction should receive particular attention. Evidence is forth-coming that such cultivars with combine yield, food quality, resistance attributes, standability, adaptability and stability are available. SPV-315 and its selections did well in dry and wet areas, and might provide the broad genetic base on which further improvements could be superimposed. Several other selections have been identified for detailed evaluation.

It is possible to establish correspondence between test locations and evolve a broad based testing mechanism across latitudes and diverse stresses which could yield rapid results.

The identification of altered genotypes needs to be followered with studies on competetion between species in space and time leading towards more productive and stable cropping system of a different order.

1982

The 50 lines selected in 1981 were evaluated further in the current season for yield and other attributes across a range of environments and planting dates. The 1982 effort is esstentially a continuation of the adaptational exercise leading to the identification of potential cultivars of agronomic worth for sole as well as inter-, relay-, and sequential cropping systems.

The seedling dead hearts attributable to shoot fly and stem borer?, were lowest in S-2, S-36 and S-40 across the range of environments. A number of other entries can be classified as moderately resistant to dead hearts included K-4, S-17, S-19, S-20, S-32, S-34, S-35, S-37 and SPV-245.

Fourteen cultivars were selected (Table 3) from the 1982 trials based upon yield, agronomic performance and tolerance to insects and disease for further evaluation in sorghum crop production systems. The five highest yielding cultivars were S-40, K-4, S-34, S-32 and S-17. The Striga resistent cultivar SRN-4841 was the highest yielding entry

Table 3. Promising Sorghum Selections identified by ICRISAT/SAFGRAD Sorghum Breeding Programme in 1982.

S. No.	Selection/ entry	Pedigree	Mean dead-hearts (% transformed)	Plant height (cm)	Days to flower	Grain yield (kg/ha)
1.	SRN-4841			200	64	5467
2.	S40	Eth. 12089	15.6	230	77	5089
3.	K4	M 36037	27.7	180	70	4778
4.	S34	Sepon 103 (1980 nursery)	31.1	180	76	4733
5.	S32	A 6213	39.0	170	76	4622
6.	S17	SPV-314	27.1	150	70	4589
7.	S35	M 91019	26.2	190	62	4489
8.	S19/20	SPV-315	27.1	150	73	4411
9.	SPV-245		27.0	150	76	4300
10.	S38	H 166	-	190	69	4156
11.	S37	M 36170	29.6	210	81	4111
12.	S10	SPV-301	28.8	150	71	4078
13.	S36	M 90411	21.8	160	71	4045
14.	S13	SPV-313	27.8	140	71	3811

in all trials and, although has red seed, could be the basis of programme for breeding for Striga resistance.

The problem

The duration of traditional cultivars has generally been much longer than the duration of the rainy season: the periods of flowering coincided with cessation of rains. Consequently, productivity risks have been there with greater probabilities in years when late rains ceased prematurely. Rainfall at the start of the season, when farmers start planting, is also uncertain and rains get established only as the season progresses. The cultivars are tall, vegetative with low harvest indices and respond only to low population and fertility levels. Improvement efforts in the past have generally been orientated towards the traditional agroclimatic zones and traditional maturities with marginal improvements in cultivar yields and management practices. Their impact to date has been marginal.

Alternative production systems for sole and mixed crops based on altered cultivars, if conceived and implemented properly, could result in the much needed improvements in productivity and stability. Suitable short season cultivars with built-in resistances and flexibilities for planting across a range of environments and planting dates could be useful in the drier areas of the north; as an assured high yield crop grown during the period when rainfall is most stable in the moderately heavy rainfall North Guinean zone and as a late sown crop in the long season heavy rainfall South Guinean zone. Superior short season cultivars are known for better harvest indices and better responses to increased population and fertility levels. They are also likely to be less competitive and amenable for greater manipulations in the development of stable and productive cropping systems in place of the traditional ones. Such cultivars could be of immediate use and also provide the basis for future improvement. In other words, the need is for an alternative base with wide adaptation as has happened in wheat and rice on a gobal basis and with sorghum to a limited scale. The use of short season sorghums in place of 6-8 month cultivars could lead towards better resource utilization - time, space and inputs.

The mechanism

To answer the cultivar needs of such situations, particularly in the immediate context, the mechanism we chose comprised of:

(a) Initial evaluation of a few commercial hybrids and varieties of India in ½-1 hectare diagnostic blocks in a range of situations primarily to assess the scope and problems of adaptation.

(b) Screening of a large number of improved tropical types available from various sources - ICRISAT centre, AICSIP, Ethiopia, Sudan, Upper Volta, Mali, etc., in different agroclimatic zones in a multi-location set up for their insect and disease reactions and adaptation *per se* during 1981..Further evaluation of a common set of selected lines during 1982 for yield and other attributes in such a diverse multi-location set up across a range of planting dates.

In the implementation of this procedure, there were limitations of management, particularly under out-station conditions. The elimination of breeding lines was drastic. Yet, 1982 data from Maroua in Cameroon (dry zone), Samaru (moderately wet) and Mokwa (heavy rainfall, long season) supplemented by visual observations at Kano, Kadawa and Yandev do lead us to useful conclusions. The mechanism takes care, to a reasonable extent, the problems of adaptation and results in incorporation of durable resistances against high yielding backgrounds of wide adaptation.

The results

The problem of stem borers has been analysed fairly critically and it has been possible to isolate lines with low deadheart percentages and good levels of mature plant resistance/tolerance that would not affect yield levels. The shootfly problem is limited and could be avoided. Tolerance levels to shootfly have also been identified.

Selected lines exhibit high level of resistance to prevalent leaf diseases in West Africa and good tolerance to grain moulds and grain deterioration.

It has been possible to separate the high yielding lines from low yielding. Among the high yielding, lines that have wide adaptation to dry, moderately wet and wet areas across a range of planting dates are discernible. That high yields and wide adaptation could go together has also been established.

When cultivars bred in India are introduced into West Africa, there is slight delay in maturity and a reduction in plant height. This needs explanation. Limited studies with hybrids do not reflect their superiority over the selected varieties. This needs critical analysis so as to enable development of suitable parents for a hybrid programme in West Africa.

Observational studies have been made on new cropping systems, particularly groundnut-sorghum and soybean-sorghum. Based on modified cultivars, the potentialities for studies on new cropping systems have been pointed out.

Immediate future

The first priority has to be for studies on production technology of new sorghums - particularly population and fertilizer studies.

The next priority should be on development of stable and productive cropping systems using modified sorghum cultivars in place of the traditional ones. Inter-, relay-, and sequence studies have place in different situations.

Long smut in drier areas and acid and problematic soils in northern portions of West Africa need special attention.

It is now possible to develop a planned hybridization programme involving local and exotic germplasm.

The long season sorghums

A reasonably critical study of germplasm collections of Northern Nigeria provides an insight into the late maturing sorghums. The _faraferas_ (Guinea types) and the _caudatums_ (yellow endosperm) are by far the best cultivars in the region. A part of the Sudanian zone (latitudes between Samaru and Kano) is virtually a melting pot in that there has been considerable natural hybridization between _faraferas_, _caudatums_, _durras_ and _broom-corns_ and a large number of hybrid forms are discernible. The areas south of Samaru generally represent a near monolith of _faraferas_ (guinea types). Some of the best hybrid forms selected in nature seem to be as good as the best _caudatums_ or _faraferas_. At best there may be marginal advantages. Even though there is considerable recombination, the panicle components seem to compensate in such a way that for final yield, the recombinants are as good as the best parental progenitors. This observation may need further analysis.

Planned hybridization between diverse high yield types from germplasm collections and selection under carefully planned mating systems should lead to late maturing types with per plant yield potential of 150-200g of grain. If this could be accomplished, the yield levels of such cultivars at 50,000-55,000 population level could touch a new high if there is no resource limitation. But then, the inherent risk due to failure of late rains is there and the resource utilization with late and tall sorghums is not certainly going to be efficient.

Entomology Programme

The basis of the entomology programme is to develop new methods of insect pest control such as cultural, crop management, bological new resistant cultivars in cooperation with breeders that require minimum input by the farmers. The programme with also carry out bological and ecological studies on various sorghum and millet insect pests to determine population levels damage symptons yield losses, and optimum time for control measures to be taken.

1981

The efforts in this, the first year was directed towards forming a basis for the entomology programme and in this regards insect collections were made from large observations plants of millet and sorghum with major emphasis on sorghum borer, Busseola fusca, and sorghum head bugs. A number of Local, Regional and International Insect Pest Nurseries were also planted. The infestation of both the sorghum stem borer Busseola fusca, and millet stem borer, Acigona ignefusalis was extremely high, 100% in the observation plots.

In the observation plots late planting of both cultivars increased stem borer infestation and also increased yield [illegible] The late planted plots were subjected only to the attack of the third generation stem borers in late August and early Spetmeber when plants were at a more advanced stage of development causing few dead hearts. Whereas, early planted plots were attacked first by the second generation stem borers, in mid-to late-July when plants were at an early stage of development causing a large number dead hearts; and then later, after tiller production, by the third generation stem borers. Forty per cent of the dissected stalks in early planted L-1499 and 55% in L-187 had no infestation while in late planted plots it was 10% and 15%, respectively. There was no correlation (r=0.33) between head yield and stem borer infestation presented as per cent internodes bored in either cultivar at both planting dates.

The stem borer infestation at harvest in the various pest nurseries was lowest in ICRISAT Sudan Nursery where 17% of the dissected plants were infested, 32% of the internodes bored and 0.2 stem borers/plant. It was slightly higher in ICRISAT Nigeria Nursery where 35% of the plants were infested, 27% internodes bored and 0.6 stem borers/plant. Busseola was the most important borer in these nurseries. Infestation in the International Stem Borer Nursery was very high; 82% of the dissected stalks were infested, 59% internodes bored and 2.0 stem borers/plant. Busseola accounted for 85% of the borers in this nursery with Acigona making up the remainder.

Stem borer infestation in the International Sorghum Stem Borer Nursery, presented as % tunnel length, ranged from a low of 28% in L-187 to 64% in IS-18633. The highest yielding cultivars IS-10711 (5879), IS-18427 (457 g) and IS-1044 (333 g) had stem borer infestations of 43, 48, and 55%, respectively.

In the ICRISAT Sudan Nursery entries S-95 and S-42 had the highest infestation of 55 and 62% but also had the highest yield.

Infestation in the ICRISAT Nigeria Nursery ranged from 11-41%. Entries SPS-7913 and Soba-8 had lowest infestation

(11%) and SPS-7923 had highest infestation of 41%.

A number of sorghum head bugs were collected in this first season and can be, tentatively, placed into 4 families and 14 species.(Table 4). The most common bug was *Eurystylus* sp. which accounts for at least 80% of the mirids. The mirids accounted for about 80% of the bugs collected. Two spp. of *Lygaeus* accounted for most of the *Lygaeidae* and although most visible on the sroghum head they make up a small proprotion of the bugs collected. Very few *Dysdercus* spp. were collected from the sorghum heads. The importance of the two species of predatory coreids (Clarigralla spp.) at this time is unknown but their unmbers are greater than the pentatomids and nearly equal to the *Lygaeids*. The highest numbers of head bugs were collected from the International material with compact heads although bugs were also collected from the local materials, L-187 with semi-compact heads, and L-1499 with open heads.

Table 4. Tentative number of sorghum head bug species collected at Samaru in 1981.

Family	No. species	Comments
Miridae	6+	*Eurystylus* sp. most common
Lygaeidae	3	two *Lygaeus* spp.
Pentatomidae	3	
Coreidae	2	both Clavigralla spp.

A number of beetles were also collected from sorghum heads belonging to Chrysomelidae, Curculionidae, Scarabaeidae and Meloidae as well as a few hymenopteran parsites and lepidopteran larvae. Two Sorghum Shootfly Nurseries were conducted at Samaru, International (ISSFN) and preliminary (PSSFN). In ISSFN dead hearts on main stem ranged from 38-83%. The lowest number of dead hearts was in PSF 14435 and had a yield of 129 g. The highest yield was obtained in PSF 14103 (668 g) and PSF 12545 (474 g) but they still had dead hearts counts of 51 and 52%, respectively. In PSSFN the dead heart counts ranged from 28-86%, the local having the highest number. The lowest number of dead hearts was in PSF 14523 which yielded 52 g. The highest yielding entries were PSF 12545 (455 g) and PSF 14103 (433 g), the same entries as in ISSFN, and they had 40 and 60% dead hearts in the main stem.

1982

The research in this year was directed towards the problem of relating stem borer damage to grain yield in both sorghum and millet. Large plot of three cultivars of millet; Nigerian Composite, Ex-Bornu and Farmer Local, and three cultivars of sorghum; S-18, BES, and K-5, on two planting date for stem borer observation.

Population studies were continued on sorghum head bug where a large plant of S-18 sorghum was sampled weekly to record number of adults, number of nymphs and the species complex.

A number of local and International Insect Pest Nurseries were also conducted during this cropping season.

Millet cultivars, Nigerian Composite, Ex-Bornu and Farmer Local, planted in mid-June had lower stem borer attack (50-

80% infestation and 8-10% internodes bored at harvest) than the same cultivars planted in mid-July (100% infestation and 60% internodes bored). Nigerian Composite was more susceptible to stem borer attack than the other two cultivars. Grain weight was decreased from 20% in Nigerian Composite to 50% in Farmer Local while the weight of 1000 seeds was decreased in Nigerian Composite and Ex-Bornu but increased in Farmaer Local by the late planting. According to the date presented here the best time plant millet cultivars for stem borer evaluation by natural populations would be early July.

Acigona infestation in the Millet Breeding Millet Stem Borer Nursery varied from 93-100%, average infestation was 99%. Internodes bored varied from 47-75%, mean 63%. The three entries INMB-22, INMB-46 and INMB-37 had the lowest infestation Rating and their grain weight was near the plot average. INMB-12 had the highest grain yield of 1115 gm but it ranked 27th out of 31 entries as far as the stem borer was concerned. The same materials in the Millet Yield Trials had lower infestation, 43-85% and mean of 66%, and lower internodes bored, 7-31% and mean of 23%. The entries KMDC, INMB-4, INMB-12, INMB-75, INMB-36, INMB-49, INMB-71, INMB-31, INMB-10 and INMB-53 had low stem borer rating but only INMB-46, KMDC and INMB-31 had low rating in both the Entomology Trial and Millet Yield Trials.

Sorghum cultivars, S-18, BES and K-5, planted in mid-June had Bussmola infestation varying from 10-10% at harvest with 4-7% of the internodes bored while in the mid-July planting infestation ranged from 50-80% and 6-25% of the internodes were bored. The late planting decreased both grain weight per head and the weight of 1000 seeds for all cultivars. All three cultivars were equally susceptible to stem borer attack throughout the observation period. Grain weight per head in cultivar S-18 was decreased only after 50% of the internodes were bored while in the other cultivars, K-5, L-187, and L-1499 the results were variable but are indications that threshold value may also be 50% internodes bored. The Index of Infestation was used to correlate stem borer infestation with grain weight per head and weight of 1000 seeds. It showed better correlation for Busseola infestation in sorghum than for Acigona infestation in millet. The data here for sorghum indicates that planting in early July can have high Busseola infestation but only by the third generation.

Busseola infestation in the Sorghum Breeding Sorghum Stem Borer Nursery ranged from 13-92%, mean of 44%, while internodes bored varied from 3-29%, mean of 11%. The entries S-8 and K-2 had the lowest stem borer rating but grain yield was below the average for the nursery. The same material in Sorghum Yield Trials had higher infestation, ranged from 37-100% and mean of 70%, and higher number of internodes bored, varied from 7-50% and an average of 23%. The entries, S-19, S-4, K-1, S-3, K-2, S-41, S-44 and S-6 had the lowest stem borer rating in these trials. Only K-2 and S-41 had low rating in both the Entomology Trial and Sorghum Yield Trial.

Stem Borer infestation in the West African Sorghum Yield Trial ranged from 47-100%, mean of 73%, and internodes bored varied from 12-48%, mean of 25%. The entry SUCR

36:80/70 had the lowest stem borer rating while the Striga resistant entry, SRN-4841, had the highest stem borer rating.

Stem borer infestation in the International Sorghum Stem Borer Nursery varied from 37-90%, mean of 66%, and internodes bored ranged from 9-42%, mean of 22%. The entries PB-8294, PB-8258, and PB-8281 had the lowest stem borer rating and grain weight was near the average for the nursery.

The Germplasm collected by the join ICRISAT/IAR team to North Eastern Nigeria in 1981 was grown at Samaru for observation. Stem borer infestation was very high with 190 of the 195 entries having 100% infestation and no entry was under 80%, the mean of 40%. The best entries were S-155, S-157 and S-159.

Total head bug population numbers collected from a medium duration sorghum (S-18) reached their maximum five weeks after the boot stage, 130 adults and 750 immatures per sample of heads, after which there was a sharp decline in their numbers in the final two weeks. Fourteen species of head bugs were tentatively identified again this year with new species being added to the list. Five species of Miridae accounted for 86% of the total adults collected and in the 5th week 2 species one of which has been tentatively identified as Calocoris sp. accounted for 71% of total adults collected on that day. Another species continued to build up for the first six weeks and then declined slightly in the final week. Two other species reached their peak in the 3rd week and then declined to their lowest number in the fifth week after which there was a slight increase in the final two weeks.

Main stem dead hearts in the International Sorghum Shoot Fly Nursery ranged from 26-66%, mean of 43%. The best entries with under 30% dead hearts were IS-4663, PB-21318, PB-14103 and IS-5484.

1983

The major emphasis this season was on estimating stem borer damage in sorghum and relating it to grain yield and continued population studies on sorghum head bugs. A number of Local and International Pest Nurseries were also carried out.

Sorghum Stem Borer: The effect of time of infestation by sorghum stem borer, *Busseola fusca*, on grain yield was investigated during the current year. A new method for evaluating stem borer damage was devised which is based upon visual estimation of stem borer damage in three parts of the stalk; lower half, upper half and the peduncle. The stalk is dissected and damage estimated in each part on a basis of 0-10, a stalk with 100% damage would have a total damage rating of 30; 10 in the lower half, 10 in the upper half and 10 in the peduncle.

Five hundred plants in each of three sorghum cultivars, S-18, K-4, and L1499, were marked 45 days after planting and then once a week until harvest each plant was checked for stem borer infestation. At harvest the number of nodes and internodes bored, visual estimation of damage and grain weight for each plant was recorded.

The visual estimation of damage (damage rating) proved to be as efficient as per cent tunnelling or per cent internodes bored in estimating stem borer damage even though the correlation between the damage rating and grain yield per head was low for all parts of the stalk (Table 5). The damage rating in the upper half provided the highest correlation and the slope of regression line was the highest, greatest change in grain weight per change in damage rating.

A high correlation was obtained between time of infestation and grain weight per head (table 6). There appears to be a critical time when stem borer infestation can have high impact on grain weight per head. This time is around boot formation and flowering after which there is no effect on grain yield. The greatest change in yield was observed in the local improved (L-1499) sorghum. This cultivars(long season) was recorded as being infested about 3-4 weeks before flowering while the other two cultivars (shorty season) were recorded as being infested 1-2 weeks before flowering where change in yield loss with time of infestation was much lower. It may be possible if these cultivars were infested about 3-4 weeks before flowering the change in yield loss would also have been higher.

There is no relationship between time of infestation and stem borer damage, and, there is no correlation between damage and grain yield. A plant infested after flowering (when yield loss is minimal) can have greater damage than plant infested before boot formation (when yield loss is maximal). Therefore, any stem borer rating system can only tell how susceptible that cultivar is to stem borers.

It is recommended that the visual rating system devised

Table 5. Correlation coefficient (r), slope (m) and Y-intercept (b) of the regression line between the damage rating and grain weight per head for three sorghum cultivars.

Cultivar		r	m	b
S-1.8	lower	-0.51	-2.2	70.1
	upper	-0.91	-3.9	76.1
	peduncle	-0.41	-1.7	69.1
K-4	lower	-0.45	-1.7	61.9
	upper	-0.81	-2.3	62.1
	peduncle	-0.22	-0.4	56.0
L-1499	lower	-0.59	-1.4	63.5
	upper	-0.46	-0.7	58.6
	peduncle	-0.75	-2.2	67.2

Table 6. Correlation coefficient (r), slope (m) and Y-intercept (b) of the regression line between time of infestation and grain weight per head for three sorghum cultivars.

Cultivar	r	m	b
S-18	0.99	6.1	22.4
K-4	0.94	4.7	22.7
L-1499	0.95	7.2	-1.7

here be used to score stem borer damage as it is faster and less expensive and would be possible to evaluate more material in a given year.

Sorghum Head Bug: Two sorghum cultivars were samples weekly from boot formation to harvest to record number of head bugs (species, adults and immatures). A selected number of sorghum heads were covered by tergal cloth bags to exclude all head bugs to determine damage caused by head bugs.

The weekly total head bugs collected in 1983 were similer to the number collected in 1982 except that number of adults collected was higher and number of immatures lower. Adult head bugs reached a peak in the third week (303 adults) and dropped to low number (7 adults) by the 6th week in S-18 sorghum planted early July. The low number of adults continued on S-18 planted in late July (Table 0). The immatures showed two peaks, one in the 5th week in the early planted sorghum and in the 6th week of late planted sorghum (9th week overall).

The species composition on S-18 in 1983 was similar to that observed in 1982, *Campylomma* sp 1 (23%) *Campylomma* sp 2 (6%) and *Eurystylus* (63%) were the most abundant bugs collected. Both *Campylomma* spp occur early as the head emerged from the boot and reached the highest number in the 2nd and 3rd weeks. *Campylomma* sp 1 retained high numbers from the 2nd to 5th weeks in 1983 while in 1982 the numbers reached a peak in the 3rd week and then dropped in the 4th week. *Eurystylus* sp reached a peak very quickly in 1983

Table 7. The weekly distribution of head bug species collected in 1982 and 1983 from S-18 sorghum at Samaru, Nigeria.

Date	Species					Total adults	Total imma-tures
	Campylomma sp. 1	*Campylomma* sp. 2	*Eurystylus* sp	Sp 1	Sp 2		
			1982				
9/9	1	7	0	3	9	28	2
16/9	7	12	5	4	15	53	3
24/9	30	18	25	11	10	106	18
1/10	10	3	23	14	9	83	243
8/10	2	5	58	20	35	136	725
14/10	4	2	38	23	11	92	343
19/10	4	3	8	15	4	38	97
Total	58	50	157	90	93	536	1421
			1983				
23/9	5	1	0	0	0	8	0
30/9	33	11	7	2	3	64	180
7/10	48	15	233	3	13	303	180
14/10	18	9	122	3	18	159	393
21/10	27	9	69	0	0	109	439
28/10	16	2	7	2	1	27	161
4/11	6	0	11	0	0	21	61
11/11	5	0	4	0	0	15	161
18/11	3	0	7	0	0	16	303
25/11	5	0	1	0	0	7	35
2/12	0	0	1	0	0	1	1
Total	166	47	462	10	35	730	1736

and by 3rd week accounted for 59% of all adults collected and continued at high level until the 5th week when they dropped to low level which was retained into the late planted sorghum. The same general pattern was observed in 1982 were Eurystylus had a high number from the 3rd to 6th week but reached a peak in the 5th week (Table 7).

The main difference between 1982 and 1983 occurs in Sp 1 and Sp 2. These two species in 1982 accounted for 35% of all adults while in 1983 they accounted for only 6% of the adults. Sp 1 was found in very low numbers throughout the collecting period in 1983, never more than 2 or 3 adults per week, while in 1982 this species increased slowly throughout the collecting period and by the 6th week accounted for 25% of the adults on that week. Sp 2 reached a peak in the third week but then dropped in the following week and after the 6th week none were collected in 1983. In total Sp 2 accounted for only 5% of the adults in 1983 while in 1982 accounted for 18% of the adults.

The various beetles found in high numbers in 1982, especially the weevils, were nearly absent in 1983. The low rainfall and extended drought periods in 1983 could have changed the abundance of the insects.

Both adult and immature head bugs reached the highest numbers in the 6th week after head emergence on the long season open head L-1499 sorghum which was planted in early July. The number of adult and immature head bugs collected from this open head sorghum was nearly equal to those collected on the compact head sorghum during the same period (Table 8).

The species composition on L-1499 was similar to that observed on S-18 with Campylomma sp 1 (14%) and Eurystylus sp (66%) the most abundant. Campylomma sp 1 ~~?~~ increased in number throughout the collecting period while Eurystylus sp reached the highest number in the 6th weeks when 78% of all Eurystylus were collected and then dropped in the final week to 8% (Table 8).

The overal population numbers of head bugs at Kano was lower than at Samaru but showed the same general pattern, adult peak in the 4th week and immature peak in the 5th week. The number of head bugs collected from S-18 was higher than those collected from K-4 (Table 9).

The species compocition at Kano was similar to that observed at Samaru although the abundance of various species was quite different. Campylomma sp 1 (36% on S-18 and 47% on K-4), Eurystylus (28%) and sp 3 (24% on S-18 and 20% on K-4) were the most common species collected.

Insect Pest Nurseries: In the 1983 season the International Sorghum Shoot Fly Nursery (ISFN), The International Sorghum Midge Nursery (ISMN and Sorghum Breeding Sorghum Stem Borer Nursery (SBSSBN) were conducted at Samaru.

(i) International Sorghum Shoot Fly Nursery (ISSFN)

The levels of shoot fly infestation was very low ranging from 0-27%, mean of 10%. The germination was poor with plants at all stages of development after 30 days, from 10 leaves to 2 leaves and the whole trial was nearly abandoned. The trial was not harvested as most of the entries did not flower because of the early cessation of the rains. The most

Table 8. The weekly distribution of head bugs species collected in 1983 from L-1499 sorghum at Samaru, Nigeria.

Date	Species					Total adults	Total immatures
	Campylomma sp. 1	*Campylomma* sp. 2	*Eurystylus* sp	Sp 1	Sp 2		
14/10	1	1	0	0	0	3	2
21/10	1	1	0	0	0	5	5
28/10	1	1	3	2	0	6	14
4/11	3	0	6	0	0	14	44
11/11	3	0	3	0	0	11	436
18/11	5	0	79	0	0	93	637
25/11	7	0	8	0	0	20	112
2/12	0	0	1	0	0	3	2
Total	21	3	100	2	0	155	1252

Table 9. The weekly distribution of head bug species collected from S-18 and K-4 sorghum at Kano, Nigeria in 1983.

Date	Species						Total adults	Total immatures
	Campylomma sp. 1	*Campylomma* sp. 2	*Eurystylus* sp.	Sp 1	Sp 2	Sp 5		
			S-18					
20/9	-	-	-	-	-	-	-	-
27/9	2	4	0	0	0	10	18	1
4/10	18	5	5	1	3	16	47	2
11/10	31	2	16	0	0	22	76	196
19/10	13	1	24	0	0	5	46	348
23/10	25	3	23	0	0	6	59	325
1/11	-	-	-	-	-	-	-	-
Total	89	15	68	1	3	59	246	872
			K-4					
20/9	-	-	-	-	-	-	-	-
27/9	3	1	1	0	0	11	16	0
4/10	10	4	7	0	0	7	29	5
11/10	24	2	17	0	0	14	44	144
19/10	10	2	15	0	0	1	33	207
23/10	32	1	6	0	0	1	45	104
1/11	-	-	-	-	-	-	-	-
Total	79	10	46	0	0	34	167	460

resistant cultivars were IS 4663, IS 22121, PS 14093 and PS 2112 with no dead hearts. The most susceptible entries were IS 18557, local CSH-1 and IS 18551 with 20, 24, 25, and 27% infestation, respectively.

(ii) The International Sorghum Midge Nursery (ISSMN)

The crop establishment was fair in this nursery but could have been much better if there was more seed. The level of midge at Samaru is very low in most years and this year was no exception. Eleven of twenty-five entries in the nursery had no infestation. The highest infestation was 3.5% in IS 8711, 1.4% in IS 19474 and 1.1% in TAM 2566. The other eleven entries had less than 1% infestation.

(iii) Sorghum Breeding Sorghum Stem Borer Nursery (SBSSBN)

The crop establishment was better in this nursery because large amount of seed but the field was uneven and some plants were affected by the drought periods. Some entries did not flower, especially long season entries from IAR Sorghum Breeder, because of the early cessation of the rains. The entries with the lowest stem borer damage were S-32, KSV-11, KSV-15, S-20 and S-10 all had a total damage rating of less than 7.

Agronomy Programme

During 1981, the then agronomist Dr. M. B. Boling prior to his resignation had initiated some agronomic work oriented towards collection of local sorghum and millet germplasm samples and on studies to determine the relative response of these cultivars to crop density and nitrogen levels. A total of 90 millet and 128 sorghum germplasm samples were collected from local markets and farmers in northern Nigeria during the three collection trips. These samples were later given to the national programe and to ICRISAT Center for evaluation.

In the agronomic field studies continued by the ICRISAT - millet breeder (after the agronomist's departure), it was noted that none of six agronomic characteristics measured (days to flower, plant height, ear length, ear weight/ha, ear number/ha, downy mildew incidence) was the cultivar X N-level interaction significant. Differences in responses between local and newly developed cultivars to 20, 40, 80 kg of N/ha were not significant. Except for downy mildew disease incidence, intra row plant spacing did not seem important in selecting for the six agronomic plant characteristics. As in the millet variety X N-level fertilizer study, grain yield was not measured because of severe bird damage.

1983 Programme

A full fledged agronomy programme was initiated during 1983 after the arrival of Dr. S. V. R. Shetty from ICRISAT Center. The programme since then has embraced the Cropping Systems research methodology. The overall objective of the programme has been to devolop improved sorghum based farming systems which would result in increased yields and more stable production.

The major approach considered is to extend Cropping from the onset of rains to as far as possible into post rainy season by the efficient utilization of resources. We believe that considering the resource base of Sudan and Guinean regions of West Africa there exists great potential to improve the existing systems and also to develop alternative production systems based on altered and improved sorghum cultivars, so that the system as a whole becomes more productive, stable and profitable. ICRISAT - Sorghum breeding programme in Nigeria has to a limited extent demonstrated that the use of improved short season sorghums in place of traditional 150-180 days sorghums could lead towards better resource (physical, biological and socio-economic) utilization (Fig. 1). During this first year of the Programme the emphasis therefore was to evaluate and select such appropriate sorghum cultivars with wide adaptation which could form basis for designing possible alternative systems for different growing conditions across sorghum belts of West Africa. Field trials were also conducted to devolop principles to optimise productivity of these improved cultivars by considering such agronomic factors as cro density and crop nutrition. Cropping systems research to examine the performance of some potential genotypes under various mixed cropping systems and to explore the possibilities of designing alternative productive cropping systems was also initiated during the year.

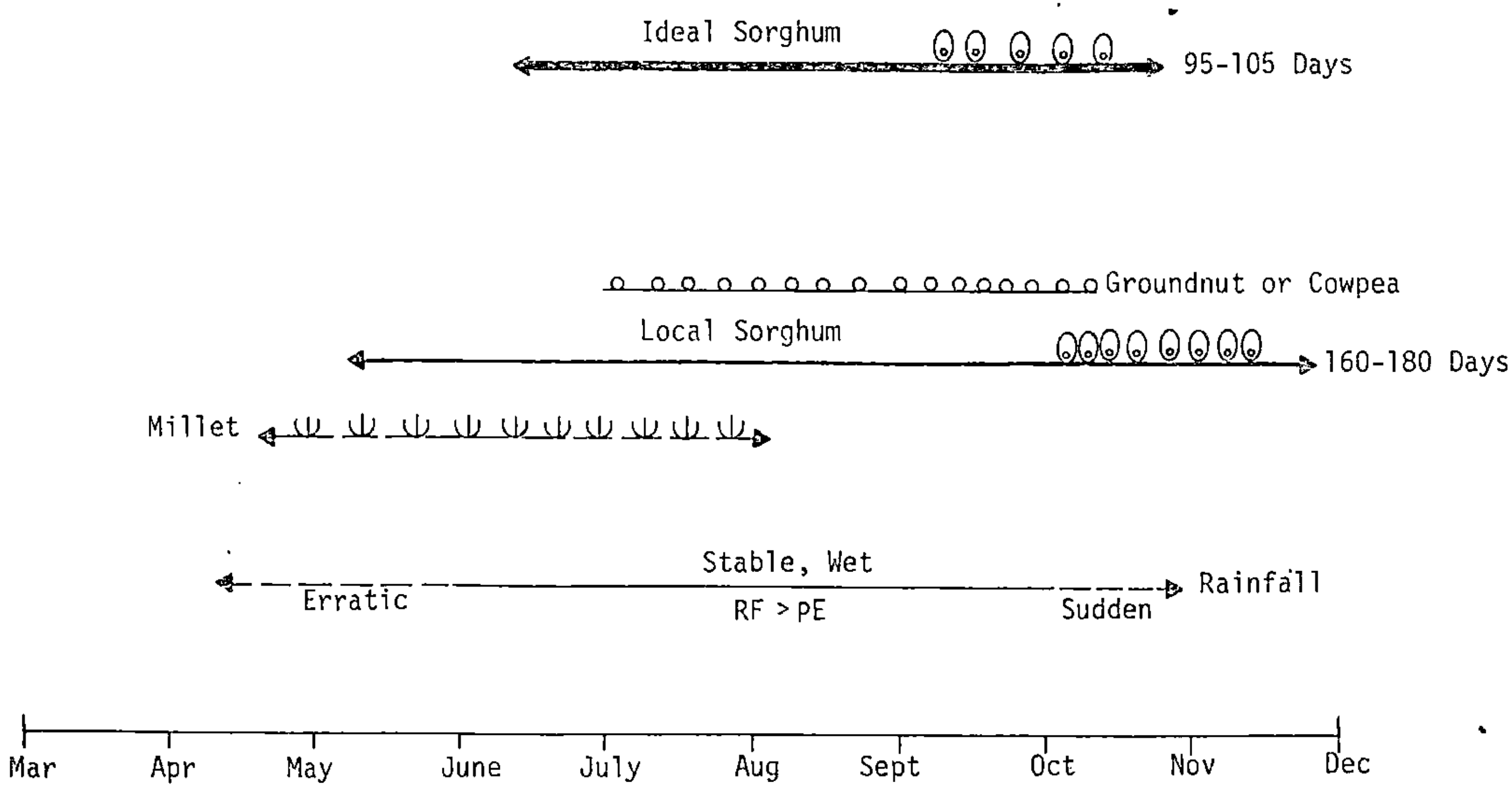

Fig 1. Traditional and Alternative Sorghum Based Cropping Systems in Sudan-Guinean Zones of West Africa

Genotype Evaluation

A number of improved tropical sorghum genotypes made available from ICRISAT and national breeding programmes were evaluated at different locations of northern Nigeria. Most of the locations received only about 60% of normal rainfall, Samaru receiving only 617 mm (normal 1087 mm). Because of sudden cessation of rains during September most of the traditional and local improved Sorghums failed to produce grains while a number of ICRISAT's early maturing genotypes performed well.

The performance of some of the selected materials as against the local checks are summarised in Table 10. Genotypes such as S34, S20, K4, S35, and BES outyielded the local checks. Most of these high yielding materials are photoinsensitive, early maturing (about 70 days to flowering), and short statured (less than 2 m in height). Further, the grain quality of these genotypes did not seem inferior to that of locals as there was no severe disease incidence. Though the rainfall during 1983 was abnormal these selected materials should form a basis for future sorghum improvement programmes. Genotypes such as S34 (which was the highest yielder at Samaru), S35, S20 and K4 will be considered in designing and developing alternative more productive cropping systems to replace the traditional systems which are based mainly on late maturing sorghums.

AGRONOMY OF ALTERED SORGHUM GENOTYPES

Genotypes X Crop Density Study

The recommended plant population for the local sorghums in Nigeria is about 50,000 plants/ha. We believe that for early

Table 10. Performance of some promising Sorghum genotypes, Nigeria, 1983.

Genotype	Pedigree	Guinean zone, Normal rainfall 1000 mm			Sudan zone, Normal rainfall, 700 mm		
		Samaru, 1983 rainfall 617 mm			Kano, 1983 rainfall 409 mm		
		Days to flower	Plant height cm	Grain yield kg/ha	Days to flower	Plant heigh cm	Grain yield kg/ha
K4	M36037	65	197	2867	68	161	2267
S13	SPV-313	68	160	3201	70	152	1610
S20	SPV-315	70	169	3117	75	122	1410
S32	A6213	70	180	3353	75	144	1453
S34	Segon 103 (1980 Nursery)	70	192	3886	76	150	1297
S35	M91019	65	187	2517	65	171	2761
S28	Improved Variety	66	182	2845	65	169	2363
Local (Improved)		105	208	2464	80	150	875
Local (Farmer)		111	370	843	100	198	220
S. Em.			6.0	182		10.0	362
LSD at 5%			17.0	513		28.0	1020

maturing short statured varieties such recommendation may have to be revised. To examine the response of some of these altered genotypes to varying levels of crop density field trials were conducted at Samaru and Kano. The genotypes were grouped into 3 categories: Local, Local Improved (tall and late maturing) and Altered (short and early maturing) for this study.

At both Samaru and Kano the grain yields were significantly increased by increasing crop density upto 75,000 plants per hectare in all the genotypes. But while in local and local improved the grain yields tend to reach the optimum at 75,000 plants per hectare, the altered genotypes showed an increasing trend as the crop density was further increased (Fig 2).

At both Samaru and Kano the altered genotypes (S34, S20, S35) out yielded the local and local improved at all density levels and further these cultivars responded better at higher crop density.

Studies will be continued to confirm the results that the short, early maturing materials required higher crop density to produce optimum yields.

<u>Genotypes X Rate of N-fertiliser Study</u>

Experiments were conducted to investigate the response of sorghum genotypes to different rates of nitrogen fertiliser and to study the differential response of some early maturing genotypes to varying levels of fertility. The same three sets of genotypes included in density X genotypes studies were evaluated under four levels of N-fertility (0, 35, 70 and 105 kg/ha). A blanket application of 40 kg each of P_2O5 and K20 per

Fig 2.

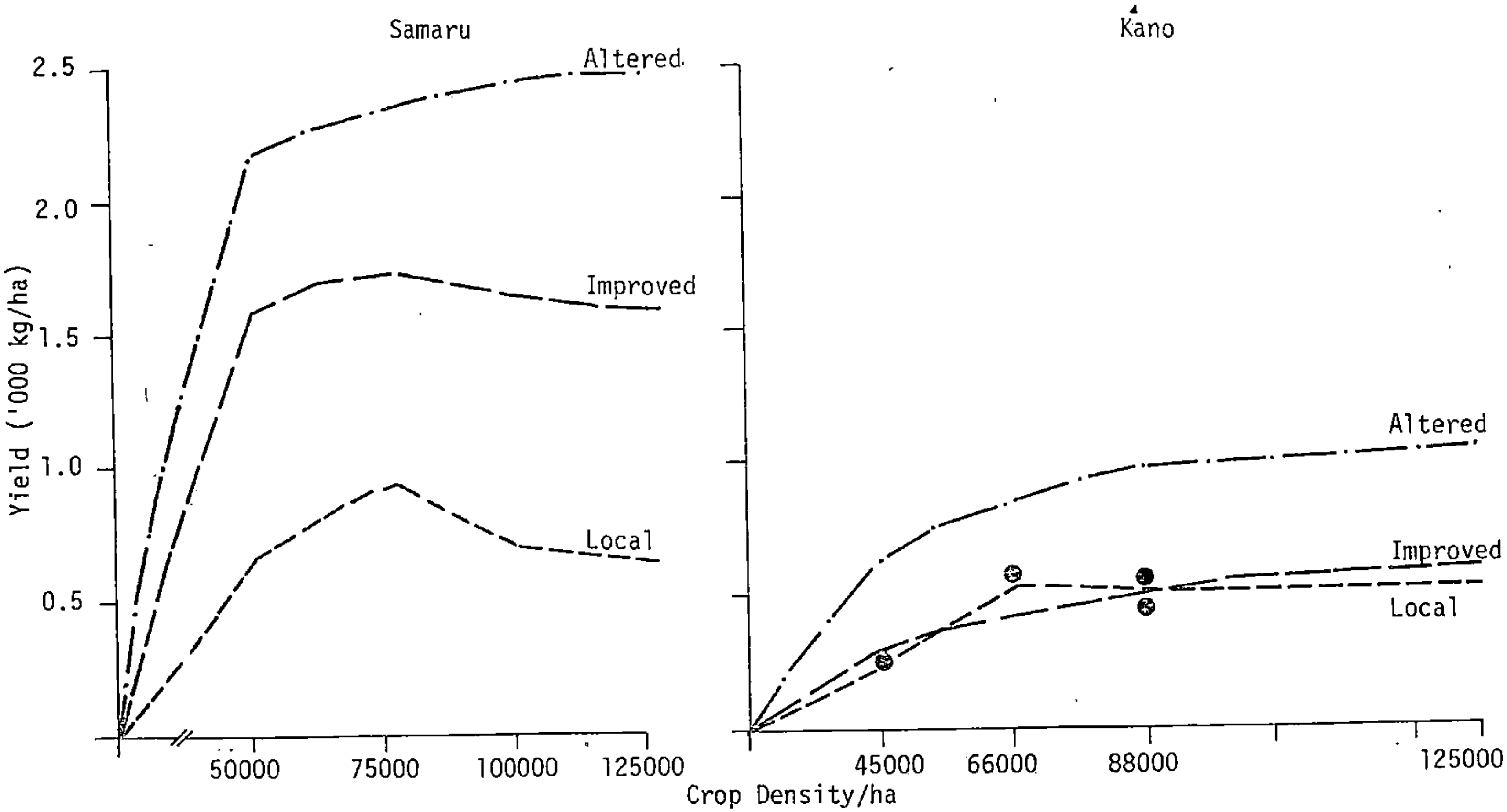

Fig 2. Response of Sorghum Genotypes to Varying Levels of Crop Density, Nigeria, 1983

hectare was given prior to sowing. The nitrogen fertilization was applied in three split doses at 3, 6, and 9 weeks after sowing.

Fig. 3 shows the response of these cultivars to different levels of N-fertility at Samaru (Guinean zone) and Kano (Sudan zone). At Samaru, grain yields were significantly increased due to higher nitrogen fertility in both improved and altered genotypes. But in local there was no increase in grain yields and in fact higher rates resulted in declining yields. This was mainly due to excessive vegetative growth during the initial part of the season and severe moisture stress during flowering because of sudden cessation of rains during this critical stage of crop growth.

While the improved genotypes showed response only upto 70 kg N/ha the altered early maturing materials showed an increasing trend in grain yields even at 105 kg N/ha. This was mainly because the improved late maturing materials suffered moisture stress during grain filling stage while the early maturing materials escaped the drought. The results indicate that the early maturing, short sorghum genotypes respond better to higher fertility and the optimum fertility rate for these genotypes can be higher than that recommended for tall late maturing types. Further studies are planned to determine such optimum rates.

There was no significant response to N-fertility at Kano because of severe drought resulting in very poor yields. However, the early maturing cultivars did perform better than other genotypes even under drought conditions.

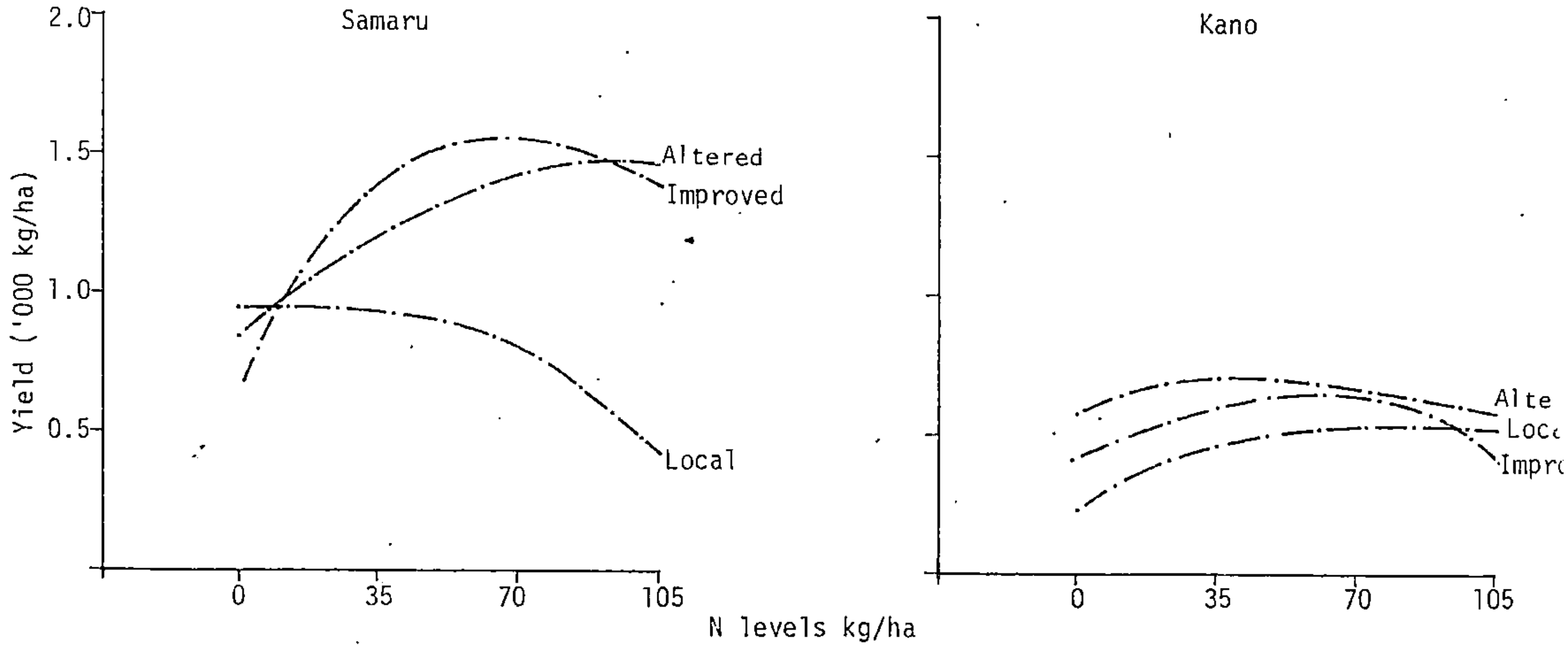

Fig 3. Response of Sorghum Genotypes to Varying Levels of N-Fertility, Nigeria, 1983

Observations on incidence of sorghum stem borer (*Busseola fusca*) and *Striga hermontheca* were recorded in both Density and Fertility trials. While crop density levels showed no significant trend in relation to stem borer damage, higher fertility plots showed greater stem borer damage. *Striga* Counts were lower in higher fertility levels.

Improved Cropping Systems with Altered Genotypes

The traditional Cropping Systems based mainly on 160-180 day sorghums are both unstable and less productive in terms of resource utilization. Early to medium maturing genotypes if incorporated to the existing mixed cropping systems could result in more productive and stable production. We conducted a series of trials utilising some selected early maturing sorghum genotypes to examine their performance under mixed and relay cropping systems. Some of the alternative cropping systems included for mixed cropping studies are indicated in Fig. 4 indicating the crop duration and the time of planting in relation to reainfall.

Sorghum/Millet Intercropping

An experiment to examine the performance of some improved Sorghum genotypes under intercropping with millet was conducted at Samaru during 1983 rainy season. Millet was planted after first rains (last week of May) while sorghums were planted in between millet rows (in alternate rows) after about 3 weeks of millet planting, a system traditionally practiced in West Africa. Table 11 summarises the performance of these short season materials in comparison with that of local sorghum. Early maturing high yielding genotypes S34 performed well both

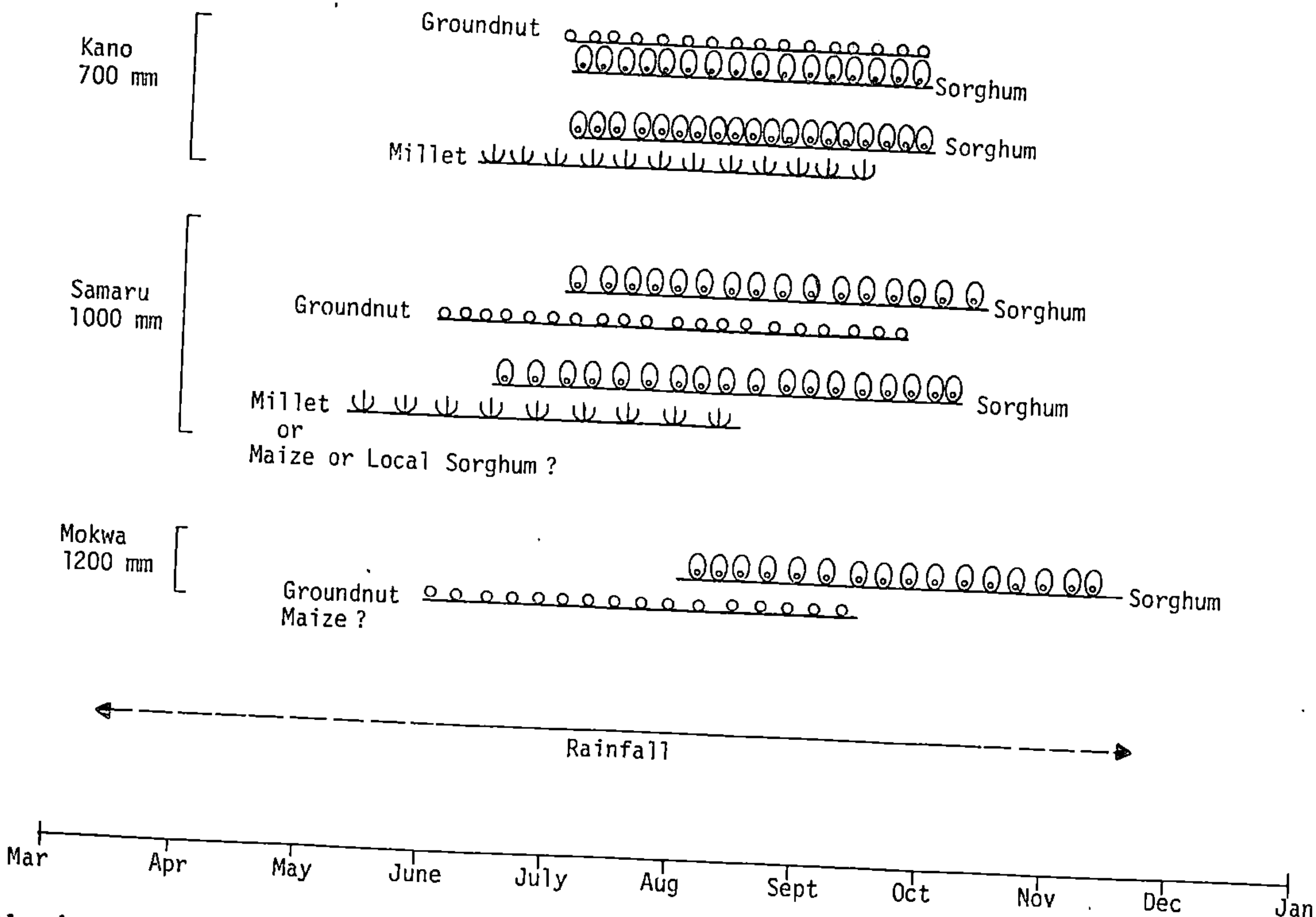

Fig 4. Possible Alternative Sorghum Based Systems for Different Zones of Northern Nigeria

Table 11. Performance of some improved sorghum genotypes under Sole and Intercropping with Millet, Samaru, 1983.

Genotype	Sorghum Yield kg/ha		Sorghum LER	Millet LER	Total LER
	Sole	Intercrop			
S20	1859	769	0.42	0.80	1.22
S34	2584	1202	0.51	0.86	1.37
S35	2540	1060	0.42	0.81	1.23
S40	2119	1042	0.49	0.88	1.37
KSV-11	3103	1192	0.39	0.90	1.29
Local	827	508	0.60	0.69	1.29
S. Em.	214				
LSD at 5%	607				

under sole and intercropping. Genotypes S20 and KSV11 which are short statured performed well under sole but poorly under intercropping mainly because of severe competition offered by millet.

The growth of millet under intercropping with sorghums was vigorous because of its early planting resulting in minimum reduction in yields. Only local sorghum offered some competion reducing millet LER to 0.69. Sorghum LERs were poor because of extra competition exerted by already growing millet However, both grain yields and LER values clearly indicate that early maturing improved sorghum genotypes performed better than the local sorghum which suffered heavily because of moisture stress. Similar trend was observed in the trial conducted at Kano though the yield levels at Kano were very low because of drought.

Sorghum/Groundnut Intercropping

In another intercropping experiment at Samaru the same improved sorghum genotypes were evaluated under intercropping with groundnuts. Groundnut was planted 2 weeks prior to sorghums to provide an initial competition free start to groundnuts. Sorghum genotypes were planted in between already established groundnuts in alternate rows. Table 12 summarises the performance of the improved Sorghum genotypes in comparison with the local sorghum. High yielding genotypes such as KSV11, S34, and S35 performed equally well under intercropping. Local sorghum performed poorly under sole system but produced 70% of its yield in intercropping. However, because of severe

Table 12. Performance of some improved Sorghum genotypes under intercropping with groundnut, Samaru, 1983.

Genotypes	Grain Yield kg/ha Sole	Intercrop	Sorghum LER	Groundnut LER	Total LER
S20	1460	741	0.54	0.54	1.08
S34	2122	1469	0.70	0.43	1.13
S35	1447	958	0.70	0.52	1.22
S40	1195	737	0.54	0.41	0.95
KSV-11	1710	1106	0.66	0.50	1.16
Local	1004	719	0.70	0.36	1.06
LSD at 5%	704				

competition offered by local sorghum the associated groundnut could produce only 36% of its sole crop yields. With the improved sorghum genotypes in general, the groundnut produced its normal growth without substantial reduction in its expected yields.

With simultaneous plantings groundnut is known to be susceptible for competition but because of staggering planting dates groundnut did not suffer much particularly with improved materials. While there was no real intercropping advantage with local, the improved early maturing materials did show substantial intercropping advantage.

Further trials are being planned to explore the possibilities of improving the productivity of this cropping system by further staggering the planting dates and/or increasing plant populations.

Sorghum/Cowpea Intercropping

An experiment conducted at Kano looked at the performance of some improved sorghum genotypes under intercropping with cowpea. It was observed that early maturing altered genotypes performed equally well under both sole and intercropping systems (Fig. 5). Mean yield of altered genotypes under sole cropping was about four times greater than that with Local genotypes, while they produced thrice the yield of Locals under intercropping. Though there was no difference in terms of total LER, because of their early maturity the altered genotypes produced substantial yields even during this drought.

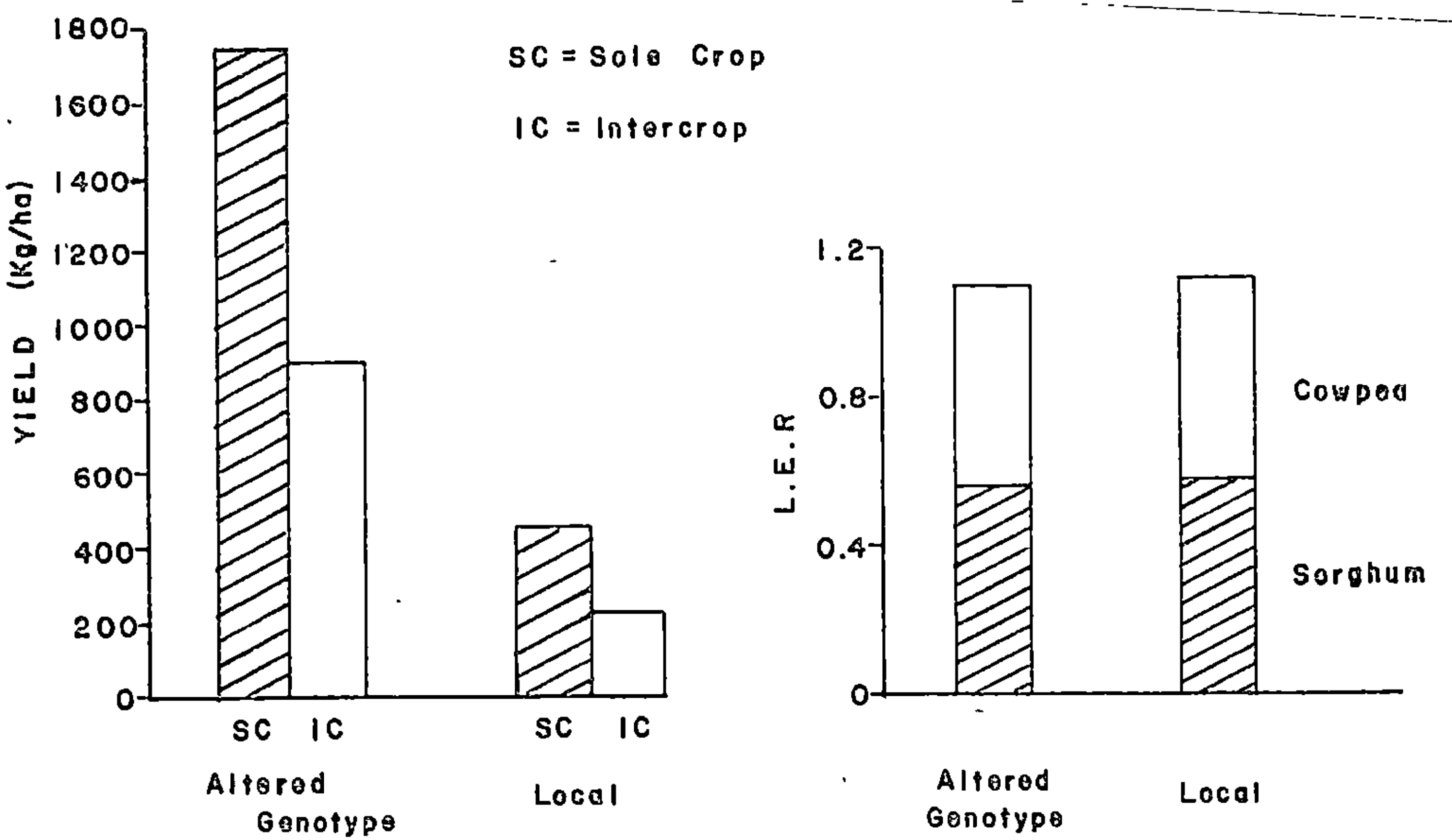

Fig 5. Performance of Local and Altered sorghum genotypes under intercropping with cowpea, Kano, 1983.

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