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JP 31

Final Report

Entomology Programme

Nigeria

Part III

EVALUATION OF INTERNATIONAL AND LOCAL INSECT PEST NURSERIES

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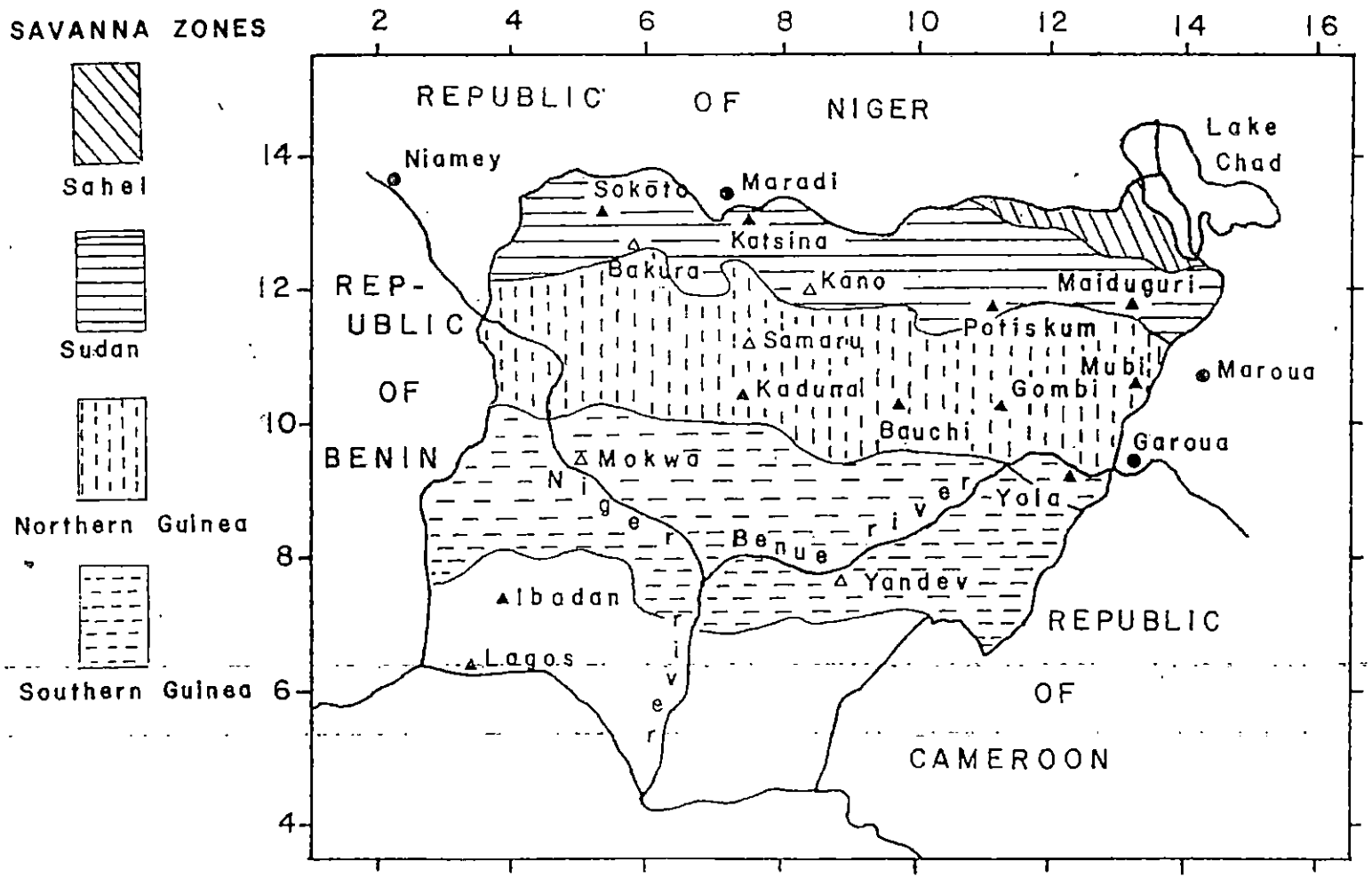
May, 1984



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Frontispiece: Map showing IAR stations (open triangle) and other towns (closed triangles) in Nigeria and neighboring countries (closed circles).

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ABSTRACT

The results of the following insect pest nurseries is reported: International Sorghum Stem Borer Nursery (ISSBN), Sorghum Breeding Sorghum Stem Borer Nursery (SBSSBN), ICRISAT-Nigeria Sorghum Stem Borer Nursery, ICRISAT-Sudan Sorghum Stem Borer Nursery, ICRISAT/IAR 1981 Sorghum Germplasm Collection for stem borer evaluation, International Sorghum Shoot Fly Nursery (ISSFN), Preliminary Sorghum Shoot Fly (PSSFN), International Sorghum Head Bug Nursery (ISHBN), Preliminary Sorghum Head Bug Nursery (PSHBN), International Sorghum Midge Nursery (ISMN) and Preliminary Sorghum Midge Nursery (PSMN).

The lack of adequate screening techniqes for the various nurseries if discussed.

1. INTRODUCTION

The use of insecticides for the control of the various sorghum insect pests is largely beyond the means of the small farmer and, usually the required insecticides are not available at the right time.

The use of plant resistance to reduce the losses caused by these pests is therefore an important part of any programme involving the small farmer if there is to be any success in increasing food production in the world.

The objectives of this programme was to evaluate various International Insect Pest Nurseries of resistant material developed by the ICRISAT-Hyderabad Programme and Local Nurseries of resistant materials developed by National Breeders and Regional ICRISAT Breeders and to help in the exchange of material between various countries.

2. CULTURAL PRACTICES

Compound fertilizer (15-15-15) at the rate of 150 Kg/Ha was applied before land preparation and ridging. Additional nitrogen, calcium ammonia nitrate or urea, was applied between the plants four weeks after planting. The plots were thinned to one plant every 25 cms about 3 weeks after planting and weeding was done whenever required.

3. WEATHER

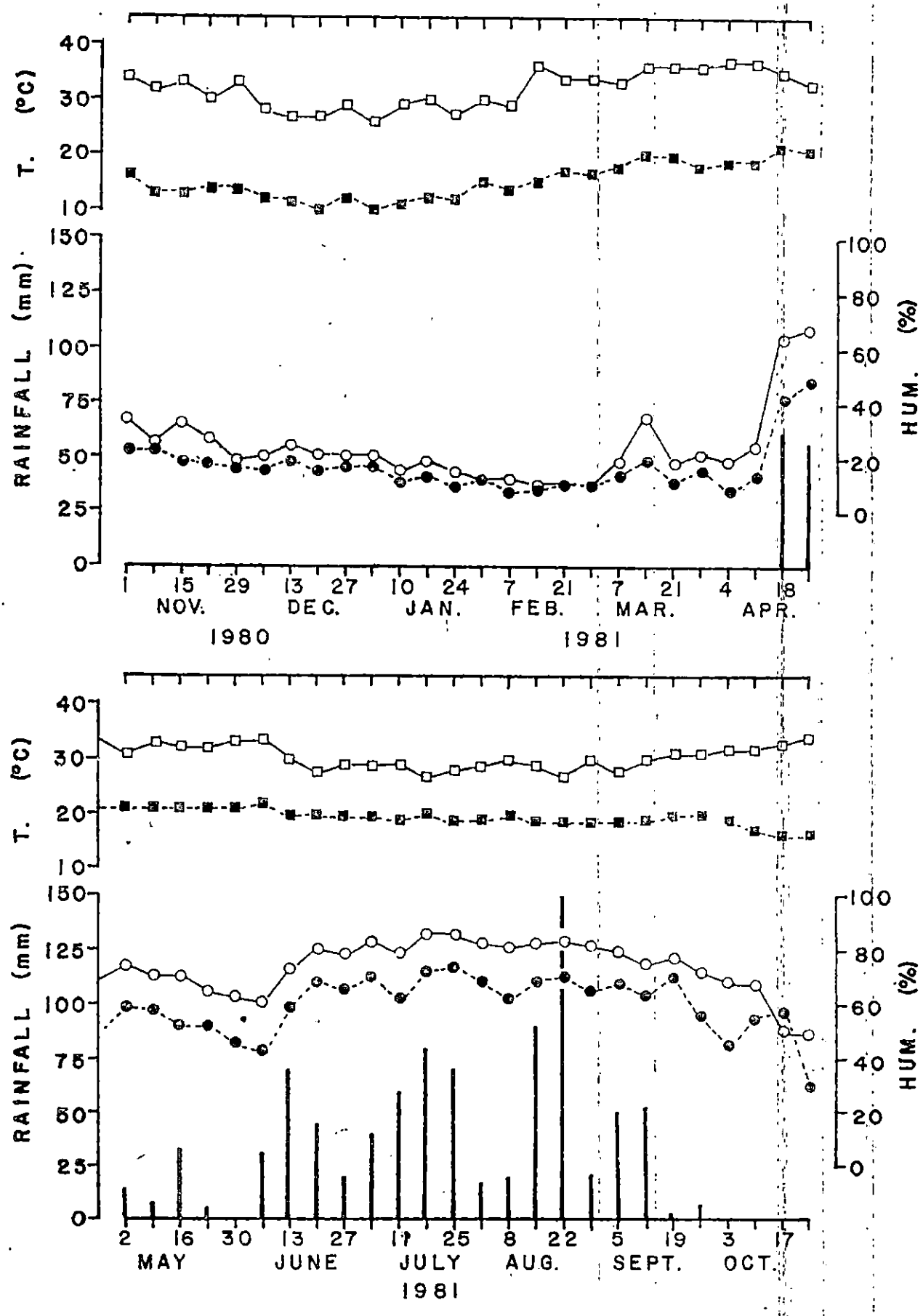
The rainfall during the 3 years of the project was highly variable; in 1981 total rainfall was about 1030 mm (98% of the 50-year mean) spread over 163 days; in 1982 total rainfall was about 750 mm (71% of the 50-year mean) spread over 179 days and in 1983 total rainfall was about 620 mm (59% of the 50-year mean) spread over 138 days. Figures 1, 2, and 3 provide detailed information on the rainfall, temperature and humidity for the three years. The temperature increased and humidity decreased slightly over the three years which may have been caused by the reduced rainfall each year.

4. RESEARCH METHODS

The following nurseries were conducted by the entomology programme in Nigeria:

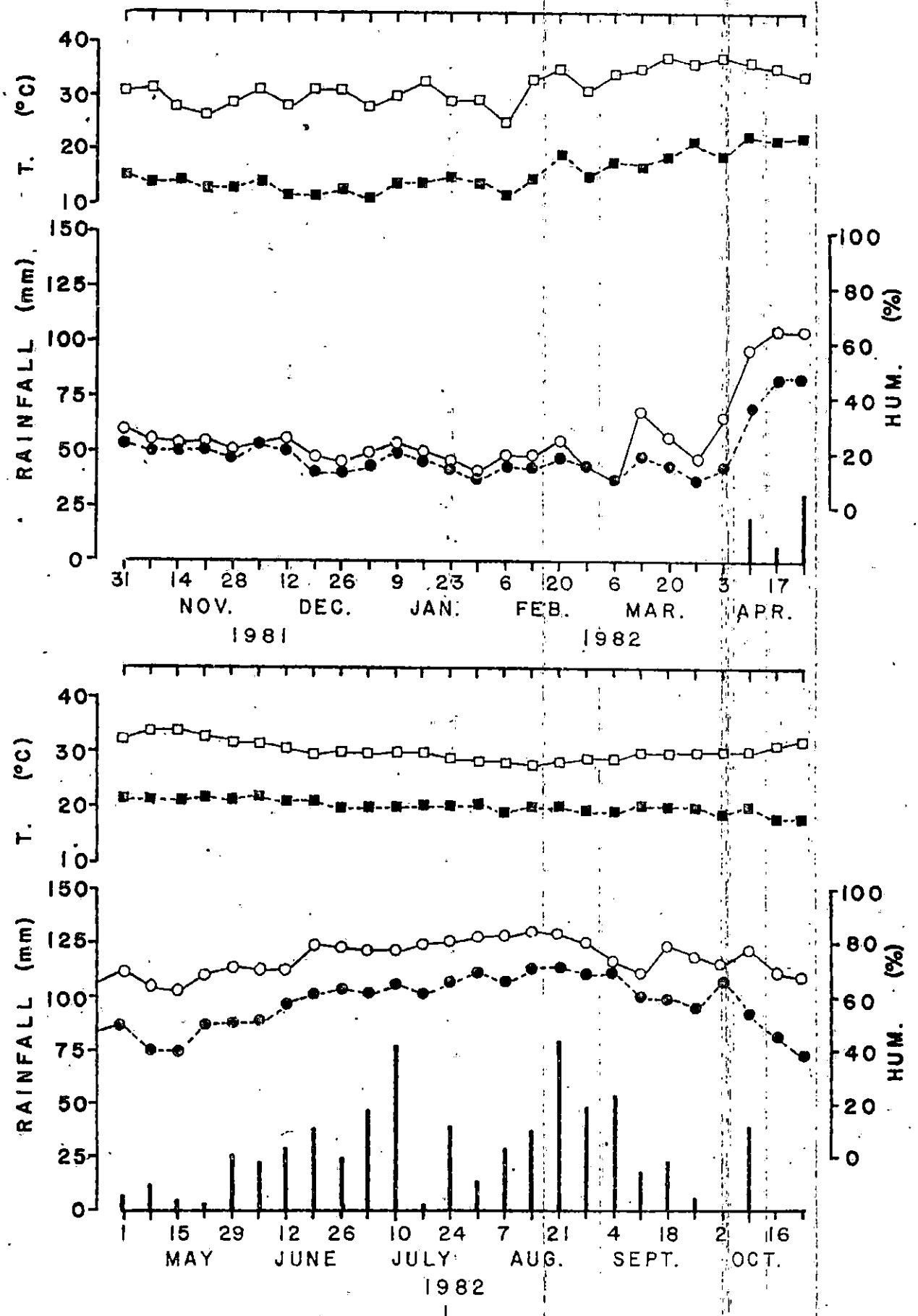
(1) International Sorghum Stem Borer Nursery (ISSBN) - 1 row by 4 replications of 25 entries of material from the ICRISAT-Hyderabad Programme and conducted in 1981 and 1983.

(2) Sorghum Breeding Sorghum Stem Borer Nursery (SBSSBN) - 1 row by 4 replications of 50 entries of material from the ICRISAT-



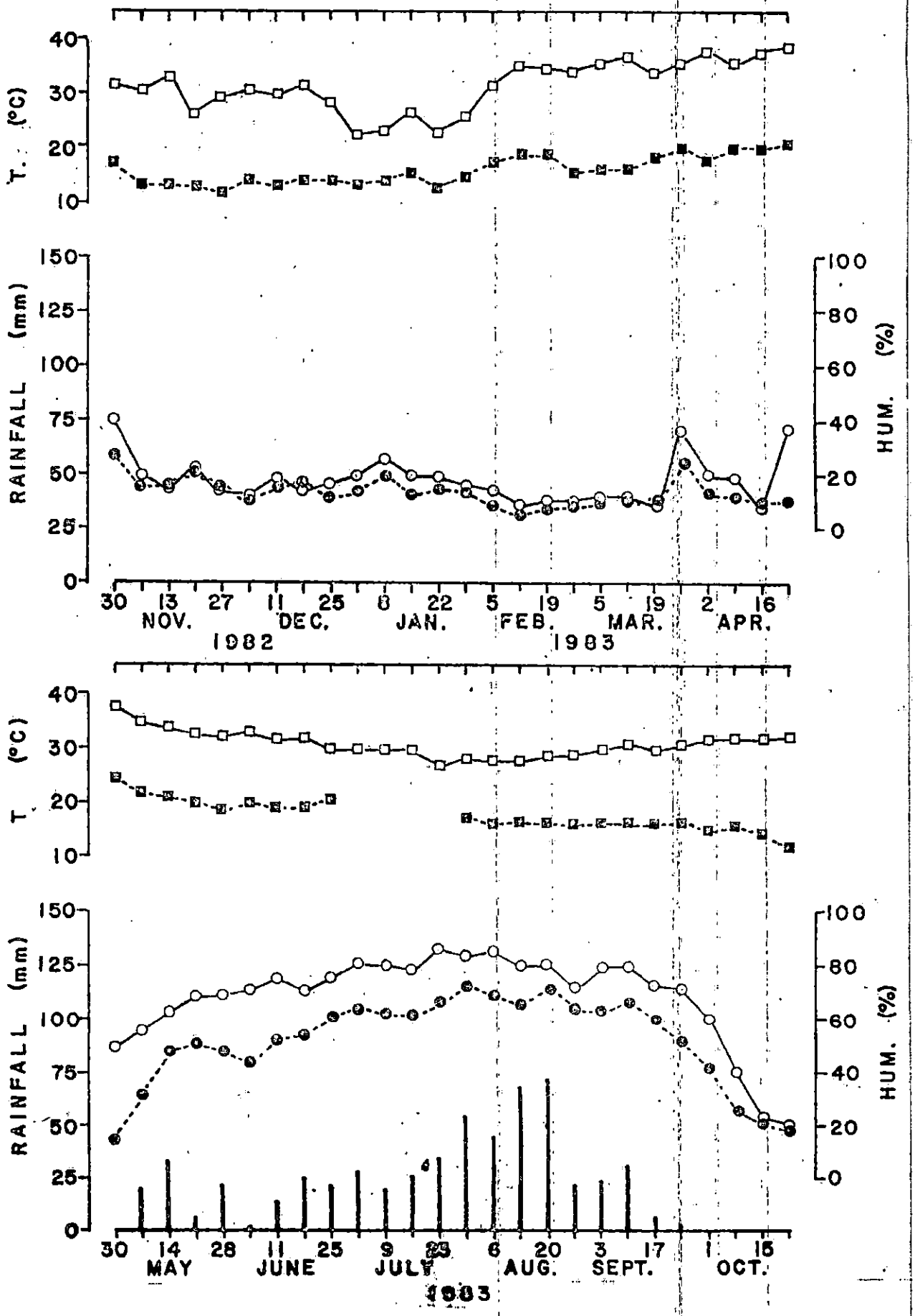
Weekly total rainfall (histogram), weekly mean high (open square) and low (closed square) temperature, weekly mean morning (open circle) and afternoon (closed circle) humidity from Nov. 1980 to Oct 1981 for Samaru, Nigeria.

Fig. 1



Weekly total rainfall (histogram), weekly mean high (open square) and low (closed square) temperature, weekly mean morning (open circle) and afternoon (closed circle) humidity from Nov. 1981 to Oct. 1982 for Samaru, Nigeria.

Fig. 2



Weekly total rainfall (histogram), weekly mean high (open square) and low (closed square) temperature, weekly mean morning (open circle) and afternoon (closed circle) humidity from Nov. 1982 to Oct. 1983 for Samaru, Nigeria.

Fig. 3

Nigeria Sorghum Breeder in 1982 and 4 rows by 3 replications of 24 entries of material supplied by the ICRISAT-Nigeria Sorghum Breeder (12) and the Nigeria National Sorghum Breeder (12) in 1983.

(3) ICRISAT-Nigeria Sorghum Stem Borer Nursery -- 2 rows by 2 replications of 17 entries of material supplied by the ICRISAT-Nigeria Cereal Pathologist in 1981.

(4) ICRISAT-Sudan Sorghum Stem Borer Nursery -- 1 row by 2 replications of 10 entries of material supplied by the ICRISAT-Sudan Sorghum Breeder in 1981.

(5) ICRISAT/IAR 1981 Sorghum Germplasm Collection for stem borer evaluation -- 1 row of 195 entries in the Sorghum Breeding plots in 1982.

(6) International Sorghum Shoot Fly Nursery (ISSFN) -- 1 row by 4 replications of 20 entries in 1981 and 25 entries in 1982 and 1983 of material supplied by the ICRISAT-Hyderabad Programme.

(7) Preliminary Sorghum Shoot Fly Nursery (PSSFN) -- 1 row by 4 replications of 21 entries of material supplied by the ICRISAT-Hyderabad Sorghum Breeding Programme in 1981.

(8) International Sorghum Head Bug Nursery -- 1 row by 3 replications of 20 entries of material supplied by ICRISAT-Hyderabad Programme in 1981.

(9) Preliminary Sorghum Head Bug Nursery (PSHBN) -- 1 row by 3 replications of 15 entries of material supplied by ICRISAT-Hyderabad Programme in 1981.

(10) International Sorghum Midge Nursery (ISMN) -- 1 row by 3 replications of 25 entries of material supplied by ICRISAT-Hyderabad Programme in 1981 and 1983.

(11) Preliminary Sorghum Midge Nursery (PSMN) -- 1 row by 3 replications of 16 entries of material supplied by ICRISAT-Hyderabad Sorghum Breeding Programme in 1981.

In the stem borer nurseries 10 stalks were dissected at harvest and scored for stem borer damage; per cent tunnel length, per cent internodes bored or visual damage rating (see MacFarlane, 1984).

In the shoot fly nurseries the main stem dead hearts were counted 28-35 days after planting for shoot fly damage.

In the head bug nurseries 10 heads in each plot were scored for damage on a basis of 0-5 scale.

in the midge nurseries 10 plants in each plot were marked as the head emerged from the boot and 15 days later samples of spiklets were selected from the top, middle and bottom of each head and later were examined for midge infestation.

In all nurseries the number of plants, harvestable heads, chaffy heads, tiller heads, main heads and grain weight were recorded for each plot.

5. RESULTS

Only partial results of each nursery is presented here, a more detailed report on these nurseries can be found in MacFarlane (1982, 1983).

5.1. International Sorghum Stem Borer Nursery (ISSBN): The most promising entries of each nursery are shown in Table 1. Infestation and damage was high in 1981 with only 4 entries having less than 50% internodes bored. The correlation between internodes bored and plot weight or grain weight per head was low as was the correlation with tunnel length.

Infestation in 1982 was low and consequently damage was also low and may have been too low for adequate evaluation of the material. The correlation between internodes bored and plot weight or grain weight per head was lower than the previous year.

5.2. Sorghum Breeding Sorghum Stem Borer Nursery (SBSSBN): The results of the best entries are shown in Table 2. Infestation in 1982 was too low for adequate evaluation of the material, mean internodes bored was 11%, and correlation between internodes bored and grain weight per plot or grain weight per head was positive (?) and may be due to the low stem borer infestation.

In 1983 infestation was higher (92%) then the previous year and the results are more reliable. The correlation between internodes bored or damage rating and plot weight was negative the correlation with grain weight per head was positive.

The same materials in these nurseries were also evaluated for stem borer damage in the Sorghum Breeding Yield Trials (SBYT) and the best 10 entries from each year are shown in Table 3. In 1982 only 3 entries, S-41, S-29 and S-8, were common in the top 10 of both nurseries. Infestation and damage was higher in SBYT than in SBSSBN and these results may be more reliable. The correlation between internodes bored and grain weight as Kg/Ha was very low and positive.

Table 1

Selected results of the International Sorghum Stem Borer Nursery (ISSBN), Samaru, Nigeria in 1981 and 1982.

Entry Name	% infestation	% internodes bored	% tunnel length	Gn. Wt. plot g	Gn. Wt. head g
			— 1981 —		
L-187	63	32	28	630	39.4
IS-8331	83	46	51	115	7.7
IS-5092	90	48	42	104	11.6
IS-18577	83	49	43	53	10.6
IS-2122	80	51	42	130	8.7
IS-18810	63	54	38	59	4.5
IS-18479	70	54	40	151	8.9
IS-10711	87	54	43	587	30.9
IS-4329	78	56	39	98	6.1
Nursery mean	82	60	46	168	10.7
S.E.	2	2	2	33	1.7
r^2				-0.29	-0.46
r^3				-0.35	-0.42
			— 1982 —		
PB-8294	37	9	-	350	17.9
IS-4293	57	11	-	549	33.5
PB-8281	46	12	-	408	18.8
PB-8258	50	12	-	387	18.6
IS-2122	60	14	-	249	12.7
PB-8254	65	16	-	424	24.0
IS-17957	43	17	-	406	22.0
IS-2205	68	17	-	53	3.0
IS-17853	67	18	-	419	21.0
IS-5470	77	18	-	484	27.5
Nursery mean	66	22	-	374	18.7
S.E.	3	2	-	32	1.7
r^2				-0.04	+0.23

[2] Correlation coefficient with internodes bored.

[3] Correlation coefficient with tunnel length.

Table 2

Selected results of the Sorghum Breeding Sorghum Stem Borer Nursery, (SBSSBN), Samaru, Nigeria. 1982 and 1983.

Entry Name	% infestation	% internodes bored	damage rating	Gn. Wt. plot g	Gn. Wt. head g
			--- 1982 ---		
S-8	13	3	-	463	28.9
K-2	15	3	-	192	16.0
S-18	33	5	-	632	53.7
S-29	28	6	-	327	20.4
S-34	40	6	-	699	46.6
S-2	43	6	-	640	49.2
S-14	28	7	-	625	52.1
S-41	28	7	-	420	30.0
S-24	33	7	-	457	32.6
S-22	33	7	-	689	53.0
Nursery mean	44	11	-	521	37.9
S.E.	2	1	-	56	2.0
r^2				0.46	0.10
			--- 1983 ---		
S-18	80	24	7.6	800	30.8
S-20	80	24	6.5	500	43.3
KSV-11	63	26	6.2	550	22.5
S-32	80	26	5.5	700	31.8
S-10	87	27	6.8	550	44.0
SPV-245	83	36	7.6	600	25.0
S-17	90	37	8.2	700	30.4
S-36	87	37	7.3	950	27.5
S-38	90	39	8.1	650	24.1
S-13	97	39	9.1	850	35.4
Nursery mean	92	45	10.7	700	33.3
S.E.	2	3	0.8	30	2.7
r^2				-0.10	0.16
r^3				-0.05	0.59

[2] Correlation coefficient with internodes bored.

[3] Correlation coefficient with damage rating.

Table 3

Selected results of stem borer evaluation in the Sorghum Breeding Yield Trial (SBYT), Samaru, Nigeria, 1982 and 1983.

Entry Name	% infestation	% internodes bored	Gn. Wt. Kg/ha
	--- 1982 ---		
S-41	37	7	3.3
S-4	43	8	2.9
S-44	50	9	3.5
S-6	50	10	2.8
S-19	37	10	4.1
S-29	53	11	3.5
K-1	43	11	3.7
S-21	60	12	4.0
S-8	57	13	3.1
S-3	47	13	2.6
Nursery mean	70	22	3.4
S.E.	2	1	0.2
r^2			0.2
	--- 1983 ---		
S-34	83	18	5.8
S-36	85	25	4.2
CSH-5	98	25	5.6
S-20	93	25	4.7
S-10	83	28	4.1
S-37	100	29	4.6
S-32	93	29	5.1
CSH-9	95	32	5.7
S-13	85	33	4.8
SFV-245	90	34	3.9
Nursery mean	95	39	4.1
S.E.	1	3	0.2
r^2			0.82

[2] Correlation coefficient with internodes bored.

In 1983 the results can be compared with more assurance as infestation and damage was high in both nurseries (Tables 2 & 3). Six entries (S-36, S-20, S-10, S-32, S-32 and SPV-245) were in the top 10 of both nurseries. The correlation between internodes bored and grain weight as Kg/Ha was high for SBYT (Table 3).

5.3. ICRISAT-Nigeria Sorghum Stem Borer Nursery: These materials are tall and photosensitive and were considered as having little value in a breeding programme. Stem borer damage was low in most entries, the best entries are shown in Table 4.

5.4. ICRISAT-Sudan Sorghum Stem Borer Nursery: The results of the best entries of the nursery are shown in Table 5. The materials did not do well in Samaru and grain weight was very low. The correlation with internodes bored or tunnel length with plot weight or grain weight per head was low.

5.5. ICRISAT/IAR 1981 Sorghum Germplasm Collection: The stem borer infestation and damage of the 10 best entries are shown in Table 6. Only 6 of the 195 entries had less than 100% infestation and the overall infestation was 99.987%. The mean internodes bored was 40% for the nursery. There was no correlation between internodes bored and grain weight per head.

5.6. International Sorghum Shoot Fly Nursery and Preliminary Sorghum Shoot Fly Nursery: The best entries of these nurseries are shown in Tables 7 & 8. In 1981 and 1982 only 2 entries appeared in the top 10 of the nurseries while in 1983 there was no common entries. Shoot fly infestation was high in 1981 (60%), reduced in 1982 (43%) and very low in 1983 (10%). The 1983 nursery was affected by the low rainfall which resulted in poor germination and poor crop establishment while the early cessation of the rains resulted in most entries not flowering. The Preliminary Nursery conducted in 1981 had 3 entries in common with the International Nursery. Overall the infestation was lower in the Preliminary Nursery even though both nurseries were in the same field

5.7. International Sorghum Head Bug Nursery and Preliminary Sorghum Head Bug Nursery: The results of these nurseries are shown in Tables 9 & 10. This was the only year the head bug nursery was evaluated because the screening techniques need to be improved.

5.8. International Sorghum Midge Nursery and Preliminary Sorghum Midge Nursery: No results were obtained from these nurseries because midge infestation was too low at Samaru for adequate screening.

Table 4

Selected results of the ICRISAT-Nigeria Sorghum Stem Borer Nursery, Samaru, Nigeria, 1981.

Entry Name	% infestation	% internodes bored	% tunnel length	Gn. Wt. plot g	Gn. Wt. head g
L-187	30	16	18	695	18.5
Soba-8	15	18	11	675	18.0
FFBC	15	18	12	648	14.2
SPS-7902	35	18	19	615	11.6
SPS-7913	25	20	11	450	10.2
SPS-7922	60	20	12	585	13.6
Nursery mean	35	27	20	621	16.3
S.E.	4	2	2	29	1.0
r^2				-0.36	0.27
r^3				-0.45	0.19

Table 5

Selected results of the ICRISAT-Sudan Sorghum Stem Borer Nursery, Samaru, Nigeria, 1981.

Entry Name	% infestation	% internodes bored	% tunnel length	Gn. Wt. plot g	Gn. Wt. head g
L-187	30	16	18	695	18.6
S-102	30	17	13	96	5.3
GSA-5029	20	21	23	36	2.6
GSA-5031	20-	21	27	112	8.6
GSA-5024	30	32	40	100	8.3
Nursery mean	22	37	41	148	5.4
S.E.	3	5	6	56	0.7
r^2				-0.32	-0.39
r^3				-0.33	-0.33

[2] Correlation coefficient with internodes bored.

[3] Correlation coefficient with tunnel length.

Table 6

Selected results of stem borer evaluation on the ICRISAT/IAR Germplasm Collection, Samaru, Nigeria, 1982.

Collection Designation	% infestation	% internodes bored	Gm. wt. head (g)
S-157	86	12	101
S-160	100	14	132
S-185	100	16	85
S-155	80	20	114
S-103	100	21	106
S-102	100	21	110
S-130	100	21	28
S-98	100	22	99
S-105	100	23	86
S-126	100	26	138
Nursery mean	100	40	98
S.E.	0	1	3
r^2			-0.07

[2] Correlation coefficient with internodes bored.

Table 7

Selected results of the International Sorghum Shoot Fly Nursery, Samaru, Nigeria, 1981, 1982, 1983.

Entry Name	Dead Hearts	Gn. wt. plot (g)	Gn. wt. head (g)
PSF-14435	38	129	7.2
PSF-13702	44	266	14.8
PSF-14103	51	668	31.8
PSF-12545	52	474	23.7
IS-16332	52	266	13.3
PSF-14404	53	118	9.8
IS-2280	53	107	9.7
IS-5567	56	300	23.1
IS-18369	58	183	11.4
IS-18354	59	372	24.8
Nursery mean	60	238	15.9
S.E.	3	24	1.5
		1982	
IS-4663	26	137	15.2
PB-21318	28	106	9.6
PB-14103	29	273	21.0
IS-5484	30	259	18.5
PB-13702	32	206	15.9
IS-2122	33	172	9.6
PB-21171	34	227	9.5
PB-21141	38	450	18.8
PB-21185	38	31	4.4
PB-14401	40	102	10.2
Nursery mean	43	207	12.8
S.E.	2	23	1.0
		1983	
PS-21112	0	--	--
PS-14093	0	--	--
IS-22121	0	--	--
IS-4664	0	--	--
IS-2146	4	--	--
PS-18822-4	5	--	--

Table 7 (continued)

PS-19794	5	--	--
PS-14454	5	--	--
IS-5566	5	--	--
PS-18607-3	5	--	--
Nursery mean	10	--	--
S.E.	2	--	--

Table 8

Selected results of the Preliminary Sorghum Shoot Fly Nursery, Samaru, Nigeria, 1981.

Entry Name	Dead Hearts (%)	Gn. Wt. plot (g)	Gn. Wt. head (g)
PSF-14523	28	52	5.8
PSF-14404	34	43	7.2
PSF-12510	35	184	12.3
PSF-14382	36	30	7.5
PSF-13527	37	249	16.6
PSF-14103	40	433	22.8
PSF-14403	41	233	15.5
PSF-14093	42	289	17.0
PSF-14454	43	145	16.2
PSF-14435	43	42	7.0
Nursery mean	48	169	13.6
S.E.	3	28	1.3

Table 9

Selected results of the International Sorghum Head Bug Nursery (ISHBN), Samaru, Nigeria, 1981.

Entry Name	Head bug score	Gn. Wt. plot (g)	Gn. Wt. head (g)
IS-16207	0.7	1	1.0
IS-16572	0.9	3	0.8
DJ-6514	1.1	97	19.4
IS-15483	1.5	339	18.3
IS-2328	1.7	115	10.5
IS-1151	1.7	123	17.8
TAM-2566	2.2	47	6.7
L-187	2.2	89	8.9
CSH-1	2.6	184	11.5
Nursery mean	1.6	111	10.5
S.E.	0.2	35	2.3

Table 10

Selected results of the Preliminary Sorghum Head Bug Nursery (PSHBN), Samaru, Nigeria, 1981.

Entry Name	Head bug score	Gn. Wt. plot (g)	Gn. Wt. head (g)
PHB-795	0.1	74	10.6
L-187	0.7	348	34.8
PHB-931	0.8	112	16.0
PHB-926	0.8	66	13.2
PHB-902	0.9	131	18.7
PHB-166	0.9	40	8.0
PHB-161	1.0	100	12.5
PHB-900	1.0	162	16.2
PHB-1069	1.0	69	13.8
Nursery mean	1.1	121	14.6
S.E.	0.1	23	1.8

6. DISCUSSION

The evaluation of the resistant sorghum lines to the various insect pests has shown a few entries that would be useful in a breeding programme. The major problem in the stem borer and head bug nurseries is the lack of adequate screening techniques. Over the years the stem borer nurseries have been evaluated using per cent tunnel length but there is no correlation between tunnel length and grain weight, the entry with the lowest tunnel length has the lowest grain weight and vice versa. MacFarlane (1984) has shown that time of infestation is more important than the amount of stalk damage and therefore the method for the evaluation of stem borer nurseries needs to be revised.

The sorghum head bug nursery was conducted only in the first year because of the lack of adequate screening techniques. It is also possible that different screening techniques may have to be developed for different regions due to the differences in the head bug species complex. There is also need to screen the resistant material in the head bug nurseries for grain quality.

Screening the sorghum shoot fly material presents no problem at Samaru when the nursery is planted in early August, usually have high shoot fly numbers without fish meal bait.

The sorghum midge nursery cannot be adequately screened at Samaru because midge populations are too low. Higher midge populations are found at Sokoto but presently there is no adequate state organization that could help with the screening.

7. ACKNOWLEDGEMENTS

The author wishes to express his sincere thanks to Mrs. Emila Karngong and Mr. Patrick Chukwu, Technical Assistants, for their help in all phases of this work and to the Director, Institute for Agricultural Research, Samaru, for research facilities.

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1984-05

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AU-SAFGRAD