PN-AAW-455

AGRICULTURAL RESEARCH CORPORATION

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

KADUGLI AGRONOMY RESEARCH 1983

WSARP PUBLICATION No. 24

APRIL 1984

AGRICULTURAL RESEARCH CORPORATION
WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

THE GOVERNMENT OF SUDAN
UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
WORLD BANK
CONSORTIUM FOR INTERNATIONAL DEVELOPMENT
WASHINGTON STATE UNIVERSITY

KADUGLI AGRONOMY RESEARCH 1983

Joe R. Gingrich	Agronomist, WSARP
Ahmed K. Elseed	Senior Technician, Agronomy, WSARP
Mukhtar M. Kenani	Agronomist, WSARP
W. Trent Bunderson	Range Scientist, WSARP

WSARP PUBLICATION No. 24

APRIL 1984

THE WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

is supported by

The Government of Sudan

The Agricultural Research Corporation

US Agency for International Development

The World Bank

The USAID portion of the project is being implemented by

The Consortium for International Development
Tucson, Arizona, USA

with

Washington State University, Pullman, Washington, USA

as the Lead University

Correct Citation:

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

Kadugli Agronomy Research
Report by Joe R. Gingrich, Agronomist; Ahmed K. Elseed, Senior Technician Agronomy; Mukhtar M. Kenani, Agronomist and Station Director; and W. Trent Bunderson, Range Scientist
WSARP Publication No. 24
Khartoum, Sudan and Pullman, Washington, USA.

AGRONOMY

AGRICULTURAL RESEARCH CORPORATION

WESTERN SUDAN AGRICULTURAL RESEARCH PROJECT

KADUGLI

1983

prepared by

Joe R. Gingrich, Agronomist

Ahmed K. Elseed, Senior Technician Agronomy

Mukhtar M. Kenani, Agronomist and Station Director

and

W. Trent Bunderson, Range Scientist
Participant in Forage Research

AGRONOMY

As construction of the road across the swamp to the new Agronomy Research Station was delayed, most of the agronomy trials were put out at Telo, approximately 20 km north with a few at Elafin, about 35 km northeast by road from the ARC/WSARP compound. Some legume and grass forage trials were started on the new agronomy research area. Trials of all three areas were on vertisols. In addition, two groundnut trials and a millet trial were put out on coarse textured, footslope soils within the ARC/WSARP compound.

Land at Telo and the ARC/WSARP compound (Saraaf) was plowed with an old 3-disc plow and later smoothed by dragging with a heavy chain and tool bar. The tail wheel of the plow was missing so the plow followed at an angle leaving many undulations that were impossible to completely remove with the chain and toolbar. The end result was not an ideal seedbed. Furrows were then made at Telo and the Saraaf with old cultivator shanks attached to a tractor mounted toolbar. Although this was somewhat faster and better than making furrows with a stick, it was still far from ideal. The land at Elafin was plowed and smoothed with GTZ/NMAC equipment. There was no mechanized land preparation for the forage trials on the Agronomy Research Station.

Rainfall data for the four sites (Telo, Elafin, Agronomy Research Station, and the ARC/WSARP compound) are shown in Table 1. Nonuniform distribution of rainfall among the four locations is very obvious. No effective precipitation occured at Telo from July 24 until August 8, a little over two weeks. After September 15 rainfall at Telo and Elafin was considerably below normal.

Sorghum

Thirteen separate sorghum trials were put out in 1983, 11 at Telo and 2 at Elafin. Two trials involved response to fertilizer, 1 was an evaluation of local collections, 3 were primarily concerned with resistance to leaf diseases, 2 with resistance to Striga, and 5 were evaluations of new lines, hybrids, or varieties.

Shortly after emergence, all trials at Telo were set back by an attack of shoot fly. At the end of the season the rains stopped early and all trials were subjected to severe moisture stress from late September onward. Consequently, long duration varieties never matured.

A. Local sorghum collection evaluation trial

1. Objective: to compare the performances of several local collections of dura with improved varieties.

Table 1. Rainfall distribution during the four month cropping period.

	July			August			September				October			
	Telo	Elafin	Saraaf	Telo	Elafin	Saraaf	Telo	Elafin	Saraaf	Agron. farm	Telo	Elafin	Saraaf	Agron. farm*
1				1.5										
2				1.5			4.5							
3						9.0								
4		3.0			10.8	4.0					2.0			
5												13.3		
6							26.0	27.7						5.0
7	1.5			2.0					69.1	75.0	9.5	2.6	1.4	
8					1.5	18.0								3.5
9											10.0		1.0	
10	2.1	14.6		8.0										
11				8.0	8.7	3.0						0.7		
12				16.0	12.5	25.0								
13						29.0	12.5			16.0				
14				48.0	106.0				29.4					
15							13.5			17.0				
16	37.0					43.0		28.2	19.4					
17				6.0										
18				40.0	36.0	1.0								
19						27.0								
20	1.0			11.0										
21	16.0	3.5			25.7	14.0								
22	8.0	30.2	7.0				2.5			16.0				
23	26.0	19.5	6.1						15.5					
24		32.4	6.8			1.0								
25						1.0								
26			1.3											
27	1.0	11.5	4.0	15.0		1.0								
28	2.5				18.6	7.0								
29			14.1				4.0							
30							8.0			36.0				
31														
Total	95.1	114.7	39.3	157.0	219.8	183.0	71.0	55.9	133.4	160.0	21.5	16.6	49.0	8.5
Kadugli long time average			139			172			139				75	

* Rain gauge not installed until September 1.

2. Procedure

Sixteen local varieties collected from the Nuba Mountain Region, based on general appearance in the field and/or their performances from previous trials, were selected for this year's trial at Telo. Improved varieties chosen for comparison were Gadam el Hamam, Dabar, and an improved Sudan grass. Seeds were distributed in excess at the bottom of a small furrow and plants later thinned to approximately 10 cm in the row.

Experimental design: RCB	Within row spacing: 1 plant/10 cm
No. of reps.: 4	Gross plot area: 16.8 m^2
No. of rows/plot: 4	Net plot area: 6 m^2
Row length: 7 m	Planned population: 70,000/f
Row spacing: 60 cm	

Planted: 16 July	1st weeding: 22 August
Emerged: 21 July	2nd weeding: 11 September
Thinned: 13 August	Harvest: 2 November

3. Results

None of the local varieties matured before soil water became depleted. Only the two shorter duration, improved varieties and Sudan grass produced any seed. Forage yields were taken from five meters of the two center rows of each plot and the data are shown in Table 2.

As would be expected the local, taller varieties produced approximately twice as much forage as the two improved varieties and the Sudan grass, an important factor to consider by those farmers who have a number of cattle to carry over the extreme dry season.

3. Response of several sorghum lines to fertilizer

1. Objective: to evaluate the response of several improved sorghum lines and a local variety to moderate application of fertilizer.

2. Procedure

Four crosses from ARC that performed well the previous season, an improved variety (Gadam el Hamam), and a local selection (Kuri) were grown at Telo without any fertilizer and with a single application rate of 40-40-0. Seed was distributed in excess in furrows and later plants thinned to approximately 10 cm.

A weighed quantity of triple superphosphate (46%) equivalent to an

Table 2. Local sorghum collection trial - stover yields. Kadugli, 1983

	kg/6m^2						
	R-I	R-II	R-III	R-IV	Avg.	kg/ha	kg/f
Kuri 288	4.45	2.60	3.95	4.05	3.76	6267	2632
Kulum 283	1.65	2.85	2.50	3.60	2.65	4417	1855
Kuri 293	1.90	2.90	3.15	3.50	2.86	4767	2002
Kuri 292	3.10	3.00	2.20	3.70	3.00	5000	2100
Tabroro 287	1.50	2.8	3.20	3.10	2.65	4417	1855
Kuri 282	1.70	2.30	3.10	3.25	2.59	4317	1813
Kuri 290	3.70	2.05	2.60	2.80	2.79	4650	1953
Forjago 280	2.65	1.30	2.85	2.60	2.35	3917	1645
Korgi 279	2.20	3.70	3.55	2.60	3.01	5017	2107
Kuri 294	1.50	1.60	2.70	2.90	2.18	3633	1526
Sudan grass	1.00	0.65	1.20	0.60	0.86	1433	602
Lugago 285	1.80	2.10	4.25	3.30	2.86	4767	2002
Gadam el Hamam	1.45	0.90	1.70	1.40	1.36	2267	952
Forjago 284	3.20	3.35	4.15	2.75	3.36	5600	2352
Forjago 281	2.90	2.20	3.05	2.50	2.66	4433	1862
Babar	1.20	1.70	1.15	1.30	1.34	2233	938
Sabag el Garad 286	3.10	1.65	4.10	4.85	3.43	5717	2401
Kuri 291	1.35	2.20	3.20	2.85	2.40	4000	1680
Kuri 289	2.20	3.35	3.10	3.10	2.94	4900	2058
C.V.					25%		
LSD					0.89		

application rate of 40 kg P_2O_5/ha was distributed in each row with the seed before covering with soil. A weighed quantity of urea (46%) equivalent to an application rate of 40 kg N/ha was sidedressed along each row approximately one month after planting.

Experimental design: RCB	Within row spacing: 1 plant/10 cm
No. of reps.: 4	Gross plot area: 16.8 m^2
No. of rows/plot: 4	Net plot area: 6 m^2
Row length: 7 m	Planned population: 70,000/f
Row spacing: 60 cm	

Planted: 16 July	1st weeding: 22 August
Emerged: 21 July	2nd weeding: 11 September
Thinned: 13 August	Harvest: 29 October
Sidedressed: 16 August	

3. Results

Yield data and plant heights at two dates are shown in Table 3. The long duration, local collection (Kuri) did not mature before the available soil water became depleted so was not included in analyzing yield data. For the other five varieties the yield of each was approximately doubled by the fertilizer treatment. Yield differences between varieties and the variety x fertilizer interaction were not statistically significant. The local collection exhibited marked differences in plant height due to the fertilizer even though it failed to produce grain. Considerable differences in growth appeared before sidedressing with urea which was evident of a marked response from phosphorus.

C. Response of an improved sorghum variety to several rates of nitrogen and phosphorus on a Nuba Mountain vertisol.

1. Objective: to determine to what extent sorghum yields are limited by inadequate levels of N and P and to determine if low to moderate amounts of N and P can be economically applied to sorghum in the Nuba Mountain area.

2. Procedure

Gadam el Hamam, a short duration, high yielding, improved variety was selected for the study at Telo. Although it is not grown very widely by traditional farmers it is grown on several of the mechanized schemes.

The experiment was a factorial with rates of 0, 20, 40, and 60 kg of N and P_2O_5/ha. Seed was distributed in excess in furrows and plants were later thinned to approximately 10 cm. A weighed quantity of triple super-

Table 3 . Response of several sorghum lines to fertilizer. Kadugli, 1983

Line	grain yield gr/6m^2 R-I	R-II	R-III	R-IV	Avg.	kg/ha	kg/f	plant height - cm Aug. 30	maturity
40-40-0									
40:216	989.5	892.5	1526.5	819.5	1057.0	1762	740	119	134
35:38	1545.0	738.0	1033.0	893.0	1052.3	1753	736	107	135
34:14	910.2	796.0	962.5	1060.5	977.3	1628	684	112	133
49:513	591.0	951.0	1354.0	939.5	958.9	1598	671	114	134
G.H.	469.0	898.5	980.5	997.5	836.4	1393	585	115	120
Kuri	did not mature							132	170
0-0-0									
35:38	776.5	409.5	619.1	587.5	598.2	997	419	64	127
40:216	725.0	716.5	431.0	409.5	570.5	952	400	73	123
49:513	313.5	924.5	338.0	309.0	471.3	785	330	64	121
34:14	497.0	571.0	320.5	405.5	448.5	748	314	66	123
G.H.	417.0	402.5	297.5	199.5	329.1	548	230	70	111
Kuri	did not mature							70	120
C.V.					33%			10%	7%
LSD					351.0			13	13

phosphate (46%) equivalent to the desired application rate was distribited with the seed in each row before covering with soil. A weighed quantity of urea (46%) equivalent to the desired application rate was sidedressed along each row approximately one month after planting.

Experimental design: RCB
No. of reps.: 4
No. of rows/plot: 4
Row length: 7 m
Row spacing: 60 cm

Within row spacing: 1 plant/10 cm
Gross plot area: 16.8 m^2
Net plot area: 6 m^2
Planned population: 70,000/f

Planted: 19 July
Emerged: 23 July
Thinned: 13 August
Sidedressed: 16 August

1st weeding: 22 August
2nd weeding: 11 September
Harvest: 31 October

3. Results:

Yield data and average number of days to maturity are shown in Table 4. The overall fertilizer effect was highly significant. All treatments with only phosphorus were significantly greater than the untreated control, but none of the treatments with only nitrogen were significantly different from the control. In fact, treatments which did not include phosphorus were affected much more with anthracnose than other treatments. In this experiment nitrogen with phosphorus did not increase yields significantly. However the coefficient of variation is quite large requiring large differences for significance so one can not say from this one experiment that nitrogen is not necessary. Yields were not high for fertilized sorghum because of severe moisture stress at maturation. Nevertheless, the experiment indicates it is likely that low available soil phosphorus is limiting sorghum yields and probably yields of other crops as well.

The fertilizer treatments had no effect on stover yields but had a highly significant effect on number of days to maturity. In general, phosphorus tended to delay maturity slightly.

To further substantiate this response to phosphorus, a nonreplicated mini-trial was planted on August 31 at the Agronomy Research Station on land that had been cropped continuously to sorghum for several years. Treatments consisted of 0-0-0, 40-0-0, 0-40-0, and 40-40-0. It was recognized from the beginning that because of this late planting the sorghum would probably never mature even in a normal year. Again, the phosphorus application produced a marked difference in plant growth with very little

Table 4. Response of an improved sorghum variety to several rates of nitrogen and phosphorus. Kadugli, 1983

Treatment	grain yield gr/6m^2 R-I	R-II	R-III	R-IV	Avg.	kg/ha	kg/f	Stover kg/f	Days to maturity
40-40-0	515.4	925.5	1231.4	722.3	848.7	1414.5	594.1	4250	87
60-40-0	765.3	651.3	1180.0	733.7	832.6	1387.7	582.8	4604	88
60-60-0	738.5	716.8	946.8	925.7	832.0	1386.7	582.4	4438	86
40-60-0	1092.9	953.4	765.4	501.7	828.4	1380.7	579.9	4250	86
20-60-0	767.8	672.2	1002.4	635.3	769.4	1282.3	538.6	4333	87
20-20-0	813.0	776.0	932.8	501.9	755.9	1259.8	529.1	4104	89
20-40-0	882.4	556.5	813.8	710.9	740.9	1234.8	518.6	4313	88
0-40-0	618.7	763.0	1023.8	543.8	737.3	1228.8	516.1	4708	88
0-60-0	579.5	387.4	1124.0	590.1	670.3	1117.2	469.2	4271	88
0-20-0	607.5	840.4	517.1	686.3	662.8	1104.7	464.0	3583	89
60-20-0	568.7	745.0	617.4	574.9	626.5	1044.2	438.6	4592	88
40-20-0	503.0	379.4	620.5	471.7	493.7	822.8	345.6	4188	88
60- 0-0	328.6	350.5	310.5	370.5	340.1	566.8	238.1	3750	89
0- 0-0	346.2	226.6	337.3	405.8	329.0	548.5	230.4	3458	94
20- 0-0	301.3	217.4	408.9	303.8	307.9	513.2	215.5	3354	91
40- 0-0	324.8	124.5	248.1	327.2	256.2	427.0	179.3	2917	96
C.V.					26%			19%	3%
LSD					223.2			ns	4

response to nitrogen.

D. Sudan national sorghum variety trial

1. Objective: to evaluate promising new varieties under Nuba Mountain conditions.

2. Procedure

Twenty-four varieties from ARC/ICRISAT were evaluated on a cracking clay soil at Telo. Seeds were dropped in hills spaced 20 cm apart in a furrow.

Experimental design: RCB	Within row spacing: 1 plant/20 cm
No. of reps.: 3	Gross plot area: 15.0 m^2
No. of rows/plot: 4	Net plot area: 7.5 m^2
Row length: 5 m	Planned population: 28,000/f
Row spacing: 75 cm	

Planted: 21 July	1st weeding: 24 August
Emerged: 25 July	2nd weeding: 12 September
Thinned: 13 August	Harvest: 30 October

3. Results

Yield, days to flowering, and plant height data are shown in Table 5. Yield and days to flowering differences were highly significant ranging from 120 to 442 kg/f for yields and 63 to 83 days to flowering.

E. Sudan national sorghum hybrid trial

1. Objective: to evaluate promising hybrids under Nuba Mountain conditions.

2. Procedure:

Twenty-four lines from ARC/ICRISAT were evaluated on cracking clay soil at Telo. Seeds were dropped in hills spaced 20 cm apart in the row.

Experimental design: RCB	Within row spacing: 1 plant/20 cm
No. of reps.: 3	Gross plot area: 15.0 m^2
No. of rows/plot: 4	Net plot area: 7.5 m^2
Row length: 5 m	Planned population: 28,000/f
Row spacing: 75 cm	

Planted: 21 July	Thinned: 15 August
Emerged: 25 July	2nd weeding: 26 August
1st weeding: 14 August	Harvest: 30 October

Table 5 . National sorghum variety trial. Kadugli, 1983

Pedigree	yield gr/7.5m^2 R-I	R-II	R-III	kg/ha	kg/f	days to flower	plant ht.-cm
Su Cr 35:20	1040.5	991.0	335.8	1052	442	67	113
Su Cr 40:36	1032.0	612.0	677.0	1032	433	63	137
Su Cr 35:5	944.0	285.5	819.5	911	382	75	111
Su Cr 51:16	663.5	747.0	621.3	903	379	72	112
Su Cr 40:36	893.5	520.5	552.5	874	367	64	127
Su Cr 43:33	731.5	421.5	632.5	794	333	74	120
Su Cr 54:43	712.0	488.0	550.2	773	327	72	119
Dabar 1/1	656.0	569.5	463.3	751	315	76	108
Gadam el Hamam	638.5	573.0	437.0	733	308	75	106
Su Cr 54:36	662.0	553.5	386.5	712	299	76	128
M - 91362	603.0	473.8	403.4	658	276	77	108
P - 967083	531.0	563.0	379.0	655	275	75	127
GSA - 5580	392.5	546.0	418.3	603	253	76	113
M - 62641	583.0	546.0	192.3	587	247	76	131
M - 63594	680.2	310.4	171.5	517	217	78	115
GSA - 5552	366.1	337.5	451.0	513	216	81	109
GSA - 5548	528.4	267.9	288.5	482	202	83	111
Su Cr 36:81	262.5	255.5	557.0	478	201	75	105
GSA - 5528	318.9	387.0	279.7	438	184	83	101
M - 90393	271.0	256.5	403.9	414	174	83	107
M - 39335	494.0	183.5	226.9	402	169	79	101
M - 90404	329.5	364.0	179.2	388	163	78	106
M - 90950	244.0	170.2	321.0	327	137	81	100
SPV - 138	244.0	233.1	165.2	285	120	79	125
C.V.					32%	8%	10%
LSD					135	10	19

3. Results

Yield, days to flowering, and plant height data are shown in Table 6. Although average yields ranged from 314 to 618 kg/f the differences were not significant because of wide variation within lines. Yields are good for the plant population used and the fact that the plants were subjected to severe moisture stress during maturation.

F. Striga resistance trials (jointly with IDRC and ARC)

1. Objective: to evaluate resistance of several sorghum lines to Striga sp.

2. Procedure:

Two trials were conducted in 1983 at Elafin where Striga infestion is extremely heavy. The land was plowed and smoothed by GTZ/NMAC equipment. Three to 4 seeds were dropped in hills spaced 20 cm apart in the row, later these were thinned to 1 plant/hill.

Besides yield of grain, observations common to both trials included: days (after planting) to emergence of Striga, number of Striga plants in two center rows 10 weeks after planting, number of days to flowering (number of days from emergence until 50% of sorghum plants are at antheses), number of sorghum plants in 2 center rows at flowering, and average height of five plants selected at random from two center rows at flowering. Normal weeding was carried out the first month but no weeding thereafter so that emerging Striga plants would not be destroyed.

Experimental design: RCB	Within row spacing: 1 plant/20 cm
No. of reps.: 3	Gross plot area: 12.8 m^2
No. of rows/plot: 4	Net plot area: 6.4 m^2
Row length: 4 m	Planned population: 26,250/f
Row spacing: 80 cm	

Planted: 20 July	Thinned 14 August
Emerged: 25 July	2nd weeding: 16 August
1st weeding: 3 August	Harvest: 4 November

3. Results

a. Striga project experiment No. 1.

Twenty five entries were evaluated. Dabara-1 was included three times at equally spaced intervals throughout each of the three blocks as a check on the natural distribution of Striga in the soil.

Yield and other pertinent data are shown in Table 7. Although the

Table 6 . National sorghum hybrid trial. Kadugli, 1983

Pedigree	yield gr/7.5m^2 R-I	R-II	R-III	kg/ha	kg/F	days to flower	plant ht.-cm
296AXSuCr 67:98/18	1112.5	1061.3	1134.5	1470	618	71	138
954066AXSuCr 51:32/28	1218.3	1042.5	902.0	1406	590	70	142
296AXA637	1218.0	1013.4	789.0	1342	564	73	148
296AXA653	1037.0	985.0	909.5	1303	547	74	123
623AXM36091	1244.6	873.5	688.0	1247	524	73	140
296AXA672	877.5	1123.5	777.5	1235	519	74	141
296AXA1052	757.2	1435.5	581.5	1233	518	73	134
623AXA-6011	1104.5	658.0	925.5	1195	502	74	150
296AXA642	913.2	814.5	931.0	1182	496	72	138
623AXCr 67:11/9	843.7	1083.5	711.5	1173	493	68	129
2219AXCr 4:33/26	944.5	711.2	903.1	1137	478	65	120
296AXA608	549.5	1407.5	593.5	1134	476	72	134
623AXKarper 551	470.0	1182.8	685.5	1039	436	73	114
623AX MR-727	682.5	796.0	859.5	1039	436	73	134
AOK11XCr 4:33/26	913.0	605.8	818.0	1039	436	65	113
Hageen Dura #1	857.0	863.0	595.5	1029	432	74	119
296AX M36232	1077.5	514.0	645.5	994	418	74	139
623AX77Cr 766	704.3	673.3	668.5	909	382	74	113
2077AX A752	622.5	898.0	429.5	867	364	74	140
296AX A629	620.5	391.0	920.5	859	361	74	116
2077AXA727	426.5	793.5	604.5	811	341	76	128
296AXA611	445.5	604.5	771.0	809	340	74	134
623AX(Cr 65:30/27XE35-1)-6-2-3	542.0	625.0	558.3	767	322	74	127
623AX(EC64734XE35-1)-6-2-3	458.0	742.5	489.0	751	315	72	118
C.V.					27%	5%	10%
LSD					ns	5	22

12

coeffecient of variation is high there were significant varietal yield differences. In fact, all data listed showed significant varietal differences with the exception of number of Striga plants. The inherent natural variation of Striga was very great as shown by the extreme variation in Striga plants associated with the Dabar-1 treatment.

b. Striga project experiment No. 2.

Eight entries that have shown some resistance to Striga in previous trials were further evaluated. Yield and other pertinent data are shown in Table 8.

Only days to Striga emergence, days to flowering, and plant height showed significant varietal differences. The excessive coeffecient of variation for number of Striga plants indicate extreme natural variation of Striga population over the experimental area.

G. Other sorghum trials

The ARC/ICRISAT advanced sorghum breeding lines trial (64 entries) planted on 26 July and the elite sorghum variety trial (20 entries) and the elite sorghum hybrid trial (20 entries), both planted on 27 July at Telo had very poor stands as a result of an extended dry period shortly after planting. No yields were taken, only some agronomic data which have been forwarded to ARC/ICRISAT and will not be included in this report.

Data from the international sorghum disease and insect trial (30 entries), the sorghum leaf disease reaction-variability trial (40 entries), and the international leaf disease observation nursery trial (30 entries) have been sent to the respective organizations and will not be included in this report.

Soybean

A. Screening soybean varieties for Southern Kordofan

Overall objectives: to evaluate under Southern Kordofan conditions the more promising lines of soybeans from the International Soybean Program (INTSOY); the Asian Soybean Evaluation Trial from AVRDC, Taiwan; and freely nodulating (promiscuous) lines from INTSOY and IITA, Nigeria.

1. International soybean variety evaluation experiment (ISVEX), INTSOY

a. Procedure

The trial consisted of 16 varieties on a vertisol at Telo. Inoculation was by distributing the inoculum over the seeds in the furrow

Table 7. Striga project, experiment No. 1. Kadugli, 1983

Pedigree	grain yield gr/6.4 m^2 R-1	R-2	R-3	kg/ha	kg/f	avg. days to Striga emerge.	No. of Striga	plant stand	days to flowering	plant height-cm
81W029	492	287	333	579	243	45	56	37	80	119
FXN-17	540	233	298	558	234	41	92	38	77	156
91R-442	522	283	179	513	215	43	95	39	80	126
Kassala	533	270	176	510	214	40	92	39	57	155
IS-7349	297	188	408	465	195	41	62	35	76	159
Karkatib	277	276	183	383	161	47	50	36	81	87
Safra	284	223	225	381	160	43	120	35	87	133
FXN-32	350	130	205	357	150	39	83	39	84	142
N-13	441	145	99	357	150	42	77	38	89	131
FXN-41	190	197	240	327	137	46	73	39	83	134
IS-7129	342	204	51	311	131	40	157	34	80	127
IS-9985	208	122	245	300	126	42	102	36	89	112
Korakolo	257	167	117	282	118	38	141	32	86	143
IS-4242	222	199	117	280	118	35	113	35	80	134
IS-5603	202	51	201	236	99	38	107	32	82	96
IS-7162	262	92	73	222	93	44	137	34	77	87
P-967083	213	102	38	184	77	46	70	39	89	121
Dabar-1	198	32	65	154	65	40	165	32	89	106
IS-7271	-	-	95	148	62	36	182	31	91	87
Dabar-1	166	-	17	95	40	39	140	29	89	94
Dabar-1	85	41	14	73	31	40	168	32	90	98
Dobbs	26	52	50	67	28	45	76	35	90	117
Waggah	31	19	2	27	11	36	114	18	86	120
Fet-Fikak	-	-	-	-	-	42	163	35	-	122
Taqarib	-	-	-	-	-	36	139	16	91	96
Elbieda	-	-	-	-	-	41	137	35	-	118
IS-7913	-	-	-	-	-	38	154	38	76	103
C.V.					40%	7%	49%	17%	4%	12%
LSD					82	5	ns	9	5	22

Table 8 . Striga project, experiment No. 2. Kadugli, 1983

Pedigree	grain yield gr/6.4 m^2 R-1	R-2	R-3	kg/ha	kg/f	avg. days to Striga emerge.	No. of Striga	plant stand	days to flowering	plant height-cm
Dabar-1	550	944	856	1223	514	46	16	53	79	138
FXN-32	572	849	835	1175	494	62	5	47	73	153
N-13	550	593	699	959	403	51	2	54	77	190
IS-9830	461	778	521	917	385	44	15	47	57	169
SRN-39	564	278	809	859	361	57	4	46	78	112
Fet. Iriana	632	438	576	858	360	39	10	47	80	175
Tetron	318	555	489	709	298	51	6	52	87	191
Gadam el Hamam	385	557	102	544	228	42	70	46	82	119
C.V.					30%	14%	182%	9%	3%	7%
LSD					ns	12	ns	ns	3	20

before covering with soil. Several sprayings of malathion were required to control blister beetle.

Experimental design: RCB	Within row spacing: 1 plant/5 cm
No. of reps.: 4	Gross plot area: 12.0 m^2
No. of rows/plot: 4	Net plot area: 6.0 m^2
Row length: 5 m	Planned population: 140,000/f
Row spacing: 60 cm	

Planted: 5 July	1st weeding: 20 August
Emerged: 15 July	2nd weeding: 8 September
Thinned: 11 August	Harvest: 6 to 20 October

b. Results

Yield, plant height, days to maturity, and number of pods/plant data are shown in Table 9. Yields were extremely low primarily due to severe moisture stress during pod filling stages and to low available phosphorus in the soil. Plants of none of the varieties reached an average height of 40 cm. Although yields varied from 94 to 159 kg/f the differences were not significant due to large variations within varieties. Significant variety differences were obtained for average plant height and days to maturity.

2. Asian soybean evaluation trial (ASET), AVRDC

a. Procedure

Twelve lines from the Asian Vegetable Research and Development Center, Taiwan, were evaluated on a vertisol at Telo. Inoculum was distributed over the seeds in the furrow before covering with soil. Several sprayings of malathion were required to control blister beetle.

Experimental design: RCB	Within row spacing: 1 plant/5 cm
No. of reps.: 4	Gross plot area: 14.4 m^2
No. of rows/plot: 4	Net plot area: 6.0 m^2
Row length: 6 m	Planned population: 140,000/f
Row spacing: 60 cm	

Planted: 6 July	1st weeding: 20 August
Emerged: 21 July	2nd weeding: 8 September
Thinned: 11 August	Harvested: 6 to 20 October

b. Results

Yield, days to maturity, plant height, and number of pods/plant

Table 9. International soybean variety evaluation experiment (INTSOY). Kadugli, 1983

Variety	grain yield gr/6m^2 R-I	R-II	R-III	R-IV	Avg.	kg/ha	kg/f	days to maturity	plant height cm	pods per plant
ICA-L-124	190	135	150	435	227.5	379	159	101	31	11
BM-2	190	245	175	225	208.8	348	146	92	28	10
EGSY-91-7	165	190	225	250	207.5	346	145	92	27	11
HM-1	210	170	230	205	203.8	340	143	97	24	10
Braxton	180	120	225	275	200.0	333	140	98	21	9
Davis	205	180	155	205	186.3	311	130	96	20	9
SH 1274	105	240	235	160	185.0	308	130	96	25	12
Ecuador I	135	210	230	165	185.0	308	130	99	27	13
AGS-66	145	235	125	220	181.3	302	127	92	21	15
Imp. Pelican	205	110	170	220	176.3	294	123	93	28	11
Jupiter	125	150	185	235	173.8	290	122	100	33	13
R-315	175	125	240	130	167.5	279	117	96	24	11
PK 7386	145	180	205	120	162.5	271	114	92	22	14
DB-1601	150	175	110	185	155.0	258	109	98	26	11
SIATAS 194	200	55	155	170	145.0	242	102	107	31	13
Essex	105	130	135	165	133.8	223	94	93	16	9
C.V.					30%			3%	13%	26%
LSD					ns			4	4	ns

data are given in Table 10. As was true for the INTSOY trial, yields were extremely low primarily due to moisture stress during pod filling stage. Although the coeffecient of variation is large, there were significant yield differences between varieties.

3. Soybean promiscuous nodulation study

a. Procedure

Eleven cultivars from INTSOY and IITA were evaluated to identify sites: (1) which already have Rhizobium japonicum strains effective on American soybean cultivars, (2) which do not have R. japonicum strains which are effective on certain cultivars, and (3) which do not have strains of R. sp. effective on any soybean variety; and to identify cultivars that are promiscuous, i.e., will produce nodules in presence of R. sp. lines that are ineffective on American soybean cultivars.

Seeds were distributed evenly in rows but were not inoculated artifically.

Experimental design: RCB	Row length: 3 m
No. of reps.: 4	Row spacing: 60 cm
No. of rows/plot: 1	Plot area: 1.8 m^2
Planted: 6 July	2nd weeding: 8 September
Emerged: 22 July	Nodule counts: at flowering
1st weeding: 20 August	

b. Results

Number of nodules counted on 10 randomly selected plants at 50% flowering stage are shown in Table 11. As the three check cultivars (Jupiter, Foster, and Davis) did not possess nodules, it can be assumed that R. japonicum is not present in the soil at the particular site. Four cultivars (M-90, TGX 306-036D, TGX 306-036C, and Malayan) can be classified as promiscuous as nodules were formed. However, because of their small size they would not be very effective.

B. Response of several soybean varieties to phosphorus

1. Objective: to determine if low availability of soil phosphorus is limiting soybean yields on cracking clay soils.

2. Procedure

Five soybean varieties that have been among the top performers in previous trials at ARC, Kadugli were selected for the study. Seeds were inoc-

Table 10. Asian soybean evaluation trial (AVRDC). Kadugli, 1983

Variety	grain yield gr/6m^2 R-I	R-II	R-III	R-IV	Avg.	kg/ha	kg/f	days to maturity	plant height at maturity cm	pods per plant
AGS 129	216.7	201.7	212.3	172.8	200.9	335	141	94	24	9
AGS 162	225.3	236.0	227.0	105.0	198.3	330	139	90	27	11
AGS 79	252.8	162.5	196.7	118.3	182.6	305	128	96	30	22
AGS 160	172.0	257.7	163.2	134.2	181.8	303	127	93	32	10
AGS 66	148.8	233.8	191.0	115.8	172.4	287	120	95	22	13
AGS 143	161.7	171.2	245.3	82.3	165.1	275	116	92	31	14
AGS 124	140.5	209.5	188.8	99.7	159.6	267	112	94	26	10
AGS 167	179.3	142.2	157.7	130.0	152.3	253	106	93	31	13
AGS 65	85.0	285.7	158.3	40.2	142.3	237	99	98	29	14
AGS 19	203.0	42.2	53.0	137.2	108.8	182	76	96	26	11
IGH 23	87.8	72.7	58.2	82.3	75.3	125	53	107	33	20
ICAL 125	66.2	13.8	77.2	76.0	58.3	97	41	110	39	26
C.V.					34%			2%	8%	24%
LSD					74.1			3	3	5

Table 11. Nodulation of promiscuous soybean cultivars. Kudugli, 1983

Cultivar	> 5 mm dia.				< 5 mm dia.			
	R-I	R-II	R-III	R-IV	R-I	R-II	R-III	R-IV
Jupiter	0	0	0	0	0	0	0	0
Foster	0	0	0	0	0	0	0	0
Davis	0	0	0	0	0	0	0	0
M - 90	0	1	0	1	0	18	2	22
TGX 306 - 036D	0	1	0	0	13	13	0	0
TGX 322 - 019D	0	0	0	0	0	0	0	0
TGX 330 - 054D	0	0	0	0	0	0	0	1
TGX 306 - 036C	0	0	0	0	2	2	2	10
TGX 442 - 01C	0	0	0	0	0	0	0	0
Malayan	0	0	0	1	4	12	7	14
Hernon	0	0	0	0	0	0	0	0

ulated just prior to planting by moistening them in a plastic bag, adding the inoculum, and then mixing. A weighed quantity of triple superphosphate (46%) equivalent to an application of 40 kg P_2O_5/ha was distributed in each furrow with the seed before covering with soil to those plots receiving phosphorus. The quantity of seed supplied was not even minimal, germination was not good, and the resulting stands were poor. Several sprayings of malathion were required to control blister beetle.

Experimental design: RCB	Row length: 5 m
No. of reps.: 3	Row spacing: 60 cm
No. of rows/plot: 4	Plot area: 12.0 m^2
Planted: 6 July	2nd weeding: 8 September
Emerged: 22 July	Harvested: 22 October
1st weeding: 20 August	

3. Results

Yield, days to flowering and maturity, plant height, height to first pod, and number of nodes/plant data are shown in Table 12. As about half of the plots had poor and spotty stands at harvest time, measurements were made of the area harvested and then those yields adjusted to 6 m^2, the harvested area of the plots having reasonably good stands.

Yields were very low because of severe moisture stress during pod filling stage. However, for what the 'patched up' data are worth, there was an overall highly significant response to the 40 kg rate of P_2O_5. Significant effects due to variety and to phosphorus were obtained for number of days to flowering, plant height, and number of nodes/plant. Significant variety responses also were obtained for days to maturity and first pod height. Plants treated with phosphorus always looked much healthier and more vigorous throughout the season.

C. Other soybean trials

1. Abu Naama soybean trial

Seeds of four soybean varieties that have performed well at Abu Naama in the past were to be evaluated at Kadugli. The supply of seed was low, had poor germination, and when planted on July 27 was subjected to a drought period. The result was an extremely poor stand and the trial was abandoned.

2. AVRDC vegetable soybean trial

This trial of 20 varieties from AVRDC was planted at Telo on 6 July.

Table 12. Response of five soybean varieties to phosphorus fertilizer. Kadugli, 1983

Variety	grain yield gr/adjusted plot R-I	R-II	R-III	Avg.	kg/ha	kg/f	days to flowering	days to maturity	plant height cm	1st pod height cm
With 40 kg P_2O_5/ha										
Ecuador	288.4	139.0	91.0	172.8	288	121	49	107	28	6
Caribe	361.5	122.1	26.4	170.0	283	119	52	114	46	7
IGH 24	114.5	264.5	101.5	160.2	267	112	58	110	41	8
ICAL 125	220.0	101.2	147.5	156.2	260	109	56	113	63	9
IGH 23	179.5	159.5	97.0	145.3	242	102	57	109	48	13
Without P_2O_5										
Caribe	254.7	87.5	74.4	138.9	232	97	52	115	43	6
IGH 23	157.2	109.0	66.0	110.7	185	77	53	107	33	7
Ecuador	130.0	40.4	61.7	77.4	124	52	48	107	22	6
IGH 24	86.9	78.5	51.5	72.3	121	51	57	107	26	6
ICAL 125	80.6	58.1	46.1	61.6	103	43	53	113	48	10
C.V.				51%			3%	2%	15%	29%
LSD				ns			3	4	11	4

Germination was extremely poor with only a very few plants per plot of all varieties. This trial was also abandoned.

Food Legumes

A. Screening cowpea varieties for Southern Kordofan

1. Objective: to evaluate promising new lines of cowpeas for the Nuba Mountain Region.

2. Procedure

This evaluation consisted of eight varieties from the international cowpea variety evaluation trial of the University of California, seven from Senegal, two from Kenya, and two picked up from the Kadugli market. Seeds were planted in hills and later thinned to 1 plant/hill.

Experimental design: RCB	Spacing within row: 1 plant/50 cm (prostrate)
No. of reps.: 4	1 plant/25 cm (erect)
No. of rows/plot: 4	Gross plot area: 9.6 m^2
Row length: 5 m.	Net plot area: 4.8 m^2
Row spacing: 60 cm	

Planted: 14 July	Thinned: 23 August
Emerged: 21 July	2nd weeding: 10 September
Infilling: 9 August	1st harvest: 3 October
1st weeding: 20 August	2nd harvest: 22 October

3. Results

Data showing seed source, growth habit, yield, days to flowering and maturity, pods/plant, and seeds/pod are in Table 13. Although yields were not high, there were significant differences between varieties. With the exception of the two local varieties, prostrate types tended to yield more than erect types. The two local varieties were extremely low because being of long duration, they were subjected to severe moisture stress during maturation.

B. International mung bean variety evaluation trial

1. Objective: to evaluate promising lines of a new crop, mung beans, when grown on vertisols of the Nuba Mountain Region.

2. Procedure

Twenty-two lines were evaluated, all supplied by the Asian Vegetable Research and Development Center, Taiwan. Seeds were dropped in hills and later thinned to 1 plant/hill.

Table 13. Cowpea variety evaluation trial. Kadugli, 1983

Variety	Seed source	growth habit*	Avg. yield kg/ha	Avg. yield kg/f	Average Days to flowering	Average Days to maturity	Average pods per plant	Average seeds per pod
5[illegible]57	Senegal	P	391	164	53	73	74	8
M-66	Kenya	P	344	145	48	75	51	13
1-12-3	U.C.-R.**	E	337	141	45	74	50	6
M-80	Kenya	P	331	139	49	72	52	12
58-185	Senegal	P	326	137	54	76	38	12
Gorom-gorom	Upper Volta	P	297	125	53	76	68	8
TN 88-63	Niger	P	284	119	49	73	73	9
Calif. Blackeye No. 5	U.C.-D.**	E	268	112	44	75	48	6
1-2-1	U.C.-R.	E	239	101	44	76	50	8
4R-0267-01F	Nigeria	SP	229	96	49	73	82	10
3-4-13	U.C.-R.	E	198	83	45	73	51	7
Ndiambour	Senegal	P	179	75	51	77	57	8
Chino M1	U.C.-R.	E	178	75	45	75	49	8
8006	U.C.-D.	E	173	73	46	75	49	8
Chino E1	U.C.-R.	E	136	57	46	76	49	7
7964	U.C.-D.	E	113	48	44	75	30	8
Bambey	Senegal	E	90	38	45	74	35	6
Local #1 (small seed)	Kadugli	P	52	23	75	97	47	12
Local #2 (large seed)	Kadugli	P	21	9	79	99	43	9
C.V.			42%		3%	2%	22%	15%
LSD			128		2	2	16	2

*Prostrate, erect, or semiprostrate.

** University of California, Riverside or Davis

Experimental design: RCB	Row spacing: 60 cm
No. of reps.: 4	Within row spacing: 1 plant/15 cm
No. of rows/plot: 4	Gross plot area: 12.0 m^2
Row length: 5 m	Net plot area: 6.0 m^2

Planted: 14 July	2nd weeding: 10 September
Emerged: 21 July	1st pick: 21 September
Infilling: 9 August	2nd pick: 6 October
1st weeding: 20 August	3rd pick: 24 October
Thinned: 22 August	

3. Results

Average yields of each of the three harvests, total yields, number of pods/plant, and number of seeds/pod data are shown in Table 14. Although there were great variations within varieties as indicated by the large coefficient of variation, there were significant differences between varieties. Of the two food legumes evaluated at Telo this season, mung bean yields tended to be considerably higher than cowpeas.

Millet

A. Pearl millet national trial

1. Objective: to evaluate promising lines of millet for the coarse textured foot-slope soils of the Nuba Mountain Region.

2. Procedure

This trial, in colloboration with ARC/ICRISAT, consisted of 15 varieties on a coarse textured soil within the WSARP/Kadugli compound. Several seeds were dropped in hills and later thinned to 2 plants/hill.

Experimental design: RCB	Row spacing: 75 cm
No. of reps.: 5	Within row spacing: 2 plants/50 cm
No. of rows/plot: 6	Gross plot area: 22.5 m^2
Row length: 5 m	Net plot area: 15.0 m^2

Planted: 28 July	Thinned: 27 August
Emerged: 11 August	2nd weeding: 13 September
Infilling: 15 August	Harvested: 6 November
1st weeding: 24 August	

3. Results

Yield, days to flowering, and ear length data are shown in Table 15.

Table 14. Mungbean variety evaluation trial. Kadugli, 1983

Variety or pedigree	gr/6m^2/picking P-1	P-2	P-3	kg/ha	kg/f	pods per plant	seeds per pod
VC 1482 A/VC 1628 A	68.1	250.9	78.4	662	278	34	11
CES 1D-21/EG-MG-16	79.4	220.6	50.8	585	246	31	9
VC 1481 A/VC 1628 A (B)	50.3	233.8	62.7	578	243	38	9
VC 2388/VC 1177	52.6	236.2	57.8	578	243	36	9
VC 1481 A/VC 1560 A	71.1	191.4	83.8	577	242	39	10
BPI glab. 3/VC 1301	56.3	219.4	66.7	571	240	38	8
Shanhua 1/VC 1168 A	55.0	219.0	68.5	571	240	41	10
VC 1482 A/VC 1628 A (B)	70.1	208.3	62.1	568	238	33	10
VC 1560 C/VC 1628 A (B)	48.9	224.4	65.5	565	237	34	10
VC 1168 D/VC 1560 A	38.6	206.1	72.7	529	222	45	10
EG-MG-16/ML-3	51.2	192.3	56.1	499	210	35	8
EG-MD-6D/ML-3	56.2	177.1	47.5	468	197	38	10
CES 1D-21 (pag-asa 1)	59.4	169.0	50.4	465	195	39	11
VC 1301/PHLV 18	79.1	145.1	44.8	448	188	45	10
VC 2006/VC 2018	62.7	158.8	45.2	445	187	38	8
CES 59/ML-5	40.2	157.8	64.5	438	184	34	10
VC 1560 C/VC 1628 A	75.2	133.0	50.8	432	181	42	9
CES 1D-21/PHLV 18	50.2	143.0	49.3	404	170	42	8
Varsha	62.6	115.5	46.4	374	157	26	10
Shanhua 1/VC 1163 A	44.1	126.1	53.8	373	157	33	8
VC 1177 B/VC 1647 A	62.7	115.0	32.9	351	147	28	10
VC 1481 A/VC 1628 A46.	46.5	105.1	46.3	330	139	32	10
C.V.				48%		24%	14%
LSD				108		ns	ns

Table 15. Pearl millet national trial. Kadugli, 1983

Pedigree	Yield gr/15 m^2 R-I	R-II	R-III	R-IV	R-V	kg/ha	kg/f	days to flower	length of ear-cm
Ugandi	1643	1582	1597	533	1927	971	408	42	23.4
Kordofani	1519	2161	588	1096	1646	935	393	52	20.9
Bri tled	1471	703	1294	1288	2017	903	379	48	29.2
ICMS 7835	1009	1227	1654	1656	1113	888	373	48	25.7
IVS H - 78	1680	1726	730	1463	490	812	341	51	25.8
ICMS 7817	983	936	1043	1109	1982	807	339	47	23.5
INMB 33	921	471	888	1615	1973	782	329	50	31.5
ISMV 8223	1287	205	1200	1487	1283	728	306	49	27.4
ISMV 8222	1900	255	1499	1036	696	718	302	45	22.6
IVS 8206	1351	786	192	1254	1374	661	278	49	27.4
ITV 8003	1743	1069	380	1066	671	657	276	50	44.2
SC_1 P 8001	1081	166	1136	1085	1161	617	259	54	24.2
IVS P - 77	726	766	793	809	858	527	221	49	26.2
KMDC	728	495	110	1131	981	459	193	54	29.6
SC_1 P 8008	719	90	316	1528	711	449	188	58	19.3
C.V.							43%	5%	14%
LSD							ns	3	4.5

Although yields among the varieties ranged from 188 to 408 kg/f they were not significantly different because of the large variation within varieties. Even with several infillings, stands were spotty in many cases due to poor seed, ant damage, and severe moisture stress before the plants became established. The soil is very sandy and the surface becomes very dry shortly after any rains stop. Numerous sprayings were required to control ants, even then they managed to inflict damage to several of the plots. Days to flowering and ear length were significantly different among the varieties.

Groundnuts

Two screening trials, with seed supplied by ARC, were put out on coarse textured soils within the ARC/WSARP compound. Groundnut is a very important cash crop on the sandy foot-slopes along the Nuba Mountain range.

A. National rainfed groundnut variety trial No. 1.

1. Objective: to evaluate several exotic as well as indigenous varieties of groundnuts under Nuba Mountain conditions.

2. Procedure

This trial consisted of 18 varieties. Two seeds were dropped in each hill and later thinned to one plant.

Experimental design: RCB	Row spacing: 60 cm
No. of reps.: 4	Within row spacing: 1 plant/20 cm
No. of rows/plot: 4	Gross plot area: 28.8 m^2
Row length: 12 m	Net plot area: 12.0 m^2
Planted: 2 August	Infilling: 21 August
Emerged: 8 August	2nd weeding: 30 August
1st weeding: 18 August	Harvested: 27 October

3. Results

Yield, days to flowering, 100 kernel weight, and percent shell data are shown in Table 16. Shelling percentage data are averages of reps I and IV only. Although there are very great variations within varieties, as evidenced by the excessive coeffecient of variation, there were significant yield differences among varieties. In this experiment, only one variety had a yield significantly greater than Baberton, the most widely planted local variety, that was the highest yielding EC-5. Similarly, only one variety had a yield significantly lower than Baberton, namely 55-437. In general, yields were good for the limited seasonal rainfall.

Table 16. National rainfed groundnut variety trial I. Kadugli, 1983

Variety	Yield (in shell) gr/12m^2 RI	RII	RIII	RIV	kg/ha	kg/f	days to flower	100 kernel wt.(gr)	gr. shelled nuts/kg
EC - 5	2209	2204	254	2115	1413	593	30	31.9	628.0
EM - 9	1879	408	1519	1634	1133	476	30	30.7	552.9
GFA Spanish	1461	1305	1325	367	929	390	30	22.3	606.2
Tifspan	1611	1241	1043	506	917	385	29	25.7	567.0
Spancross	814	1570	400	1250	841	353	30	26.4	656.0
Spanette	1885	321	881	530	753	316	30	24.8	569.2
Argentine	791	459	1765	482	728	306	30	25.0	663.6
Pronto	1380	795	279	905	700	294	30	30.6	668.6
ICGS81-NCR-21-11	954	629	159	1554	687	289	32	33.5	652.8
Barberton	500	1705	716	336	678	285	30	23.5	636.0
Comet	1241	774	795	262	640	269	30	26.5	628.4
Spanhoma	1027	234	877	693	590	248	30	28.2	676.8
Toalson	375	99	1339	692	522	219	30	26.9	596.6
Tamnut	538	736	923	244	508	213	29	24.2	579.0
Spantex	1075	315	122	536	427	179	30	25.7	655.0
Dixie Spanish	370	449	803	414	424	178	30	25.6	605.8
Sellie	550	457	387	470	388	163	30	26.0	659.4
55 - 437	178	14	39	139	78	33	37	25.3	662.0
C.V.					60%		3%		
LSD					582	245			

B. National Rainfed groundnut variety trial No. II.

1. Objective: to evaluate new groundnut lines and crosses under Nuba Mountain conditions.

2. Procedure

Twenty-two selections were included in this trial. Two seeds were dropped in each hill and later thinned to one plant.

Experimental design: RCB	Row spacing: 60 cm
No. of reps.: 4	Within row spacing: 1 plant/20 cm
No. of rows/plot: 4	Gross plot area: 28.8 m^2
Row length: 12 m	Net plot area: 12.0 m^2

Planted: 28 July	Infilling: 16 August
Emerged: 4 August	2nd weeding: 29 August
1st weeding: 8 August	Harvested: 3 November

3. Results

Yield, days to flowering, 100 kernel weight, and percent shell data are shown in Table 17. Shelling percentage data are averages of reps I and IV only. Even though yields varied from 300 to approximately 800 kg/f varietal differences were not statistically significant because of wide variation within varieties.

Sunflower

A. Sunflower variety evaluation trial

1. Objective: to evaluate promising lines or varieties of sunflower as a potential cash crop for the Nuba Mountain Region.

2. Procedure

This trial consisted of 4 varieties that have performed well in recent trials at ARC, Abu Naama. Several seeds were dropped in each hill and later thinned to 1 plant/hill. All plots were sprayed three times for control of blister beetle and once during maturation for control of centoniid beetle.

Experimental design: RCB	Row spacing: 60 cm
No. of reps.: 4	Within row spacing: 1 plant/40 cm
No. of rows/plot: 8	Gross plot area: 48.0 m^2
Row length: 10 m	Net plot area: 28.8 m^2

Table 17. [illegible] groundnut variety trial II, Kadugli, 1983

Variety	Yield (in shell) gr/12m^2 RI	RII	RIII	RIV	kg/ha	kg/f	days to flower	100 kernel wt.(gr)	gr. shelled nuts/kg
ICGS81-20	2099	2437	2501	2004	1894	796	30	34.1	724.9
ICGS81-18	1160	867	2753	2285	1472	618	30	36.3	739.0
P.I. 268619	2118	1401	1843	1622	1455	611	29	42.4	730.0
ICGS81-24	1663	502	2897	1939	1458	612	29	42.8	709.1
ICGS81-44	1105	1164	2638	1880	1414	594	30	37.4	693.5
ICGS81-28	949	788	2436	2481	1387	583	30	35.5	697.5
Barberton	1754	1138	2062	1200	1283	539	30	33.6	627.2
ICGS81-43	2151	929	1357	1629	1264	531	30	38.9	646.8
C8-70	1463	1351	2066	1127	1251	526	28	47.1	691.3
ICGS81-37	1754	1487	1680	1064	1247	524	30	32.3	654.0
ICGS81-27	1388	707	2367	1421	1226	515	29	35.5	742.9
ICGS81-31	2788	414	1064	1369	1174	493	30	33.6	674.5
ICGS81-26	2473	485	692	1316	1035	435	29	41.6	749.5
ICGS81-21	1515	433	1634	1360	1030	433	28	48.0	719.3
P.I.295210	672	422	1839	1881	1003	421	30	47.6	697.3
ICGS81-33	947	1187	1487	1179	1000	420	30	36.3	736.6
ICGS81-29	1307	890	502	1846	947	398	29	39.3	747.5
ICGS81-48	1332	1187	481	1287	893	375	30	36.2	718.1
A 7404	1204	1067	655	1034	825	347	30	37.0	678.7
P.I.268782	675	838	250	1754	733	308	28	36.5	720.8
ICGS81-23	901	932	637	1046	733	308	30	31.2	712.0
ICGS81-19	546	728	331	1785	707	297	30	31.2	708.7
C.V.					41%				

Planted: 26 July	1st weeding: 23 August
Emerged: 10 August	2nd weeding: 10 September
Thinned: 23 August	Harvest: 10 November

3. Results

The soil became very dry after planting and the seeds did not emerge until around 10 August, approximately two weeks later. Yield, plant height, and days to flowering and maturity data are shown in Table 18. Yield differences among varieties were not significant.

Table 18. Sunflower variety trial. Kaduqli, 1983

Variety	Yield gr/28.8 m^2 R-I	R-II	R-III	kg/ha	kg/f	plant ht. cm	days to flower	days to maturity
Cosmarena	1305.5	1568.0	1028.0	452	190	123	67	101
Cernianka	1144.0	1214.5	978.5	386	162	96	64	99
SH 3000 XZ	1173.5	855.0	1204.5	374	157	110	70	102
Soremm	1294.5	1031.0	890.0	372	156	111	69	101
C.V.					18%	6%	4%	2%
LSD					ns	12	ns	ns

Farmer Managed On-Farm Trials

A package of practices for increasing sorghum yields on vertisols of the Nuba Mountain Region.

Diagnostic surveys in the Nuba Mountain Region reveal the need for a high yielding, short duration variety, higher plant populations, and better weeding practices. Local varieties are usually long duration and may become subjected to severe moisture stress before or during maturation if the rains cease early. Local varieties are usually sparsely spaced, often 80 x 80 to 100 x 100 cm with 1 to 3 plants/hill. The first weeding, the most critical one, is often delayed until after crop growth has been greatly suppressed by weed competition. Many farmers relate that if they plant in dry soil or if the rains fail just after planting, ants and termites destroy the seed. Several of these farmers are aware of seed dressing chemicals but they have no way to obtain them.

1. Objective: to devise a simple package of practices that any farmer can manage for increasing sorghum yields on vertisols of the Nuba Mountain Region.

2. Procedure

Recognizing these production constraints the following nonreplicated treatments or practices were proposed for farmer managed on-farm trials:

a. Improved Practice (IP): Gadam el Hamam, population of approximately 70,000/f, timely weeding, and seed dressing,
b. Improved Farmers Practice (IFP): local variety, population of approximately 70,000/f, timely weeding, and seed dressing, and
c. Farmers Practice (FP): local variety, traditional practices, and no seed dressing.

Gadam el Hamam was selected as the improved variety. It is of short duration (approximately 95 days) and high yielding and although it is not grown by many traditional farmers at the present time it is grown extensively on some of the mechanized schemes. Plant population of 70,000/f in 60 cm rows was found to be one of the better plant populations for sorghum at the Kadugli Research Station.

Three villages were selected based on a preliminary investigation of recommendation domains by a team consisting of social scientist, range scientist, and an agronomist. Three trials were proposed for each of the three villages. Selection of individual farmer cooperators was from a list prepared by the local Sheik. The team evaluated each field as to its cropping history, size, accessability during the rainy season, representativeness of vertisols, etc. Villages and farmers selected were:

a. Hamra - farmers largely transhumants, migrate north with herds in rainy season but attempt to leave someone in charge of crops.
   Salman Aris
   Gangaie Toto
   Kirya Musa
b. Bilenga - sedentary farmers with a limited number of livestock.
   Sheik Gardod
   Babiker Karakon (Hagar Anaba)
   Awad Saeed (Hagar Anaba)
c. Shaer - sedentary farmers with no livestock
   Adam Abdulla
   Mamoon A. Dulla
   Omer Makeen (Saraaf el Daie)

Individual plot size was ¼ feddan which required 3/4 feddan for the 3 practices. The total area was measured and stakes placed at the corners of each ¼ feddan plot. One length of sisil with marks every 60 cm to mark between row spacing and another length of sisil with marks every 30 cm to be used as a guide for spacing hills within each row were prepared for each farmer cooperator. It was explained to them that these were to be used as guides for planting the two "improved" plots, later they were to thin to 3 plants/hill.

One malwa of Gadam el Hamam treated with seed dressing plus a small quantity of seed dressing to be used to treat the seed of the local variety for the improved farmers practice (IFP) was distributed to each cooperator well in advance of the planting season.

Each cooperator was advised to plant his local varieties at the time he thought best but to plant the Gadam el Hamam between 15 July and August 1. The reason for the delayed planting was to escape bird damage which we were told would likely occur if the sorghum matured too early.

No definite weeding times or dates were specified to the farmer. The time of the first weeding was stressed so that the crop could get well established without suffering from weed competition. Normally this first weeding should be within two weeks after emergence.

Each cooperator was instructed several times of the objective and procedures.

3. Results

Rainfall data for the Bilenga and Shaer areas are shown in Table 19. These data are not from the trial sites but are from nearby Range Science exclosures Nos. 9 and 4. However, the data should be fairly representative

of the trial sites. No rainfall data are available for the Hamra area.

Yields and other pertinent data are shown in Table 20. In every case the improved practice (IP) had higher yields than the others. As the rains stopped early local varieties of several of the cooperators never matured which is the reason no yields are recorded. One exception is Salman's (FP) plot at Hamra. In this particular case there was some misunderstanding between the cooperator and his brother who actually put out the (FP) plot. The result was that we were not permitted to take yield data from that particular plot.

Two of the transhumant cooperators in Hamra left for the north with their herds and thought they had left their crops in good hands with some of their relatives. Visits to these areas near the end of the season revealed that they had not been weeded and they would not yield any useful information so the two trials were abandoned.

Adam Abdulla of Shaer became quite ill after planting his sorghum and was unable to hire laborers for weeding. When his trial was inspected in September it was obvious that the crop had been suffering from severe weed competition for some time so this trial was also abandoned.

Only one cooperator, Awad Saeed, made a real attempt to follow planting instructions as both the (IP) and (IFP) plots were laid out very well. Unfortunately, his trial not only suffered from severe moisture stress but his (IFP) plot had a very severe infestation of Striga which is the main reason no yields are recorded.

Table 19. Rainfall distribution for 1983 at Shaer and Bilenga.

Month	Period	mm	
		Shaer	Bilenga
May	0 - 7	0	0
	8 - 15	49.3	32.0
	16 - 23	27.7	15.0
	24 - 31	5.3	2.5
		82.3	49.5
June	0 - 7	31.8	7.9
	8 - 15	55.4	1.0
	16 - 23	7.1	2.5
	24 - 30	4.8	56.6
		99.1	68.1
July	0 - 7	0	0
	8 - 15	0	0
	16 - 23	73.7	60.2
	24 - 31	58.4	58.4
		132.1	118.6
August	0 - 7	22.1	21.6
	8 - 15	5.1	99.8
	16 - 23	38.9	19.6
	24 - 31	2.3	4.8
		68.3	145.8
September	0 - 7	23.3	84.8
	8 - 15	29.2	54.6
	16 - 23	33.5	17.8
	24 - 30	6.4	0
		132.3	157.2
October	0 - 7	49.3	36.8
	8 - 15	0	0
	16 - 23	0	0
	24 - 31	0	0
		49.3	36.8
Total		563.4	576.0

Table 20. A package of practices for increasing sorghum yields.

Farmer:	Salman			Hamoon			Gardod		
Village:	Hamra			Shaer			Belingya		
Data/treatment:	IP*	IFP*	FP*	IP	IFP	FP	IP	IFP	FP
Planting date**	27 Jul.	15 June	15 June	8 Aug.	4 June	4 June	15 Jul.	15 Jul.	15 Jul.
Planned row spacing (cm)	60	60	-	60	60	-	60	60	-
Planned hill spacing (cm)	30	30	-	30	30	-	30	30	-
Planned plants/hill	3	3	-	3	3	-	3	3	-
Actual row spacing (cm)	80	80	-	56	67	82	46	-	-
Actual hill spacing (cm)	28	35	-	45	68	75	39	-	-
Actual plants/hill	3-9	5-10	-	3-4	4-6	4	3-4	-	-
Variety seeded	GH	Melake	-	GH	Kulum	Kulum Korgi	GH	-	-
Harvest date	7 Nov.	24 Nov.	-	17 Nov.	29 Nov.	29 Nov.	27 Nov.	-	-
Harvested area (m^2)	100	100	-	320	250	250	110	-	-
No. heads harvested	2183	788	-	3305	631	559	824	-	-
Kg grain/f	865	302	-	353	119	121	240	-	-
Kg stover/f	1537	3192	-	954	2327	2162	882	-	-
Degree of Striga	nil	nil	-	nil	nil	nil	nil	-	-

* IP: Improved practice-Gadam el Hamam, seed dressing, high population, good weeding practices
IFP: Improved farmers practice-local variety, seed dressing, high population, good weeding practices
FP: Farmers practice-local variety and traditional practices

**Some planting dates are approximate

Table 20 (continued).

Farmer:	Babiker			Awad			Omar		
Village:	Hagar Anaba			Hagar Anaba			Saraf el Daie		
Data/treatment:	IP*	IFP*	FP*	IP	IFP	FP	IP	IFP	FP
Planting date**	22 Jul.	27 June	23 June	27 Jul.	26 June	26 June	15 Jul.	15 June	15 June
Planned row spacing (cm)	60	60	-	60	60	-	60	60	-
Planned hill spacing (cm)	30	30	-	30	30	-	30	30	-
Planned plants/hill	3	3	-	3	3	-	3	3	-
Actual row spacing (cm)	69	80	109	60	60	100	70	-	-
Actual hill spacing (cm)	45	90	95	30	30	100	70	-	-
Actual plants/hill	3-5	3	2-3	3	3	3	4	-	-
Variety seeded	GH	Kulum	Korgi Kulum W.dura	GH	Kulum	Korgi	GH	-	-
Harvest date	26 Nov.	8 Dec.	19 Dec.	14 Nov.	14 Nov.	22 Dec.	9 Nov.	-	-
Harvested area (m^2)	400	160	988	120	120	1050	400	-	-
No. heads harvested	2174	300	1119	1100	0	890	-	-	-
Kg grain/f	200	184	154	178	0	152	89	-	-
Kg stover/f	660	1189	865	382	805	150	400	-	-
Degree of Striga	nil	nil	nil	few	severe	nil	nil	-	-

* IP: Improved practice-Gadam el Hamam, seed dressing, high population, good weeding practices
IFP: Improved farmers practice-local variety, seed dressing, high population, good weeding practices
FP: Farmers practice-local variety and traditional practices

**Some planting dates are approximate

Forage Evaluation Trials (Jointly with Range Science)

Several forage legume and grass evaluation trials were established on vertisols at the new Agronomy Research Station and at Telo during 1983.

Overall objective: to evaluate several forage legumes and grasses, exotic as well as indigenous, alone and in combination with each other as to ease of establishment, weed competition, persistence, promiscuous nodulation in case of legumes, yield, and feed quality.

A. Forage legume and forage legume/grass evaluation trial

1. Procedure

Three trials were put out on the Agronomy Research Station, each under a different method of land preparation:

a. over 5 years fallow, native grass,

b. over 5 years fallow, native grass, sprayed with paraquat before seeding, and

c. fallow land of one season.

Legumes and grass/legume mixtures chosen were:

1. Alysicarpus vaginalis
2. Centrosema pubescens
3. Clitoria ternatea
4. Desmodium uncinatum
5. Sesbania exaltata
6. Macroptilium atropurpureum (Siratro)
7. Leuceana leucocephala
8. Stylosanthes humilis (Cook Stylo)
9. Vigna sp. (iron & clay mix)
10. Cajanus cajan
11. Vigna sp. (Kenya)
15. Desmodium/Panicum max
16. Sesbania/Panicum max
17. Siratro/Panicum max
18. Stylo/Panicum max
19. Centro/Rhodes
20. Clitoria/Rhodes
21. Desmodium/Rhodes
22. Sesbania/Rhodes
23. Siratro/Rhodes
24. Stylo/Rhodes
25. Cajanus/Rhodes

12. Alysicarpus/Panicum max
13. Centro/Panicum max
14. Clitoria/Panicum max
26. Clitoria/Columbus
27. Cajanus/Columbus
28. Vigna (Ken.)/Columbus

Each trial was a RCBD with 4 replications, each plot being 2 m x 8 m. With one exception all plots were raked by hand with a locally pruchased garden rake prior to broadcasting the seed by hand and were then raked again afterwards. The exception was for Leuceana which was planted in hills made with a stick.

The paraquat was applied on July 5 and all three replica 1's were planted on July 15 and the remaining 3 replicas on July 20.

Seeding rates, whether sown separately or in mixtures, for each 16 m^2 plot were:

Panicum maximum	10 gr
Chloris gayana (Elmba Rhodes)	10 gr
Sorghum sp. (Columbus grass)	15 gr
Centrosema pubescens	15 gr
Desmodium uncinatum	15 gr
Sesbania exaltata	15 gr
Stylosanthes humilis	15 gr
Cajanus cajan	15 gr
Leuceana leucocephala	16 gr
Macroptilium atropurpureum	20 gr
Alysicarpus vaginalis	25 gr
Clitoria ternatea	25 gr
Vigna sp. (iron & clay mix)	65 gr
Vigna sp. (from Kenya)	65 gr

Most of the imported seed arrived only a few days before planting so no germination tests could be made. We did not wish to use any type of mechanization which would not be available to traditional

farmers but it seemed that the farmer could rake in the seeds in an attempt to cover them with soil. There were no rain gauges installed at the Agronomy Research Station in July, but records from the WSARP compound about three km away showed only 39.3 mm for July and 183 mm for August. The long time averages for these two months are 139 mm and 172 mm respectively.

In addition to the above, three perennial grasses and three legumes were broadcast by hand over larger plots on grass covered fallow. The three legumes and one legume/grass mixture were broadcast on ½ feddan plots and the three grasses broadcast on ¼ feddan plots, the latter sprayed with paraquat the day before broadcasting the grass seed. The legumes were broadcast at the rate of 1 kg/plot on July 3 and the grasses at rate of 200 gr/plot on July 5. Species evaluated were:

Chloris gayana (Boma Rhodes)

C. gayana (Elmba Rhodes)

Panicum coloratum

Stylosanthes humilis (Cook Stylo)

Macroptilium atropurpureum (Siratro)

Clitoria ternatea

Clitoria/Elmba Rhodes

2. Results

Observations made throughout the season showed that none of the exotic legumes and none of the grasses had emerged. The only genera that appeared to be growing were Vigna, Clitoria, and Cajanus, genera indigenous to the area. No attempt was made to control weeds as the traditional farmer would and could not take time to do so. However, it was several weeks before competition became severe on the trials seeded in native grass and from four to six weeks before any real competition became pronounced on the other trials.

Tests made later in the laboratory showed that germination for many of the nonindigenous genera was essentially nil.

B. Legume evaluation trial

1. Procedure

This trial was conducted on cracking clay soil at Telo. The land was plowed and smoothed somewhat by dragging a large, heavy chain. Seeds were planted in small furrows spaced 60 cm apart. Row lengths were 5 m if seed supply was limited and 10 m or more if seed supply was pleantiful. All plantings were made on July 6 & 7, 1983. A total of 73 different lines were planted without replication due to low quantities of seed of some species.

2. Results

An evaluation was made on September 17 and the observations summarized in Table 21. The data show that only one genera (Macroptilium lathyroides and M. atropurpureum) not indigenous to Sudan emerged. All other genera that grew were indigenous whether or not the seed used actually came from Sudan. None of the other exotic lines emerged, probably due to old, nonviable seed. The imported seed arrived only a few days before planting so there was not sufficient time to make any germination tests.

C. Grass evaluation trial

1. Procedure

This non replicated trial was carried out at Telo on cracking clay soil that had been plowed and smoothed with heavy chain. Plots of 2 m x 4 m were seeded at the rate of 30 gr/plot for all species with the exception of three Bothriocloa varieties which were seeded on 2 m x 2 m plots at the rate of 10 gr/plot. All seeds were hand broadcasted carefully and raked in on July 12. The following species were seeded:

Panicum coloratum (purple pigeon grass)

P. maximum (common guinea)

P. maximum (Gatton)

P. maximum (Green)

P. maximum (Hamil)

P. maximum (Bambatsi)

Brachiaria obtusiflora

B. decumbus

Bothriochloa insculptum (Bower)

B. insculptum (Emerald)

B. insculptum (Biloela)

B. pertusa

Chloris gayana (Elmba Rhodes)

Setaria sphacelata (Nandi)

S. sphacelata (Narok)

S. spacelata (Kazungula)

Sehima ischaemoides

Melinis sp. (molasses grass)

2. Results

The only species that emerged and grew were Sehima Ischaemoides

and Brachiaria obtusiflora. Both were the only indigenous species in the trial, and both exhibited good growth and seed production.

D. On-farm forage trials

1. Procedure

In addition to the preceding trials, Clitoria ternatea was broadcast by hand at the rate of 2 kg/feddan on two one-feddan plots in the Belenya area and one in Hamra, all on vertisols.

2. Results

Although a number of the Clitoria plants observed throughout the season were from roots of established plants, there also were a number of seedlings. It remains to be seen how much the Clitoria, or any other introduced legume, can be increased in the very tall, dense grass vegetation that dominates shortly after the rains begin.

A better strategy for successful legume establishment and growth would be to plant on cultivated land that is about to enter the fallow period. Weed problems on such land are much less severe and the tall grasses are present at very low densities. The reduced competition should be sufficient to permit good legume establishment in one season.

E. Overall conclusions

Unfortunately many of the seeds failed to germinate and perhaps others may have germinated and then dried up. This could be especially true for those trials planted on the Agronomy Research Station on July 3, 5, 15, and 20. There were no rains until very light showers on July 22, 23, 24, 26, and 27. These rains were not adequate to wet the soil to any depth to sustain root growth but were sufficient to germinate the seeds. Probably this surface moisture was dissipated in an hour or two after the sun came out.

Nevertheless all legume seed of nonindigenous genera from Aus-

tralia and the U.S., with the exception of Macroptilium sp., failed to germinate at Telo. Indigenous genera did germinate which indicates that some of the problem was nonviable seed rather than soil moisture.

New legume seed supplies should be ordered in pleanty of time for next season so that germination tests may be made. We should also learn which seeds should be scarified before sowing.

In the meantime, until something better is found, three indigenous forage type legumes - Vigna sp., Phaseolus trilobus, and Clitoria ternatea - should be considered for inclusion in the sedentary cropping systems in the Nuba Mountain Region primarily for livestock feed and as a soil improving crop. These three grew well, nodulated freely with active nodules, and will produce seed if planted sufficiently early. Cajanus cajan - pigeon pea - had good growth and large active nodules but appears too stemmy to make good feed. Dolichos and Lablab produce abundant forage and usually had large but inactive nodules. These two species also bloom and set seed well after the time for harvest and therefore could not supply seed sources for farmers.

With regard to future tests and screening, greatest priority should be given to legumes rather than grasses because (1) legumes are often dual purpose and provide better quality forage, (2) grasses are locally abundant in the region and any improvement in quality and persistence is not likely to be cost effective, and (3) farmers are less likely to accept the use of grasses over legumes.