THIRD REPORT

A RESEARCH AND NETWORK STRATEGY FOR SUSTAINABLE SORGHUM PRODUCTION SYSTEMS FOR LALTIN AMERICA

SEP 1986 - JAN 1997

National Agricultural Research Systems in Latin America

CONTENTS

A Research and Network Strategy for Sustainable Sorghum Production Systems for Latin America

Third Season Report
Sep. 1996 - Jan. 1997

Executive Summary

The selected sorghum lines from the previous growing cycle (64 R-lines; 87 B-lines and 12 forage lines), were evaluated in a completely randomized block design with 3 replications at 3 different sites: Quilichao (CIAT), La Libertad (CORPOICA) and Carimagua (CIAT/CORPOICA), during second semester (Sep.-Dec.) 1996.

The soils in those three sites are characterized by different levels of Al saturation. In Quilichao, Al-saturation (55%) is relatively lower than at the other two sites; however, it has the highest concentration of Mn (114 ppm). La Libertad presented an intermediate level of Al saturation (66%), lower concentrations of Mn (4.3 ppm), and represents the growing conditions in the Piedmont region of Colombia. Carimagua, showed the highest saturation (75-80%) and represents the growing conditions of native savannas.

Fields were highly variable at Quilichao and La Libertad. In Quilichao the incidence of leaf diseases was very high, and enable us to select the materials both for leaf disease resistance and Al tolerance. The other two locations did not present high levels of leaf disease incidence due to the relatively lower air humidity in second semester for the Eastern part of Colombia. Since the rains ceased in the middle of December, and the materials matured in a rain-free situation, the grains were free from molds. Several lines were lodged in Carimagua as a consequence of strong winds in the months of November and December.

Carimagua was the best site for discriminating among genotypes with respect to grain production and other relevant traits. Grain production along with stay-green scores were considered as selection criteria to chose those materials with tolerance to high Al concentrations in La Libertad and Carimagua. The average grain production for the selected material in Carimagua ranged between 2.5 and 5.0 t ha^{-1}. Results for the different evaluated traits showed significant variability due to genotypes and genotype x environment interaction (G x E). The selected sorghum materials (24 R-lines; 32 B-lines and 5 forage-lines) form the test materials for the Regional Network Testing in Latin America.

During second semester 1996, two populations were planted for mass selection: a high tillering/brown mid-rib population (ICSP HT), and a large grain population tolerant to acid soils (ICSP LG). The bulks formed from mixing the mass selected male-sterile and male-fertile heads within each population were combined to form the new cycle population. During the following cycle acid soil tolerant germplasm will be introduced into both the populations.

In addition, we also evaluated pearl millets at Quilichao, introduced from India (21 R-lines, 11 A/B line pairs and 30 populations), and a total of 2 R-lines, 4 A/B pairs and 13 populations were selected. The

selected populations and R-lines will be evaluated during first semester 1997 for forage production, along with the selected forage sorghum lines.

Further we introduced the seed of A-lines corresponding to the 83 selected B-lines, and 7 high yielding restorer lines; and a maintainer population (ICSP B) from ICRISAT Asia Center and 103 R-lines from ICRISAT Western and Central Africa Center. These materials will be evaluated and multiplied at Cali during summer 1996.

In the area of training, two scientists, one (Mr Jaime Humberto Bernal) from CORPOICA (Colombia) and the other (Mr Pedro Jose Garcia) from FONAIAP (Venezuela) spent five months (Oct 1996 - Feb 1997) at ICRISAT, getting familiarized with sorghum nursery management, evaluation and selection procedures.

REPORT

1. Background Information

A large area of lowland plains (usually called savannas, plains or cerrados) in Venezuela, Colombia and Brazil are traditionally used for extensive cattle grazing. The soils in those regions are characterized by a high acidity, high Al saturation (from 0% at close to the mountains to 90% at 200 m from the mountains). To a large extent, in those regions, the rainfall pattern follows a bimodal distribution; the main dry season starting in November. Research done by CIAT (Centro Internacional de Agricultura Tropical) has contributed to the development of those regions, increasing their productivity and diversifying the production systems (introduction of improved pastures in the native savanna, rice associated with pastures, etc.). The possibility of developing germplasm from different crop species with the ability to produce an economic crop under the savanna conditions can contribute significantly to the diversification of production systems in the region.

As the result of the interaction among centers such as ICRISAT and CIAT, INSORTMIL and some National Programs in Latin America, an initiative to develop a sorghum genetic enhancement program was launched to complement CIAT's research efforts in the savannas of Latin America. An initial proposal was developed in 1993/94 by ICRISAT, INSORTMIL and CIAT, and presented to the Inter-American Development Bank (IDB), and later on a modified proposal was presented by CIAT and ICRISAT to the same institution in 1995.

ICRISAT's scientists (Drs. Belum V.S. Reddy and C.T. Hash) have traveled to the region to discuss the proposal together with CIAT's directors and scientists; CORPOICA (Colombia) and other institutions of different countries. As a result a project is approved for 1996/97 financed by IDB (US$ 250,000) and a future project for 1999/2000 (US$ 250,000) is also approved for financing by the same organization.

The basic idea of the project is to establish and strengthen an infrastructure for the genetic enhancement of sorghum in the region. The three main objectives in the project are: to transfer genetic resources useful for the region; to initiate sorghum breeding for the development of a genetic base adapted to the predominant conditions in the regions; and to provide training for scientists in some of the collaborating institutions. The specific objectives of the project are:

* To select and multiply sorghum materials that demonstrate tolerance to conditions of high soil acidity (high Al saturation) and resistance to the prevailing foliar diseases; to evaluate those materials in different sites of the Latin American savannas.

* To identify and develop parental lines with high productivity, open-pollinated varieties and restorer lines with improved tolerance to high soil acidity and low phosphorous content, combined with the resistance to foliar diseases (mainly anthracnose, rust and grey leaf spot) through evaluation, selection and recombination.

* To establish an effective network of scientists and institutions for the evaluation of lines and hybrids, where the information about different materials is freely exchanged in workshops, training events or through other formal or informal communication channels.

* To evaluate the potential of millets for acid soils of Latin America.

2. Past testing of sorghum materials

The program for `A Research and Network Strategy for Sustainable Sorghum Production Systems for Latin America' was initiated in December 1995 with the introduction of large number of lines (restorer, maintainer and forage). Those lines were multiplied and evaluated for leaf diseases in 1996 summer (Jan-Apr) at CIAT farm near Cali (see first report). The selected lines were evaluated for tolerance to high Al saturation in replicated trials at two sites: Quilichao (CIAT) and La Libertad (CORPOICA) during the first semester (May-Aug) of 1996 (see second report). The selected materials from this report formed the test materials for the second semester evaluations in Sep-Dec 1996 at the same two sites (Quilichao and La Libertad) and an additional location, Carimagua (CIAT/CORPOICA).

3. Experimental materials

The description of the different lines selected during the first semester evaluation and the check materials used during the second semester trials is presented in **Table 1**.

All three types of materials were evaluated at 3 sites using a completely randomized block design with three replications. Each plot consisted of 4 rows of 3 m-length. In forage lines trial, the check material was a maize cultivar released by CORPOICA and CIMMYT as tolerant to acid soils.

Table 1. Lines selected in semester I 1996 and check materials.

Materials	Remarks
LINES	
Restorers (64)	Obtained from I semester testing
Mantainers (87)	Obtained from I semester testing
Forage (12)	Obtained from I semester testing
CHECKS	
SBL 107	Used in B and R lines trials as Al tolerant check
Sorghica Real 60	Used in B and R lines trials as Al tolerant check
SPRU 94008	Used in B and R lines trials as Al susceptible check
A-2267-2	Used in B and R lines trials as leaf diseases resistant check
IS 18442	Used in B and R lines trials as leaf diseases susceptible check
Icaravan	Used in B lines trial as Al tolerant check
Sikuani (Maize)	Used in Forage lines trial as check

4. Second semester trials: Quilichao (CIAT)

4.1. Location

The experimental station of Quilichao is located in the Cauca valley in the South Western region of Colombia (3^0 6' N, 76^0 31' W), in the geographic region of the Cauca River. The station is located 50 Km from Cali in the highway that communicates Cali with Popayan.

4.2. Soil characteristics

The characterization of the soil (amorphic isohyperthermic oxic dystropept) can be found in the second report of activities (Jun-Sep 1996).

The lot E-10 has high porosity and excellent drainage, conferred by a very good soil structure. However, the soil analysis revealed less organic matter in the lower part of the terrain where the trials were in second semester than in the upper part where the trials were established in first semester. The relatively higher content of Al (55% saturation) and Mn (140 ppm) was a constraint for achieving high average production, but represented excellent conditions for the selection of genotypes that tolerate those adverse conditions.

Soil analysis can be found in **Annex 1.**

4.3. Climate

During second semester 1996, the climate at Quilichao was characterized by a high relative humidity, which resulted in difficulties to control weeds and a higher incidence of leaf diseases.

Climate description can be observed in **Figure 1**.

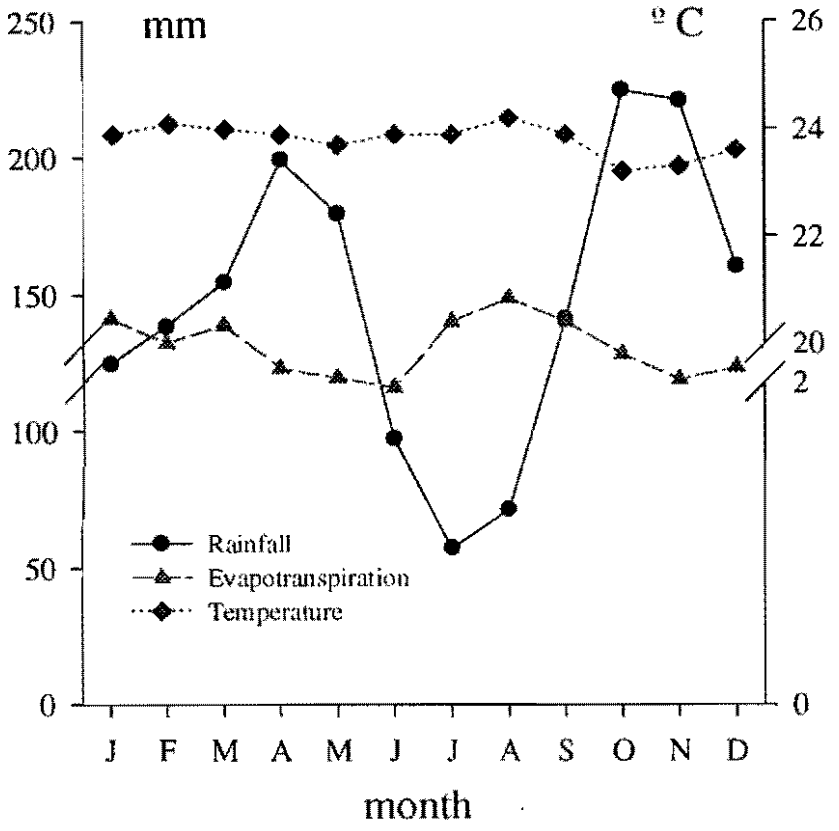

Figure 1. Description of climate in the experimental station at Quilichao, 1996.

4.4. Planting

The selected materials from the first semester (Table 1) were planted on September 28 in the lower part of lot E-10 field. The R lines were planted in 3 different sub-lots due to the limitation in space. One of those sub-lots presented very high Mn concentration, which was a constraint for the development of materials in the first replication of the R-line trial.

4.5. Trial management

The lower part of lot E-10 field was previously planted with cassava. Land preparation consisted of a pass of rotavator, followed by 2 passes of flexible chisel plough to loosen the soil and remove the

residues of the previous crop. Furrows for planting sorghum were opened with a flexible chizel plough at 10 cm depth and 60 cm apart.

Soil presented an intermediate Al saturation (55%), high Mn content (140 ppm) and a moderate saturation of interchangeable bases (44%). The fertilization plan (120N:32 P_2 O_5:95 K_2O kg ha^{-1}) formulated on the basis of soil analysis results, consisted in a basal application of 40% of the recommended N dose (105 kg ha^{-1}), 70 kg of KCl and 150 kg of triple superphosphate. After thinning, the rest of the N was applied.

Weeds were controlled through the application of Atrazine (1.5 lt ha^{-1}) after planting. Due to the excess rainfall in early crop establishment, the effect of the herbicide was not satisfactory, and manual weeding was taken up twice (during thinning and prior to flowering) to achieve a desirable control in the field.

An early application against the army worm (*Spodoptera frugiperda*) was done with granulated Hostathion (25 kg ha^{-1}). During second semester, pests were not a severe constraint for the development of the crop, except for localized attacks of *Diatrea* spp. in some susceptible materials.

Contrary to what was observed during first semester, the incidence of leaf diseases was very high (high relative humidity), providing good opportunities for the selection of resistant genotypes for anthracnose (*Colletotrichum graminicola*), rust (*Puccinia. purpurea*) and grey leaf spot (*Cercospora sorghi*).

4.6. Traits Evaluated

Evaluations for the following traits were done in the two central rows.

1) Vigor: 15 days after planting; 1=very vigorous; 5= less vigorous.

2) Plant height: of an average plant at flowering stage, in meters.

3) Length of 5th leaf at flowering (cm).

4) Length of the 5th internode at flowering (cm).

5) Days to flowering: Number of days since crop emergence till 50% of the plants have 50% of their panicles with emerging anthers.

6) Green leaf area at flowering, scale of 1 to 9; 1=more than 90% of leaf area is green; 2=81-90%; 3=71-80%; 4=61-70%; 5=51-60%; 6=41-50%; 7=31-40%; 8=21-30%; and 9=less than 20% of the foliar area is green.

7) Agronomic score: Evaluated at maturity, 1-5 scale: 1=most desirable types; 5=less desirable types.

8) Foliar diseases: evaluated using a 1 to 9 scale for anthracnose (AN), rust (RU) and white spot (LB); 1=0% of leaf area with symptoms, 2= 1 to 5%; 3= 6 to 10%; 4= 11 to 20%; 5= 21 to 30%; 6= 31 to 40%; 7= 41 to 50%; 8 =51 to 70%; and 9- more than 70% of the leaf area with symptoms.

For grain molds, the incidence was evaluated with the same 1 to 9 scale but referring to the surface of grains covered with symptoms.

The incidence of maize mosaic virus was evaluated using a 1 to 5 scale (1=0% infested plants; 2= 1 to 10%; 3= 11 to 25%; 4= 26 to 50%; and 5= more than 50% infested plants).

9) Pest incidence was evaluated on a 1 to 9 scale:
Shoot fly : 1 < 10% affected plants; 9 > 90%.
Stem borer : 1 < 10% affected plants; 9 > 90%.
Midge : 1 < 10% sterile flowers; 9 > 90%.
Head bug : 1 < 10% symptom severity; 9 > 90%.

10) Number of tillers.

11) Foliage fresh weight: in the trial involving forage lines, the foliage was cut at (i) 20 days after flowering (around 85 days after thinning), and (ii) 35 days after first cut (120 days after thinning).

12) Foliage recuperation, evaluated 30 days after the foliage was cut using a 1 to 5 scale similar to the one used for evaluating vigor.

4.7. Evaluation and selection

Belum V. S. Reddy visited the materials during 2nd and 3rd week of Jan 1997. The rains were continuing even on the day of the visit. The materials were at hard dough to maturity stage and was proper time for scoring the materials for agronomic desirability. Evaluation of R lines was done in different fields, and the field with high soil Mn concentration showed marked reduction in vigour. In other fields where Mn concentration was relatively lower, reduction in height was around 30% compared to normal development conditions, like in ICRISAT Asia Center.

There was severe incidence of leaf diseases and all the Al tolerant checks were highly susceptible. Many test lines were either dead at early stages of development or dried up near grain filling stage, indicating the level of Al toxicity in relation to the resistance level in the test material. Some tillers in the forage lines presented ergot (*Sphacelia sorghi*) dew dripping from the panicles.

The materials were scored for agronomic desirability and the lines with high level of disease resistance were noted. The data taken for different traits were analysed along with data collected on agronomic desirability. The means for various traits are presented in **Tables 2, 3** and **4**. In general, B-lines are shorter, and less vigorous, but were late in flowering compared to R-lines.

Table 2. Descriptive statistics (means and standard deviations) for different traits evaluated on R-lines, Quilichao, II semester, 1996.

Trait	N	Mean	Std Dev	Min.	Max.
Vigour	70	2.35	0.68	1.00	4.33
Plant height	69	1.40	0.24	0.92	1.95
Length 5th leaf	69	61.80	7.96	47.00	91.00
Length 5th internode	69	13.60	3.78	6.50	24.33
Days to50% flowering	69	75.00	5.17	60.00	87.00
Leaf green area	69	1.70	0.84	1.00	6.00
Agronomic score	70	2.26	0.76	1.00	4.33

As in the first semester; the forage lines were very vigorous and were very tall with greater leaf length

Table 3. Descriptive statistics (means and standard deviations) for different traits evaluated on B-lines, Quilichao, II semester, 1996.

Traits	N	Mean	Std Dev	Min.	Max.
Vigour	93	2.62	0.81	1.00	4.67
Plant height	80	1.10	0.23	0.60	1.73
Length 5th leaf	80	56.3	7.14	32.00	73.00
Length 5th internode	80	10.5	2.69	4.00	18.00
Days to50% flowering	80	79.0	4.49	71.00	92.00
Leaf green area	80	2.71	1.20	1.00	6.00
Agronomic score	93	3.12	0.90	1.00	5.00

Table 4. Descriptive statistics (means and standard deviations) for different traits evaluated on forage-lines, Quilichao, II semester, 1996.

Traits	N	Mean	Std Dev	Min.	Max.
Vigour	14	2.55	1.01	1.00	4.00
Plant height	11	1.90	0.43	1.00	2.37
Length 5th leaf	11	67.7	7.06	54.00	78.00
Length 5th internode	11	19.9	5.50	9.00	25.50
Days to50% flowering	11	77.0	7.14	61.00	87.00
Leaf green area	11	3.14	1.63	1.00	6.00
Agronomic score	14	2.62	1.29	1.00	4.67
Forage fresh weight	10	6.45	4.61	2 50	15.20

The data for all traits and for all lines are presented in **Annex 2.** Agronomic desirability, green leaf area at flowering and early vigour were considered in the selection criteria. The data for the selected entries are presented in **Tables 5, 6** and **7.** As can be seen from the tables, the selected lines are either superior or close to the Al tolerant checks in agronomic productivity. Most of the lines selected for agronomic productivity were also highly resistant to the leaf diseases.

Table 5. Performance of the selected R-lines in Quilichao, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to Flowering	Green leaf area	Agronomic score	Resistance to diseases
				Leaf	Internode				
213	ICSR 102	1.33	1.4	59.7	11.0	67	1.00	1.00	high
4	A 2267-2	2.33	1.5	64.0	12.0	80	2.33	1.00	high
654	ICSV 112	2.00	1.4	51.7	14.3	73	1.33	1.00	moderate
801	IS 30469-1187-2	2.00	1.7	55.0	19.7	72	2.00	1.00	high
818	IS 30469C-1518T-3	2.33	1.7	73.7	15.0	76	1.00	1.00	high
793	IS 18758C-710-3	1.33	1.8	60.0	16.5	72	2.50	1.00	high
852	ICSR-143	1.67	1.2	61.0	11.0	81	2.00	1.00	high
969	ICSV 95126	2.00	1.6	71.0	11.5	78	1.00	1.00	high
514	ICSV 95072	2.33	1.3	58.5	11.0	70	1.00	1.00	moderate
826	IS 30469C-1526-5	2.00	2.0	71.5	21.5	71	1.50	1.00	moderate
182	ICSR-74	2.00	1.2	62.0	9.5	82	1.50	1.00	moderate
519	ICSV 95084	3.00	1.5	68.0	15.0	71	1.00	1.00	moderate
804	IS 30469-1187-5	2.33	1.7	57.0	17.0	73	1.50	1.00	high
1	REAL 60	2.00	1.4	68.7	10.7	74	1.67	1.33	susceptible
288	ICSR 194	1.33	1.8	69.7	18.3	74	1.67	1.33	moderate
303	ICSR 89012	1.33	1.5	66.3	16.3	66	1.67	1.33	high
806	IS 30469C-1508T-2	2.33	1.8	52.0	24.3	70	1.33	1.33	moderate
295	ICSR 89005	2.33	1.2	56.5	12.5	79	1.00	1.50	moderate
426	ICSR 91031	2.00	1.8	70.5	22.0	76	1.50	1.50	high
374	ICSR 90008	1.67	1.6	73.0	12.0	82	3.00	1.50	high
534	ICSV 95096	2.33	1.7	58.5	16.5	75	1.00	1.50	moderate
749	ICSV 95016	2.67	1.4	68.5	14.0	70	1.50	1.50	high
1065	GD 27669	2.00	1.5	75.5	13.0	74	1.00	1.50	high
178	ICSR 71	3.33	1.0	60.0	6.5	81	1.00	1.50	high
506	ICSV 93043	2.67	1.6	69.5	14.5	82	1.00	1.50	high
794	IS 18758C-710-4	3.00	1.6	65.5	12.0	76	1.50	1.50	moderate
816	IS 30469C-1518T-1	2.00	1.7	67.0	15.0	78	1.50	1.50	high
850	ICSR-102	2.00	1.2	55.0	11.5	81	1.00	1.50	high
309	ICSR 89019	2.67	1.2	59.5	11.0	78	1.00	1.50	high
222	ICSR 110	2.00	1.2	55.7	10.0	72	1.33	1.67	high
803	IS 30469-1187-4	2.67	1.4	55.0	20.5	73	2.50	2.00	high
149	ICSR 45	2.33	1.0	62.5	8.5	78	2.00	2.00	high
504	ICSV 93042	2.33	1.3	63.5	13.0	78	1.00	2.00	high

Table 6. Performance of the selected B-lines in Quilichao, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score	Resistance to diseases
				Leaf	Internode				
1614	SPA2 94013	1.00	1.5	61.3	16.7	76	2.00	1.00	high
1117	ICSB 38	1.67	1.2	69.3	10.0	71	1.00	1.33	high
1142	ICSB 73	1.67	1.2	53.0	12.0	82	2.00	1.33	high
1154	ICSB 93	2.67	1.2	60.3	14.0	81	2.33	1.33	high
1178	ICSB 89002	2.67	0.9	64.3	9.3	79	1.67	1.67	high
1234	SPMD 94004	2.67	1.4	61.5	11.0	79	1.50	1.67	high
1236	SPMD 94006	2.00	1.3	60.3	11.7	76	1.67	1.67	high
1251	SPMD 94019	2.33	1.1	56.5	9.0	81	1.00	1.67	high
1269	SPMD 94036	1.33	1.1	63.3	9.7	75	2.00	1.67	high
1503	SPAN 94008	2.33	1.4	58.0	12.7	80	1.33	1.67	moderate
1279	SPMD 94050	1.67	1.5	60.5	10.5	79	1.50	2.00	high
1643	SPA2 94039	2.67	1.3	53.5	13.5	83	1.00	2.00	high
1148	ICSB 81	3.67	1.5	45.0	10.0	91	2.00	2.33	high
1517	SPAN 94046	1.67	1.6	56.0	17.0	78	2.50	2.33	high
1531	SPLB 94009	3.00	1.1	50.0	13.7	73	3.00	2.33	high
4	A 2267-2	2.67	1.7	63.0	11.5	81	2.00	2.33	high
1162	ICSB 88004	3.00	1.1	60.0	9.0	81	1.00	2.67	high
1180	ICSB 89004	1.67	1.2	55.7	9.0	82	3.33	2.67	high
1191	ICSB 91001	1.67	1.2	73.0	11.0	80	3.00	2.67	high
1534	SPLB 94012	3.00	1.1	59.5	10.5	84	2.50	3.00	high

Table 7. Performance of the selected forage-lines in Quilichao, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score	Forage fresh weight (t)
				Leaf	Internode				
1064	GD 27668	1.67	2.0	61.7	25.0	78	4.33	1.00	5.47
879	IS 31496	2.67	1.9	73.0	22.5	87	1.00	1.00	7.60
471	ICSR 93024	2.00	2.4	78.0	23.3	80	5.00	1.33	5.66
981	GD 47818	2.00	2.3	75.0	25.5	80	4.50	2.00	3.89
913	IS 31446	2.33	1.6	56.0	12.0	80	1.33	2.33	2.50

The correlations among the various traits are presented in **Tables 8, 9** and **10** for R-lines, B-lines and forage lines trials. In general, early vigour, leaf length and internodal length, green leaf area at flowering and earliness are positively related to the agronomic productivity under acid soil conditions at Quilichao.

Table 8. Correlation matrix among traits evaluated on R-lines. Quilichao, II semester, 1996.

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomic score
Vigour		-0.28*	0.04	-0.11	0.25*	-0.17	0.44**
Plant height			0.29*	0.71**	-0.38**	0.08	-0.48**
Leaf length				0.04	0.11	0.04	-0.22
Internode length					-0.41**	0.21	-0.13
Days to flowering						-0.27*	-0.02
Leaf area							0.31**

* Significant at 5% level.
** Significant at 1% level.

Table 9. Correlation matrix among traits evaluated on B-lines. Quilichao, II semester, 1996.

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomic score
Vigour		-0.26*	-0.33**	-0.33**	0.45**	-0.07	0.56**
Plant height			0.22*	0.49**	0.01	-0.24*	-0.51*
Leaf length				0.32**	-0.34**	-0.06	-0.32**
Internode length					-0.18	-0.02	-0.43
Days to flowering						-0.31**	0.12
Leaf area							0.45**

* Significant at 5% level.
** Significant at 1% level .

Table 10. Correlation matrix among traits evaluated on forage-lines. Quilichao, II semester, 1996

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomíc score	Forage fresh weight (t)
Vigour		-0.79**	0.32	-0.43	0.66**	0.34	0.80**	-0.73**
Plant height			0.65*	0.73**	-0.14	-0.04	-0.78**	0.22
Leaf length				0.68**	0.15	0.22	-0.54	0.01
Internode length					0.28	0.27	-0.69**	-0.44
Days to flowering						0.45	0.12	-0.67**
Leaf area							0.20	-0.55**
Agronomic score								-0.36

* Significant at 5% level.
** Significant at 1% level.

5. Second semester Trials: La Libertad (CORPOICA)

5.1. Location

The Experimental Center of La Libertad (CORPOICA) is located in the Meta Department, in the municipality of Villavicencio. Geographically, it is located at 4° 03' N and 73° 29' W, on the road that communicates Villavicencio and Puerto López (Caro, 1981).

5.2. Soil Characterization

Geographic and geologic description of the region can be found in the Second Report (Jun-Sep 1996). The trials were planted in the lot named as "Loma 8", in the Northeastern part of La Libertad experimental station. The soil presented low organic matter content (2.6%, almost a 40% of the OM content in Quilichao). Al saturation was high (66%), and the content of inter-changeable bases were very low. However, the concentration of Mn in the soil was low and did not represent a problem for sorghum establishment. The concentration of minor elements in the soil, was at acceptable levels for sorghum production; although some deficiency of B and Zn could have been expected. Soil analysis can be found in **Annex 3.**

5.3 Climate

The climate in the region during planting time was unusual/erratic. High rainfall continued until mid November, which allowed for a good establishment and development of most materials. At the same time, relative humidity was not as high as in the first semester, resulting in lower incidence of leaf diseases. Climatic characterization can be observed in **Figure 2.**

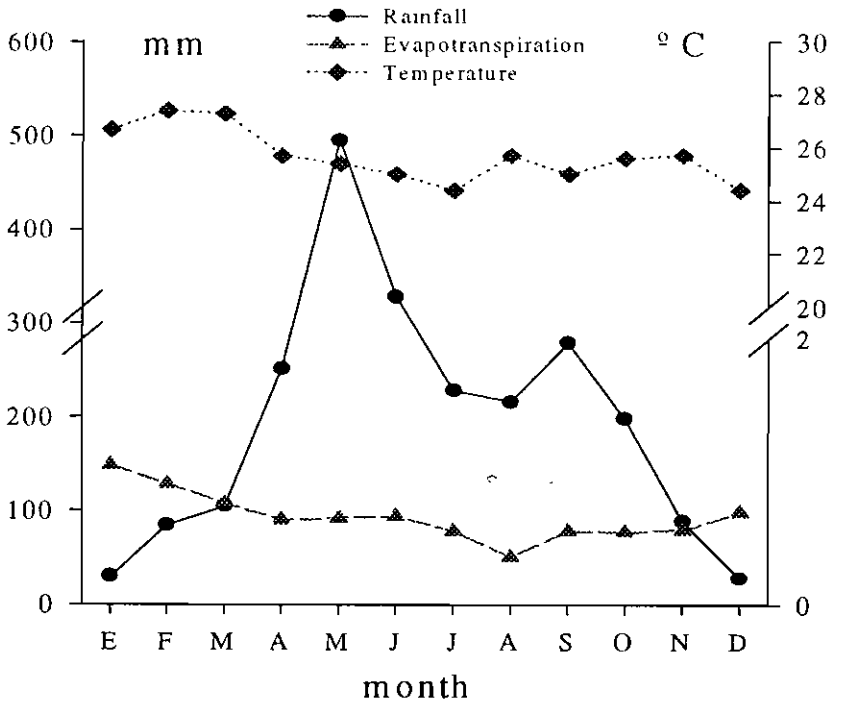

Figure 2. Climatic description; La Libertad Experimental Station, 1996.

5.4 Planting

The trials were planted on Oct. 4, 1996, with the same experimental design used in the previous semester (completely randomized block design), except the row length was increased to 5 m.

5.4.1 Trial management

The experimental lot was previously planted with Brachiaria. Land preparation was preceded by killing the pasture with the use of a systemic herbicide (Glyphosate, 4.0 l ha^{-1}). Pasture residues were incorporated with the use of a disk mould plow, followed by 2 crossed passes of disk harrow. Furrows were opened with a flexible chizel plow at 60 cm. Fifteen days after planting the fertilizer amendements were applied [(300 kg of dolomitic calcareous, 100 kg of "Sulcamag"(S, Ca and Mg) and Borax 2 kg ha^{-1}]

At planting, the whole dose of phosphorous and half the dose of potassium were applied to the soil (100 kg of superphosphate and 50 kg of KCl per hectare). Nitrogen was applied in 2 doses; the first one 15 days after germination (100 Kg of urea); together with the rest of the K dose The second dose was applied 30 days after germination using 2 sources of N (50 kg of urea and 100 kg of Nitromag).

Weed management was centered on the control of Brachiaria regrowth. The management consisted on the application of 2.5 l ha^{-1} of Atrazine in pre-emergence and 4.0 l ha^{-1} of Prowl in post-emergence (15 days after germination). 35 days after germination Glyphosate (2.0 l ha^{-1}) was applied to the spots where Brachiaria was persistant. In certain parts of the lot, it was necessary to proceed with manual control of the re-sprouted Brachiaria.

Control of insects such as *Diatrea* sp. and *S. frugiperda* was done early, through the application of biological control agents *Telenomus* sp.and *Trichogramma* sp. In spite of that, an application of Hostathion (25 kg ha^{-1}) was needed before flowering. During grain filling and physiological maturity stage there was certain incidence of webworm (*Selama sorghiela*), but the severity was low, not justifying any control measure.

5.5. Evaluation and Selection

Belum V.S. Reddy visited the material at the maturity stage in the third week of Jan 1997. It rained in the second week of Dec. 1996. As a result, even though the materials were planted later by 10 days than those at Quilichao, the material reached faster to maturity. Materials were free of leaf diseases; but there was moderate incidence of lodging, and leaf drying. Further, the reduction in plant height was similar to that observed at Quilichao. Higher levels of panicle inter nodal length codensation occurred with the result the panicles became very compact harbouring the webworm, *Selama sorghiela* which feeds on the developing grain, while the open heads were free of the larvae and hence the damage to the grain. The growth in the one fourth along the length of the field was severely affected perhaps due to water logging in the early stage.

Data on agronomic desirability was taken. Stay-green and/or non-lodging traits were considered as part of agronomic desirability. Data of this trait and other traits collected earlier were analysed and are presented in **Annex 4**. The means for various traits are presented in **Tables 11, 12** and **13** for R-lines,

B-lines and forage lines trials. Unlike Quilichao, the B-lines almost took same number of days to flower as R-lines.

Table 11. Descriptive statistics (means and standard deviations) for different traits evaluated on R-lines. La Libertad, II semester, 1996.

Trait	N	Mean	Std Dev	Min.	Max.
Vigour	70	2.36	0.61	1.00	3.67
Plant height	68	1.40	0.24	0.90	2.03
Length 5th leaf	70	59.60	7.90	44.50	80.00
Length 5th internode	70	10.90	3.01	5.00	19.67
Days to50% flowering	70	76.00	6.17	59.33	86.00
Leaf green area	70	4.15	0.70	2.67	6.00
Agronomic score	70	2.11	0.86	1.00	4.00

Table 12. Descriptive statistics (means and standard deviations) for different traits evaluated on B-lines. La Libertad, II semester, 1996.

Traits	N	Mean	Std Dev	Min.	Max.
Vigour	93	2.68	0.65	1.33	4.33
Plant height	87	0.80	0.33	0.00	1.00
Length 5th leaf	86	51.6	8.64	33.00	71.50
Length 5th internode	86	9.10	2.39	4.00	14.67
Days to50% flowering	90	76.0	5.84	62.50	87.00
Leaf green area	90	4.09	0.57	3.00	5.00
Agronomic score	91	2.02	0.72	1.00	4.00

Table 13. Descriptive statistics (means and standard deviations) for different traits evaluated on forage-lines. La Libertad, II semester, 1996.

Traits	N	Mean	Std Dev	Min.	Max.
Vigour	14	2.45	0.81	1.00	3.67
Plant height	14	1.80	0.27	1.23	2.23
Length 5th leaf	14	65.30	7.37	48.67	77.50
Length 5th internode	14	17.30	3.93	9.50	23.50
Days to50% flowering	13	71.00	7.80	54.00	82.50
Agronomic score	14	2.45	0.83	1.33	4.00
Forage fresh weight	13	4.08	1.59	2.00	7.00

Selection was carried out based on the agronomic desirability, and the top 30% of such selections were assessed for the grain yield. The data for the selected entries are given in **Tables 14, 15,** and **16**. The selected lines were as productive as the A1 tolerant checks.

Table 14. Performance of selected R-lines in La Libertad, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to Flowering	Green leaf area	Agronomic score
				Leaf	Internode			
222	ICSR 110	2.00	1.1	61.3	10.0	76	4.00	1.00
288	ICSR 194	1.67	1.9	59.0	17.0	66	3.33	1.00
303	ICSR 89012	1.33	1.6	62.0	12.0	67	2.67	1.00
415A	ICSR 91020	1.33	1.4	52.0	9.3	84	4.00	1.00
514	ICSV 95072	2.00	1.4	67.7	10.0	78	3.67	1.00
654	ICSV 112	1.67	1.5	45.7	10.3	76	4.00	1.00
793	IS 18758C-710-3	1.33	2.0	63.7	19.7	66	2.67	1.00
801	IS 30469-1187-2	1.67	1.4	65.0	16.0	74	3.50	1.00
182	ICSR-74	2.00	1.4	55.0	7.3	80	3.50	1.00
534	ICSV 95096	2.67	1.3	61.7	12.0	66	4.00	1.00
816	IS 30469C-1518T-1	2.00	1.9	62.5	13.0	76	4.33	1.00
168	ICSR 62	1.67	1.6	70.3	12.3	78	4.00	1.33
369	ICSR 90004	1.33	1.6	77.0	16.0	65	2.67	1.33
407	ICSR 91012	2.00	1.3	66.0	11.7	80	3.67	1.33
415B	ICSR 91020	1.00	1.3	59.7	11.0	84	5.00	1.33
504	ICSV 93042	2.00	1.5	68.7	10.3	80	3.50	1.50
1065	GD 27669	2.33	1.3	60.0	14.3	65	4.33	1.50
178	ICSR 71	2.67	1.1	60.0	6.0	74	4.50	1.50
324	ICSR 89033	2.67	1.6	77.5	11.0	85	5.00	1.50
519	ICSV 95084	2.67	1.3	54.7	8.7	73	4.33	1.50

Table 15. Performance of selected B-lines in La Libertad, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score
				Leaf	Internode			
1142	ICSB 73	2.33	1.0	45.3	10.3	70	3.67	1.00
1156	ICSB 94	2.00	0.7	57.7	13.3	73	3.67	1.00
1269	SPMD 94036	1.33	1.0	71.0	9.3	73	4.67	1.00
1271	SPMD 94037	2.67	1.0	55.7	8.3	67	3.67	1.00
1623	SPA2 94021	2.00	1.0	63.0	11.0	76	4.00	1.00
1632	SPA2 94029	1.67	1.0	57.3	10.3	68	4.00	1.00
1643	SPA2 94039	2.67	1.0	49.5	10.5	80	3.67	1.00
1177	ICSB 89001	2.00	1.0	70.5	7.0	81	4.00	1.00
1180	ICSB 89004	2.67	1.0	56.5	8.5	77	3.00	1.00
1517	SPAN 94046	1.67	1.0	59.0	11.5	81	3.67	1.00
1614	SPA2 94013	1.33	1.0	59.3	14.7	73	3.00	1.33
1617	SPA2 94016	2.00	1.0	55.3	7.7	71	4.33	1.33
1624	SPA2 94022	2.00	1.0	58.3	12.3	77	4.00	1.33
3	ICARAVAN	2.33	1.0	68.3	11.0	66	3.00	1.33
1	REAL 60	3.67	1.0	71.5	11.0	72	3.67	1.50
1090	ICSB 14	4.00	1.0	53.0	9.5	63	4.00	1.67
1100	ICSB 23	1.67	0.7	52.3	8.0	71	4.33	1.67
1101	ICSB 24	3.00	0.0	36.0	6.0	67	3.00	1.00
1159	ICSB 102	2.00	1.0	42.3	13.7	72	4.00	1.67
1162	ICSB 88004	2.00	0.5	42.0	9.0	83	3.50	1.50
1173	ICSB 88015	2.67	1.0	43.5	7.0	79	4.00	1.67
1234	SPMD 94004	3.00	1.0	54.0	12.0	79	4.00	1.00
1251	SPMD 94019	3.67	1.0	51.0	9.0	78	4.33	1.67
1275	SPMD 94045	3.67	1.0	49.0	8.0	76	4.50	1.67
2	SBL 107	2.67	1.0	48.3	13.0	66	3.33	1.67

Table 16. Performance of selected forage-lines in La Libertad, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Agronomic score	Forage fresh weight (t/ha)
				Leaf	Internode			
879	IS 31496	2.00	1.9	65.7	18.3	78	1.33	4.90
913	IS 31446	1.67	2.2	66.0	18.0	78	1.33	7.00
471	ICSR 93024	3.00	1.9	67.3	13.0	83	2.33	5.95
981	GD 47818	3.00	1.8	48.7	19.0	71	2.33	3.80
1064	GD 27668	2.00	1.6	66.7	19.0	73	2.67	3.10

The correlations among traits presented in **Table 17, 18** and **19** showed similar trend as those of Quilichao. Further, many of the selections made here were only moderately resistant to the leaf diseases.

Table 17. Correlation matrix among traits evaluated on R-lines. La Libertad, II semester, 1996.

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomíc score
Vigour		-0.24*	-0.17	-0.22	0.10	0.31**	0.44**
Plant height			0.24*	0.64**	-0.21	-0.34**	-0.42**
Leaf length				0.29*	-0.03	-0.10	-0.22
Internode length					-0.35**	-0.38**	-0.36**
Days to flowering						0.41**	0.16
Leaf area							0.45**

* Significant at 5% level.
** Significant at 1% level.

Table 18. Correlation matrix among traits evaluated on B-lines. La Libertad, II Semester, 1996.

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomic score
Vigour		-0.03	-0.19	-0.08	0.19	0.04	0.13
Plant height			0.15	0.33**	-0.14	0.02	-0.43**
Leaf length				0.22*	-0.09	0.02	-0.18
Internode length					-0.21	-0.17	-0.16
Days to flowering						0.27*	0.08
Leaf area							0.24

* Significnt at 5% level.
** Significant at 1% level.

Table 19. Correlation matrix among traits evaluated on forage-lines, La Libertad, II semester, 1996.

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Agronomic score	Forage fresh weight (t)
Vigour		-0.26	-0.42	-0.24	0.46	0.39	0.06
Plant height			0.35	0.61*	-0.01	-0.72**	0.12
Leaf length				0.37	-0.15	-0.01	-0.02
Internode length					-0.02	-0.40	-0.14
Days to flowering						-0.10	0.48
Agronomic score							-0.25

* Significant at 1% level.
** Significant at 5% level.

6. Second Semester Trial, Carimagua (CORPOICA/CIAT)

6.1. Location

The trial was planted at the Centro Nacional de Investigaciones Agropecuarias "Carimagua", in the Eastern Plains of Colombia. This center is located in the plains, 320 km east of Villavicencio in the Department of Meta, close to the border with the Department of Vichada. Its geographic location is between 4° 27' and 4° 45' of North latitude, and between 71° 0,5' and 71° 25' of West longitude. Its altitude is between 150 and 175 m above mean sea level (IGAC, 1983).

6.2. Soil characterization

Carimagua belongs to the isohypertermic well-drained savanna system. The basin is constituted by sediments transported from the nearby mountains. In Carimagua the geologic events are represented by the clay deposits, that were posteriorly covered by a layer of lime of different nature, including some volcanic lime (eolic erosion) (IGAC, 1983). This succession of geological events explains the diversity of textures, the abundance of kaolinite and oxides, the acentuated desaturation of bases and the low concentration of essential nutrients in the soil.

The trial was planted in the lot denominated "La Reserva". It is located on the Carimagua soil taxonomic unit, that extends between the Carimagua stream and the Muco river. The relief is plain (0 to 3% slope). Soils are very deep, well drained and developed from alluvial clay sediments. The soils have well developed structure, they are permeable and have a high activity of micro-organisms (IGAC, 1983). The soil is classified as mixed fine clay Isohypertermic Typic Haplustox , and occupies 40% of the complex soils (CR-TM).

The soils have good permeability in the first 35 cm (Ap and AB), as a result of its defined structure and fine clay texture. However, there is a superficial layer of 2cm formed by the deposition and dispersion of clays, which seals the soil avoiding the entrance of water (E. Amézquita, personal communication). Soils in the region allow for a deep and profuse root development as a result of the structure and the depth of the soil (150 cm). The main impediment for root development is the high concentration of toxic elements such as Al, Mn and Fe.

Soils present a very acid reaction, particularly in the upper layers (pH 4.6). The clay element has low reactivity and the organic matter concentration is moderate (2.6%). As a consequence, there is a low availability of nutrients in the soil, and a high Al saturation. Iron is present at high levels, particularly in its oxidative forms, which results in reddish layers of soils together with Fe precipitates. Availability of P is low due to the fixation in complexes with Al, Mn and Fe.

Description of chemical properties of soil sample is presented in **Annex 5**.

6.3 Climate.

The region is in a transition zone between humid and dry tropical forests. The average rainfall is 2344 mm, distributed mainly between the months of April and November. There is a high evaporation (1838 mm) and the mean daily temperature is 26°C in the region. The hotest months are during the dry period (Dec - Mar) and the lowest temperatures can be observed during the rainy season (Jun - Aug) (IGAC, 1983). As in La Libertad, rainfall was unusual during the second semester of 1996, extending until mid December, which favored the development of the established sorghum lines (**Figure 3**).

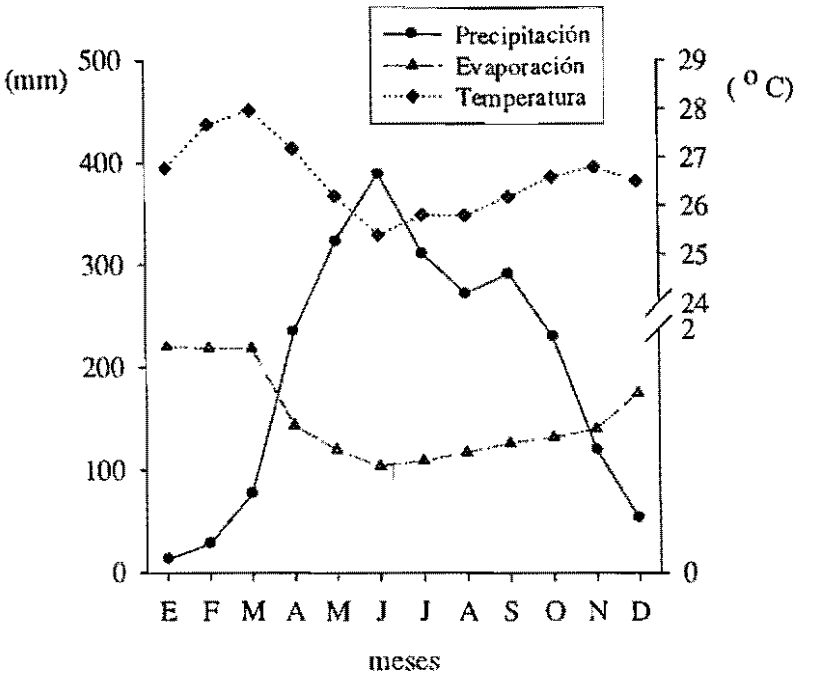

Figure 3. Climatic description for Carimagua experimental station, second semester, 1996.

6.4 Planting

Trials were established on October 12, 1996, in the lot called "La Reserva", with the same experimental design and type of experimental unit as described for the trials in La Libertad.

6.5. Trial management.

The field was fallow for 3 years, after 2 crop cycles of cassava in 1991 and 1992. Land preparation was initiated with a pass of a grass mover; 15 days later a systemic herbicide was applied (glyphosate, 3.0 l ha^{-1}), once weeds have re-sprouted. One month later, all residues were incorporated with 2 perpendicular passes of a disk plow. A deep plowing was performed afterwards with a rigid chizel plow. Seed bed was refined with 2 passes of a disk harrow and a pass of flexible chizel plow to open the furrows at 10 cm depth and 60 cm apart..

At planting time, 300 kg of dolomitic calcareous, 33 kg of KCl , 230 kg of ammonium sulfate and 160 kg of triple superphosphate were applied. After thinning, the rest of the N was applied as urea (150 kg).

Atrazine was applied right after planting (1.5 l/ha) and posterior weed control was done by hand throughout the development of the crop.

Control of *S. frugiperda* was done at an early stage with the application of granulated Lorsban (20 kg ha^{-1}), directly applied where the pest attack was most severe. The most important pest during the crop cycle was a native rodent called "chiguiro", who preferred the plots with maize in the forage-line trial. Preventive control was applied in the form of fencing and night-watch laborers.

6.6. Selection and evaluation

Belum V.S. Reddy visited the trails at maturity in the third week of Jan 1997. The field was uniform and the material expression was very good enabling the excellent discrimination among the genotypes. Lodging was more severe than La Libertad. It was decided to take data on the agronomic desirability and grain yield on the entire set of R- and B-lines. The test materials' earhead in general were more compact and were affected by the earhead worm, *Selama sorghiela*, while the open heads were unaffected by the worm. Like La Libertad leaf diseases were negligible.

Means of the traits are given in **Tables 20, 21** and **22**. The data for the entire set of materials are given in the **Annex 6**. Selection for further testing was based on the agronomic desirability and grain yield in R- and B-lines and agronomic desirability and forage weight at maturity.

Table 20. Descriptive statistics (means and standard deviations) for different traits evaluated on R-lines. Carimagua, 1996.

Trait	N	Mean	Std Dev	Min.	Max.
Vigour	70	2.14	0.56	1.00	3.33
Plant height	70	1.50	0.26	0.97	2.23
Length 5th leaf	70	68.80	8.22	51.00	88.33
Length 5th internode	70	13.20	3.77	7.33	24.33
Days to50% flowering	70	73.00	5.36	63.67	82.67
Leaf green area	70	1.25	0.40	1.00	2.67
Agronomic score	70	2.00	0.81	1.00	4.00

Table 21. Descriptive statistics (means and standard deviations) for different traits evaluated on B-lines. Carimagua, 1996.

Traits	N	Mean	Std Dev	Min.	Max.
Vigour	93	2.39	0.61	1.33	4.33
Plant height	93	1.10	0.23	0.63	1.83
Length 5th leaf	93	63.10	6.91	41.67	86.33
Length 5th internode	93	9.30	2.50	5.33	17.67
Days to50% flowering	93	74.00	5.78	63.00	84.67
Leaf green area	93	1.43	0.44	1.00	2.67
Agronomic score	93	2.16	0.77	1.00	4.00

Table 22. Descriptive statistics (means and standard deviations) for different traits evaluated on forage-lines. Carimagua, II semester, 1996.

Traits	N	Mean	Std Dev	Min.	Max.
Vigour	14	2.12	0.65	1.00	3.00
Plant height	13	1.70	0.23	1.40	2.13
Length 5th leaf	13	67.30	5.95	57.00	75.67
Length 5th internode	13	17.70	2.48	13.67	21.33
Days to50% flowering	13	77.00	4.75	71.33	84.00
Leaf green area	13	1.33	0.47	1.00	2.67
Agronomic score	14	2.43	1.02	1.00	4.00
Forage fresh weight	13	10.43	5.17	5.43	21.87

The data for the selected entries for all the types of materials are presented in **Tables 23, 24** and **25.** Most of the selected entries had high agronomic desirability and grain yield similar to the to the Al tolerant checks.

Correlations among different traits are presented in **Tables 26, 27** and **28** for the R-lines, B-lines and forage-lines, respectively.

Table 23. Performance of selected R-lines in Carimagua, II semester, 1996

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score
				Leaf	Internode			
1065	GD 27669	1.67	1.4	64.7	11.7	65	1.00	1.00
182	ICSR-74	1.67	1.3	69.0	12.3	79	1.33	1.00
2	SBL 107	1.33	1.4	58.7	17.7	65	2.00	1.00
303	ICSR 89012	1.00	1.8	80.0	14.7	68	1.00	1.00
403	ICSR 91008	2.00	1.8	71.0	14.0	69	1.00	1.00
407	ICSR 91012	2.33	1.2	65.0	10.0	83	1.00	1.00
415B	ICSR 91020	1.67	1.2	66.0	11.0	76	1.00	1.00
478	ICSR 93033	1.67	1.8	79.7	19.0	65	1.00	1.00
504	ICSV 93042	2.67	1.8	76.0	14.7	75	1.00	1.00
514	ICSV 95072	2.33	1.4	61.0	11.0	81	1.00	1.00
528	ICSV 95091	2.33	1.6	62.3	11.0	70	1.00	1.00
801	IS 30469-1187-2	2.67	1.6	78.3	16.3	80	1.33	1.00
803	IS 30469-1187-4	1.67	1.4	60.0	16.0	75	1.33	1.00
804	IS 30469-1187-5	2.67	1.6	68.3	15.7	76	1.33	1.00

Table 24. Performance of selected B-lines in Carimagua, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score
				Leaf	Internode			
1142	ICSB 73	2.67	1.1	58.0	8.0	75	1.00	1.00
1152	ICSB 89	2.33	1.5	57.3	13.7	66	1.33	1.00
1154	ICSB 93	2.33	1.4	69.0	12.3	69	1.00	1.00
1156	ICSB 94	2.00	1.3	59.7	10.3	72	1.33	1.00
1173	ICSB 88015	2.00	1.3	70.0	10.0	71	1.67	1.00
1178	ICSB 89002	2.67	1.1	65.3	8.3	72	1.00	1.00
2	SBL 107	2.00	1.4	59.7	12.0	63	1.67	1.00
3	ICARAVAN	2.33	1.6	70.7	13.3	70	1.67	1.00
1	REAL 60	3.00	1.8	86.3	15.3	68	2.00	1.33
1153	ICSB 90	2.33	1.3	69.7	10.0	76	1.67	1.33
1159	ICSB 102	2.33	1.2	64.3	12.7	70	1.33	1.33
1162	ICSB 88004	2.00	1.1	48.7	6.3	79	1.67	1.33
1212	SPSFR 94002	2.67	0.9	63.3	7.7	77	1.00	1.33
1234	SPMD 94004	2.00	1.3	63.0	8.7	76	1.00	1.33
1251	SPMD 94019	2.67	1.1	65.0	8.0	73	1.33	1.33
1275	SPMD 94045	2.00	1.2	60.0	10.0	68	1.67	1.33
1296	SPHB 94006	2.00	1.3	71.7	17.7	66	1.00	1.33
1416	SPDM 94024	3.33	1.0	60.3	7.0	79	1.67	1.33
1503	SPAN 94008	2.33	1.4	61.0	11.3	77	1.00	1.33
1614	SPA2 94013	1.33	1.4	64.0	11.0	76	1.00	1.33
1632	SPA2 94029	1.33	1.5	59.7	14.3	70	1.00	1.33
1643	SPA2 94039	1.67	1.4	62.7	10.3	77	1.00	1.33

Table 25. Performance of selected forage-lines in Carimagua, II semester, 1996.

Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to Flowerin g	lGreen eaf area	Agronomic score	Forage fresh weight (t)
				Leaf	Internode				
879	IS 31496	3.00	1.7	69.0	20.3	84	1.33	1.00	20.57
471	ICSR 93024	2.00	1.4	73.7	13.7	84	1.33	1.67	9.80
975	GD 47805	3.00	1.5	63.0	17.7	77	1.33	2.00	7.97
1064	GD 27668	1.33	1.7	69.3	17.7	73	1.00	3.00	9.43
466	ICSR 93011	2.33	1.5	65.7	16.7	73	1.33	3.00	7.57
897	IS 13868	1.33	2.0	73.7	18.0	77	1.00	3.33	12.07

Table 26. Correlation matrix among traits evaluated on R-lines. Carimagua, II semester, 1996.

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomic score
Vigour		-0.06	0.00	-0.04	0.25*	-0.07	0.14
Plant height			0.28*	0.67**	-0.04	0.12	-0.20
Leaf length				0.34**	0.16	-0.10*	-0.07
Internode length					-0.14	0.30*	-0.18
Days to flowering						-0.29*	-0.20
Leaf area							0.25*

* Significant at 5% level.
** Significant at 1% level.

Table 27. Correlation matrix among traits evaluated on B-lines, Carimagua, II semester, 1996

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomic score
Vigour		-0.43**	-0.20	-0.24*	0.28**	0.36	0.12
Plant height			0.48**	0.75**	-0.44**	-0.30	-0.37**
Leaf length				0.37**	-0.07	-0.16	-0.20
Internode length					-0.35**	-0.19	-0.25*
Days to flowering						0.44**	0.04
Leaf area							0.22

* Significant at 5% level.
** Significant at 1% level.

Table 28. Correlation matrix among traits evaluated on forage-lines, Carimagua, II semester, 1996.

	Vigour	Plant height	Leaf length	Internode length	Days to flowering	Leaf area	Agronomic score	Forage fresh weight (t)
Vigour		-0.39	-0.31	-0.05	0.04	0.40	-0.28	-0.01
Plant height			0.38	0.68**	-0.23	-0.22	0.03	-0.10
Leaf length				-0.15	0.08	-0.45	0.15	-0.07
Internode length					-0.06	-0.09	-0.34	0.07
Days to flowering						-0.25	-0.80**	0.82**
Leaf area							0.18	-0.31
Agronomic score								-0.68**

* Significant at 5% level.
** Significant at 1% level.

7. Sorghum genotypes and locations

7.1 GxE interactions

We analysed the data of days to 50% flowering, plant height at flowering, and agronomic desirability for GxE interactions over three locations for R-lines and B-lines traits. Fresh fodder weight data were also analysed for forage lines traits in addition to the above three traits. ANOVA estimates are given in **Table 29** for R-lines, **Table 30** for B-lines, and **Table 31** for forage populations lines.

Table 29. ANOVA for various traits, sorghum R-lines, genotypes over location, semester II 1996.

Source	Days to flowering		Plant height (m)		Agronomic score	
	Df	MSS	Df	MSS	Df	MSS
Replications in stations (R)	6	318.9 **	6	0.463 **	6	4.34 **
Stations (S)	2	509.8	2	0.457	2	3.89
Genotypes (G)	69	143.1 **	69	0.328 **	69	3.94 **
S * G	137	39.6 **	135	0.054	138	0.94 **
Error	319	20.4	304	0.044	414	0.68

** Significant at 0.01 level of probability

R-lines: Variances due to locations were not significant for all the three traits studied. Variances due to genotypes were highly significant for all the traits. However, variances due to GxE interactions were highly significant for days to 50% flowering and agronomic desirability, but not for plant height. This indicated that opportunities exist for site specific selection for agronomic productivity.

Table 30. ANOVA for various traits, sorghum B-lines, genotypes over location, II semester, 1996.

Source	Days to flowering		Plant height (m)		Agronomic score	
	Df	MSS	Df	MSS	Df	MSS
Replications in stations (R)	6	200.4 **	6	0.224 **	6	1.05
Stations (S)	2	1387.2 **	2	0.09	2	89.2 **
Genotypes (G)	92	124.3 **	92	0.226 **	92	2.91 **
S x G	168	28.6 **	165	0.004	184	1.21 **
Error	364	18.9	364	0.038	552	0.78

** Significant at 0.01 level of probability

B-lines: Similar patterns as that of R-lines, were noticed as for as genotype and GxE interactions concerned indicating the possible advantage of site specific selection.

Table 31. ANOVA for various traits , sorghum forage-lines, genotypes over location, semester II 1996.

Source	Days to flowering		Plant height (m)		Agronomic score		Forage weight (t ha^{-1})	
	Df	MSS	Df	MSS	Df	MSS	Df	MSS
Replications in stations (R)	6	26.7	6	0.076	6	3.66 **	6	17 *
Stations (S)	2	361.9 **	2	0.289 **	2	0.45	2	283.9 **
Genotypes (G)	13	158.4 **	13	0.301 **	13	6.53 **	13	81.3 **
S x G	21	64.4 **	22	0.144 *	26	1.84 **	20	30.6 **
Error	50	30.1	56	0.086	78	0.49	54	8.9

* Significant at 0.05 level of probability

** Significant at 0.01 level of probability

Forage lines: Genotype and GxE interaction variances were highly significant for all the traits studied. Further, variances due to stations were highly significant for all the traits except agronomic desirability. Here again site specific selection has an advantage.

Means across the locations for the selected entries for the above traits are given in **Table 32** for R-lines, **Table 33** for B-lines and **Table 34** for forage lines.

Table 32. Means across the locations for the selected R-lines, semester II, 1996

Line	Pedigree	Plant height (m)	Days to flowering	Agronomic score
801	IS 30469-1187-2	1.6	76	1.00
303	ICSR 89012	1.6	67	1.11
514	ICSV 95072	1.4	77	1.22
654	ICSV 112	1.5	73	1.22
213	ICSR 102	1.4	70	1.33
222	ICSR 110	1.2	72	1.33
793	IS 18758C-710-3	1.9	69	1.33
182	ICSR-74	1.3	80	1.44
288	ICSR 194	2.0	70	1.44
369	ICSR 90004	1.5	67	1.44
403	ICSR 91008	1.5	76	1.44
415A	ICSR 91020	1.3	81	1.44
415B	ICSR 91020	1.3	80	1.44
818	IS 30469C-1518T-3	1.7	74	1.44
804	IS 30469-1187-5	1.7	76	1.56
806	IS 30469C-1508T-2	1.7	71	1.56
1065	GD 27669	1.4	67	1.67
295	ICSR 89005	1.3	78	1.67
407	ICSR 91012	1.3	80	1.67
Controls	Pedigree	Plant height (m)	Days to flowering	Agronomic score
1	REAL 60	1.6	71	1.56
2	SBL 107	1.4	62	2.00
4	A 2267-2	1.7	82	2.11
7	CSH 9	1.4	69	2.67
3	IS 18442	1.7	64	3.00
5	SPRU 94008	1.0	70	3.67

Table 33. Means across the locations for the selected B-lines, semester II, 1996.

Line	Pedigree	Plant height (m)	Days to flowering	Agronomic score
1142	ICSB 73	1.2	76	1.11
1614	SPA2 94013	1.5	75	1.22
1154	ICSB 93	1.3	76	1.44
1643	SPA2 94039	1.3	80	1.44
1178	ICSB 89002	1.1	74	1.56
1234	SPMD 94004	1.4	78	1.56
1251	SPMD 94019	1.1	77	1.56
1156	ICSB 94	1.1	75	1.67
1503	SPAN 94008	1.4	78	1.67
1623	SPA2 94021	1.4	76	1.67
1275	SPMD 94045	1.1	74	1.78
1159	ICSB 102	1.2	72	1.89
1162	ICSB 88004	1.1	81	1.89
1148	ICSB 81	1.5	83	2.00
1236	SPMD 94006	1.3	74	2.00
1269	SPMD 94036	1.2	73	2.00
1296	SPHB 94006	1.3	70	2.00
1632	SPA2 94029	1.3	70	2.00
Controls	Pedigree	Plant height (m)	Days to flowering	Agronomic score
3	ICARAVAN	1.6	72	1.44
1	REAL 60	1.6	73	1.67
2	SBL 107	1.3	67	1.78
4	A 2267-2	1.5	80	2.11
7	CSH 9	1.2	74	2.67
5	SPRU 94008	0.9	72	3.67

Table 34. Means across the locations for the selected forage-lines, semester II, 1996

Line	Pedigree	Plant height (m)	Days to flowering	Agronomic score	Forage weight (t ha^{-1})
879	IS 31496	1.8	79	1.11	12.13
471	ICSR 93024	1.9	81	1.78	7.28
897	IS 13868	2.1	69	2.11	12.76
1064	GD 27668	1.8	69	2.22	6.00
975	GD 47805	1.7	77	3.22	7.97
Controls	Pedigree	Plant height (m)	Days to flowering	Agronomic score	Forage weight (t ha^{-1})
6	SIKUANI	1.9	60	3.11	12.40
7	CSH 9	1.3	71	4.00	5.53

7.2 Stability analysis

We carried out stability analyses for plant height, days to 50% flower, and agronomic desirability score of R-lines, B-lines and forage sorghum lines trials. As indicated earlier, one of the major criteria for advancing the lines is agronomic desirability score. The stability parameters of the selected R-lines are given in Table 35. R-lines, IS 30469-1187-2, ICSR 89012, ICSR 110, and ICSR 90004 showed wide adaptation while others (e.g., ICSV 95072, ICSV 112, ICSR 74 etc.) did not. They were more responsive to the improvement in the environment. Six R-lines stability performance whose regression coefficients are diverse are presented graphically in Fig 4. Stability parameters for the selected B-lines are given in Table 36. B-lines like ICSB 73, ICARAVAN, SPA2 94039, SPA2 94021, etc. were highly adapted while others (e.g., ICSB 94, SPA2 94029, etc.) were not, and these showed specific adaptation. Fig.5 gives graphics representation of stability in performance of the selected seven B-lines. Stability performance parameters of the selected four forage sorghum lines are given in Table 37; and they are graphically represented in Fig.6. Lines such as IS 31496, and IS 31446 followed similar response to that of Sukuani, control a maize cultivar, while other two showed wide adaptability; but were low-yielders.

Table 35. Selected sorghum R-lines means, regression coefficients and sum of squares deviations from regression in R-lines Trial, II semester, 1996, Colombia.

	Plant height (m)			Days to 50% flower			Agronomic score		
R-line	Mean	Reg. coefficient	Deviation from reg.	Mean	Reg. coefficient	Deviation from reg.	Mean	Reg. coefficient	Deviation from reg.
IS 30469-1187-2	1.59	1.876	0.026	75.50	-1.853	15.073	1.00	0.000	-0.228
ICSR 89012	1.61	1.868	0.012	67.11	-0.281	-4.312	1.11	1.056	-0.195
ICSV 95072	1.41	-0.058	-0.012	77.38	-0.797	88.117	1.22	2.113	-0.097
ICSV 112	1.52	0.641	-0.003	72.67	1.837	-5.056	1.22	-2.684	-0.198
ICSV 102	1.38	2.713	-0.012	70.44	3.132	14.837	1.33	-0.771	-0.027
ICSR 110	1.18	0.471	-0.012	72.00	2.130	-5.294	1.33	0.771	-0.027
IS 18758C-710-3	1.85	-3.543	-0.012	68.63	-1.077	-1.094	1.33	-1.627	-0.103
ICSR 74	1.31	-1.029	-0.003	79.86	-0.068	-3.783	1.44	3.454	-0.151
ICSR 194	1.97	3.654	0.023	69.56	-0.906	19.734	1.44	-2.969	-0.036
ICSR 90004	1.50	-1.811	-0.012	67.38	-0.499	0.187	1.44	1.056	-0.195
ICSR 91008	1.52	4.976	-0.012	75.88	2.778	11.536	1.44	2.684	-0.198
IS 30469-C-1518T-3	1.66	4.331	-0.012	74.38	-1.156	-2.781	1.44	-2.113	-0.097
ICSR 91020	1.29	-1.335	-0.008	80.00	2.224	-5.055	1.44	3.454	-0.151
IS 30469-1187-5	1.66	-0.826	-0.006	76.29	1.320	31.328	1.56	3.740	-0.227
IS 30469C-1508T-2	1.66	1.806	0.006	71.38	1.228	0.781	1.56	0.571	0.057
ICSR 89005	1.27	-1.691	-0.011	78.38	-1.635	-4.227	1.67	0.000	-0.228
ICSR 91012	1.27	-0.617	-0.005	80.00	-0.728	30.575	1.67	5.567	0.179
ICSR 93033	1.61	3.794	-0.011	70.25	2.597	-0.659	1.67	3.254	0.269
ICSR 93042	1.55	3.388	0.022	77.43	1.316	-3.854	1.67	5.567	0.179
IS 30469-1187-4	1.41	-0.920	-0.006	75.71	1.295	19.121	1.67	4.796	-0.191
ICSR 143	1.24	-1.428	-0.012	80.43	0.091	-4.863	1.67	-0.771	-0.027
ICSV 95126	1.75	2.797	0.006	80.63	0.325	14.458	1.67	-2.398	-0.218
GD 27669	1.37	0.866	0.025	67.38	-0.136	26.243	1.67	4.796	-0.191
Checks :									
REAL 60	1.56	2.410	0.044	70.56	0.554	9.446	1.56	0.571	0.057
SPRU 94008	1.00	0.599	-0.005	70.43	2.261	68.564	3.67	-0.856	0.412
Mean	1.418			74			2.144		
SE+/-	0.096			2.873			0.391		
SE (Reg. coeffi.)+/-		1.819			1.668			2.873	

Table 36. Selected sorghum B-lines means, regression coefficients and sum of squares deviations from regression in B-lines Trial, II semester, 1996, Colombia.

Entry number	Plant height (m)			Days to 50% flower			Agronomic score		
	Mean	Reg. coefficient	Deviation from reg.	Mean	Reg. coefficient	Deviation from reg.	Mean	Reg. coefficient	Deviation from reg.
ICSB 73	1.24	-2.268	0.014	76	1.267	43.566	1.11	0.340	-0.261
SPA2 94013	1.50	-2.294	-0.007	75	-0.081	1.961	1.22	-0.340	-0.261
ICARAVAN	1.60	1.536	-0.008	72	1.615	31.873	1.44	0.841	-0.195
ICSB 93	1.34	5.405	0.007	76	1.995	52.555	1.44	-0.198	0.233
SPA2 94039	1.30	2.708	-0.007	80	0.858	-3.930	1.44	0.860	-0.215
ICSB 89002	1.08	3.117	0.028	74	1.319	3.724	1.56	0.142	0.245
SPMD 94004	1.35	-1.520	-0.005	78	0.228	-0.784	1.56	0.161	-0.203
SPMD 94019	1.08	-0.946	-0.008	77	1.575	-3.690	1.56	0.161	-0.203
ICSB 94	1.08	7.414	0.005	75	1.706	0.871	1.67	2.042	-0.258
SPAN 94008	1.41	0.762	-0.008	78	0.649	2.825	1.67	-0.019	-0.039
SPA2 94021	1.35	-3.670	0.001	76	-0.513	-4.172	1.67	1.040	-0.062
SBL 107	1.29	6.914	-0.008	67	1.712	-3.253	1.78	1.343	-0.005
SPMD 94045	1.05	6.157	-0.005	74	2.091	-0.883	1.78	0.841	-0.195
ICSB 102	1.20	2.314	-0.007	72	0.920	-3.665	1.89	1.182	-0.190
ICSB 88004	1.07	-1.052	-0.007	81	0.201	-0.110	1.89	1.182	-0.190
ICSB 81	1.50	-0.352	-0.003	83	1.824	-1.043	2.00	0.501	-0.199
SPMD 94006	1.25	-1.546	-0.006	74	0.225	35.208	2.00	-0.501	-0.199
SPMD 94036	1.16	3.085	-0.005	73	0.956	-3.510	2.00	-0.445	2.502
SPHB 94006	1.27	3.869	0.006	70	1.879	8.950	2.00	1.002	-0.014
SPA2 94029	1.34	9.221	-0.008	70	0.407	2.737	2.00	2.562	-0.231
Controls :									
REAL 60	1.56	10.719	0.011	73	2.079	-2.873	1.67	0.501	-0.199
SPRU 94008	0.91	0.039	-0.006	72	3.556	20.823	3.67	0.539	0.221
Mean	1.12			76			2.47		
SE+/-	0.09			2.61			0.40		
SE (Reg. coeffi.)+/-	3.992				0.948			0.709	

Table 37. Selected sorghum forage lines means, regression coefficients and sum of squares deviations from regressio in Forage lines Trial, II semester, 1996, Colombia.

	Plant height (m)			Days to 50% flower			Agronomic score			Fodder fresh wt (t/ha)		
Cultivar	Mean	Reg. coefficient	Deviation from reg.	Mean	Reg. coefficient	Deviation from reg.	Mean	Reg. coefficient	Deviation from reg.	Mean	Reg. coefficient	Deviation from reg.
IS 31496	1.80	0.945	-0.017	79	1.616	-5.152	1.11	-0.737	-0.100	12.13	2.287	-1.510
IS 31446	1.83	3.278	0.081	81	1.089	-5.827	1.56	6.632	-0.147	11.57	2.763	32.575
ICSR 93024	1.90	4.583	0.002	81	0.738	-2.457	1.78	-3.316	0.119	7.28	0.806	-1.962
IS 32811	1.98	0.051	-0.020	70	0.503	10.120	1.78	-1.105	-0.115	5.78	0.670	-2.045
Control												
Sukuani	1.92	1.140	-0.014	60	-0.095	139.899	3.11	-9.579	-0.065	12.40	1.020	12.660
Mean	1.81			73			2.50			7.92		
SE+/-	0.12			4.26			0.33			1.49		
SE (Reg. coeffi.)+/-		0.166			1.075			3.160			0.47	

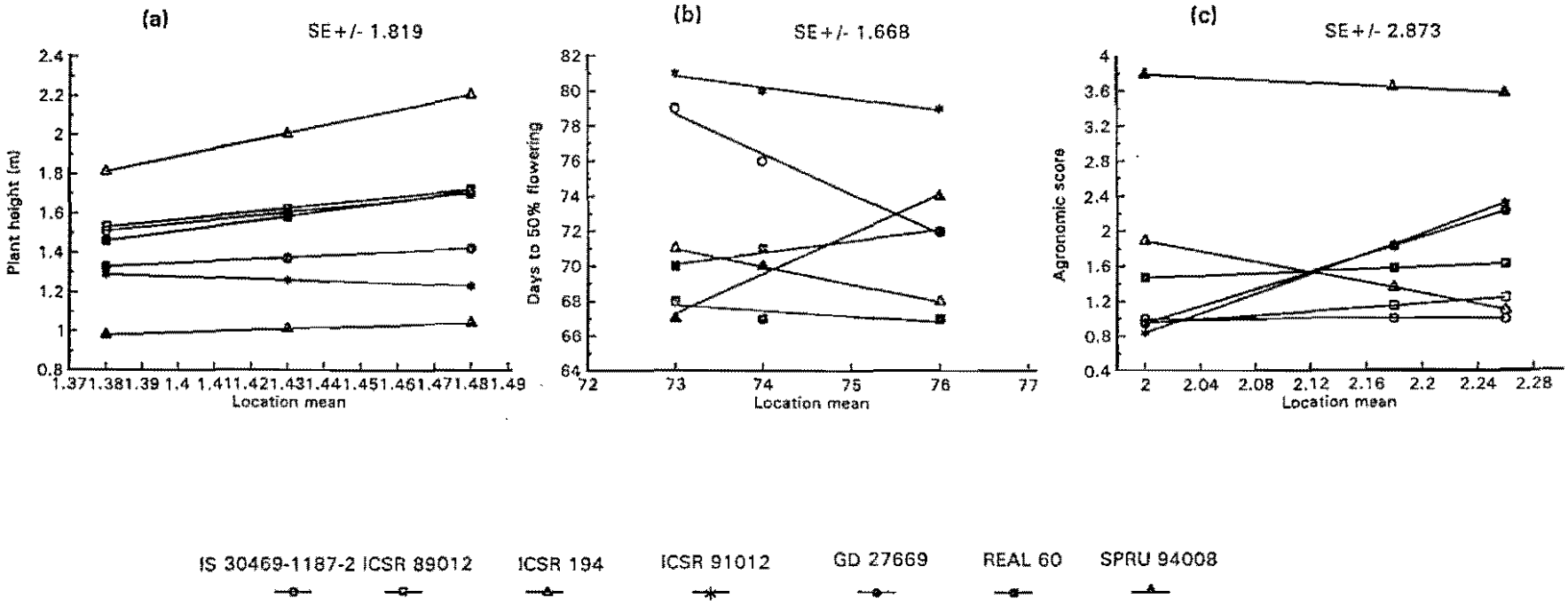

Fig 4.Stability of the selected sorghum R-lines, II season, 1996, Colombia- (a) Plant height, (b) Days to 50% flowering and (c) Agronomic score.

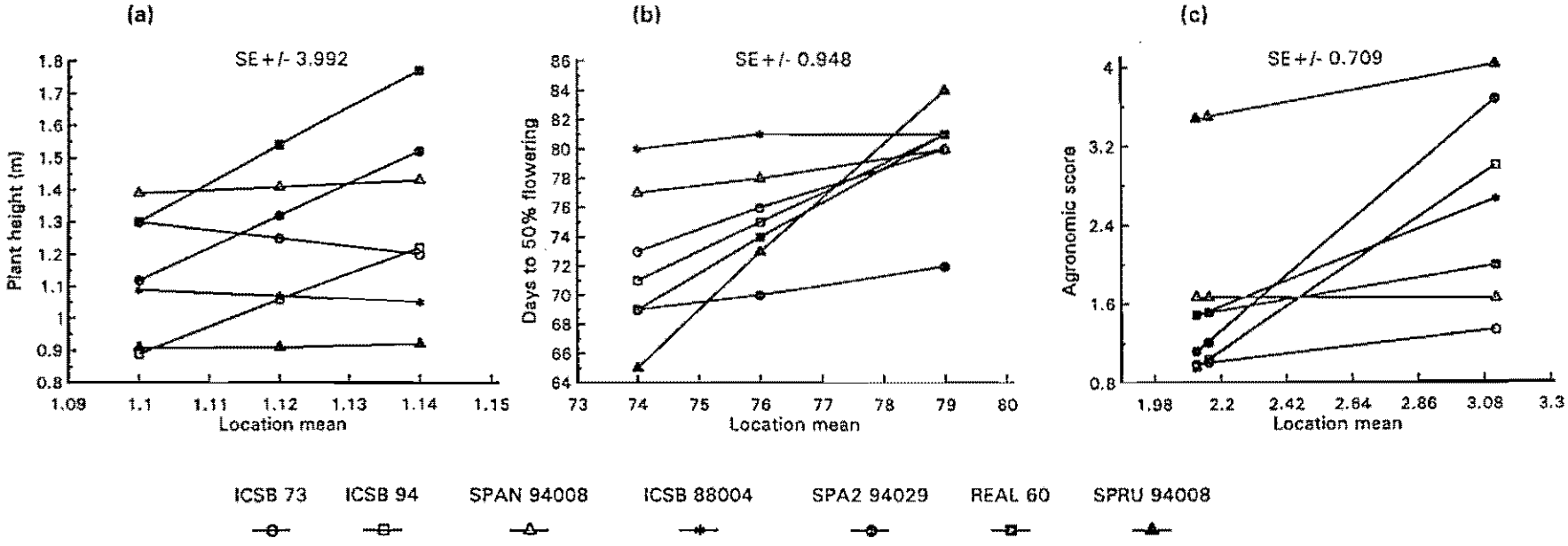

Fig 5.Stability of the selected sorghum B-lines, II season, 1996, Colombia- (a) Plant height, (b) Days to 50% flowering and (c) Agronomic score.

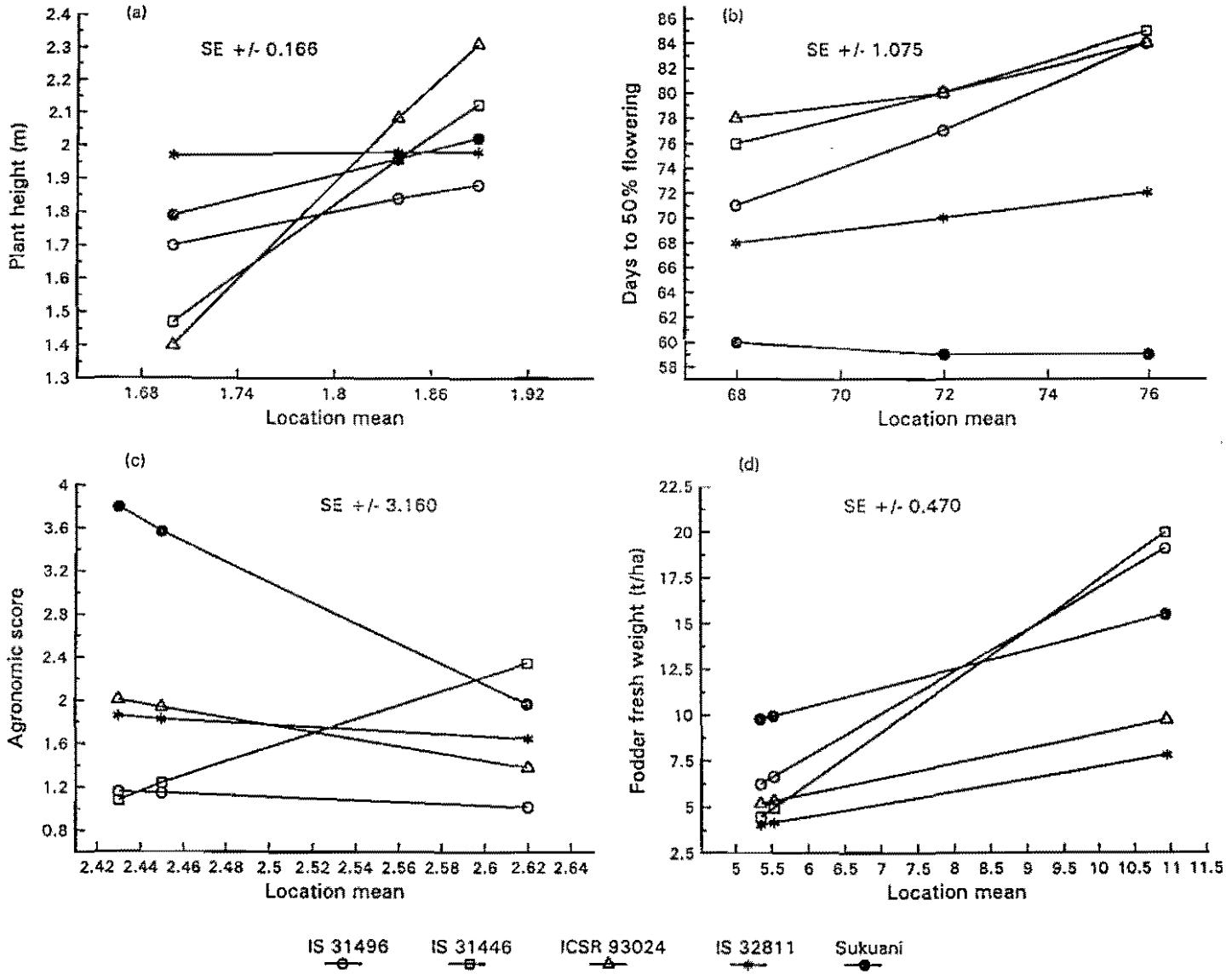

Fig 6. Stability of the selected sorghum forage lines, II season, 1996, Colombia - (a) Plant height, (b) Days to 50% flowering, (c) Agronomic score and (d) Fodder fresh weight (t/ha).

8. Sorghum populations

We evaluated the large grain population (ICSP LG) bulk, and high tillering population (ICSP HT) bulk for acid tolerance at Quilichao.

In ICSP LG we mass selected the male-sterile plants and male-fertile plants based on their yielding ability and the bulk seeds threshed from the male-sterile plants and the male-fertile plants were mixed in 1:1 to make bulk for the next population cycle.

In ICSP HT, we removed the single-culm plants at early stage before flowering leaving the multiculmed plants to intermate. We also tagged the plants with white midrib at 50 days after planting. We mass selected among the brown midrib plants both male-sterile and male-fertile plants based on high tiller number, high biomass and resistance to leaf disease. The bulk seeds from the male-sterile plants and male-fertile plants were mixed in 3:1 to make the bulk for next populations cycle.

We plan to introgress the acid soil tolerance lines, and leaf diseases resistant lines into these populations in summer, 1997.

9. Pearl millet materials

We received 30 pearl millet populations, 21 pollinators and 10 A& B pairs. These were evaluated in a 4-row plot nursery for forage purpose at Quilichao under acid soil conditions (60% Al saturation). Simultaneously they were also seed increased by sibbing in populations, in B-lines, and in pollinator lines and by crossing male-sterile plants with their respective B-lines in A-lines. The data collected are given in Annex 7. Based on high tillering as indicated by the scores on agronomic desirability, and plant height we selected the populations (13) and pollinators (2) for further testing as forage materials along with the selected forage sorghum lines. Only four A and B pairs could be maintained and selected as there were wide differences among the A and B lines for days to 50% flowering.

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12. Tour report of Belum V S Reddy

Belum V S Reddy visited Quilichao, La Libertad and Carimagua during Jan 9-Feb 18, 1997. The report he filed is being included here in.

KEY INSTITUTIONS AND PERSONS VISITED: 1. Dr Carlos Iglesias, CIAT; 2. Mr. Luis Alfonso Gonzales, Centro de Investigaciones, La Libertad, 3. Dr Jaime Traina, Director, Region 8, CORPOICA, La Libertad, 4. Dr Dario Leal Monsalve, Coordinator, LA libertad; 5. Dr Juvenile gomez, Director, Centro de Investigaciones, Carimagua; 6. Ing. Carlos Guillermo, Coordinator, Centro de Ivestigaciones, Carimagua, 7. Dr Aart van Schoonhoven, DDG-Genetic Resources, CIAT; 8. Mr. Jorge Saravia, Project Officer, CIAT; 8. Mr. Gustavo A Granada, Pathologist, Apartado Aereo 233, ICA, Palmira and 9. Dr Raul R Vera, Leader, Tropical Low Lands Program, CIAT.

OBJECTIVE(S) OF THE TOUR: To evaluate the sorghum materials for acid soil tolerance, to help in analyzing data, to decide the entries for seed increase and crossing blocks and arrange protocols for them, plan regional testing program, prepare the draft progress report and to plant the seed increase and crossing blocks if possible.

MAIN OBSERVATIONS: The visit was at right time. I evaluated the sorghum (R-lines, B-lines and forage lines) trails at three locations. Genotype expression was excellent at Carimagua (80% Al^{+3}

saturation). High wind in the region (Central Llanos), shallow red soils, and cessation of rains in the second week of December led to lodging in many plots. Since plant stands were excellent and the field was uniform, after taking the scores for agronomic desirability (high grain and fodder yield, less lodging and stay green), we decided to take yield data; so harvesting was also taken up. "Chiguiros" (giant mice) preferred to eat maize (check plot) stems and leaves over sorghum. At La Libertad (CORPOICA) similar situation including the Al^{+3} saturation was observed; but the field was variable. Evaluation was carried out for agronomic desirability. In both the locations there were no diseases and the grain was excellent. At Quilichao (CIAT: Al^{+3} saturation at 50% but high Mn^{+2}) fields were variable, and also many genotypes were either died at early stage or dried up in later stage. So we limited data taking to the scores on agronomic desirability. There were severe leaf diseases particularly rust on the INTSORMIL Al^{+3} tolerant checks. Since the test materials were selected earlier for leaf diseases, many entries were resistant or moderately resistant to the diseases. So the lines with high level of resistance were noted. We mass selected the individual plants in Large Grain and High Tillering Sorghum Populations and made the bulks for the next cycle. The earheads of many of the IAC developed lines were more compact in Al^{+3} toxic conditions than in IAC (normal) conditions and they were infested more with *Selama sorghiela* than the open headed types. Mr. Felipe earlier harvested the pearmillet materials. All data collected earlier including those on agronomic desirability were fed and analyzed. Many entries were found to be as productive as the Al^{+3} tolerant check, Real 60. We selected 24 sorghum R-lines, 26 B-lines, 5 forage lines, and 15 pearl millet populations (forage) for seed increase and regional testing in the main seasons (May-Aug. and Sep-Dec) in the region. Detailed protocols for the seed increase and crossing were prepared and explained to Dr. Carlos and Mr. Felipe. The Mali introductions (R-lines) and the IAC male-sterile lines which were received were verified and the A-lines were matched with the selected B-lines (only three selected B-lines did not have seed of their counter part A-lines). Every thing was arranged for sowing the seed increase nursery (and sowing would have been completed on the 17th Feb.). The draft progress report covering the work in the Sep-Dec 1996 season was prepared and left with Mr. Felipe to fill in the tables in the required format.

A letter was drafted addressing the collaborators outlining the objectives and the progress of the LA sorghum program, the purpose of the regional testing and the details of the material available for such testing. Dr. Carlos agreed to take further action on mailing the letters to the collaborators. Scientists addresses in the region were assembled as a file and left with Mr. Felipe.

I met twice with Dr. Schoonhoven and once with Mr. Saravia. The DDG appreciated the progress made in this project and agreed to store all the sorghum introductions at CIAT provided ICRISAT pays for rejuvenation. Mr. Saravia agreed to transfer immediately the budget share due to ICRISAT (about US$ 90,000) from the first and second installments received from IDB by CIAT. I met twice with Dr Vera and Dr Iglesias to review the project. Dr Iglesias is taking over the project liaison function from Dr Vera. The following were finalized: a). ICRISAT should write to Brazil on training component, b). Finalized the contents of the letter drafted by BVSR to the collaborators on regional testing, c). Agreed that August 1998 as the most appropriate time for Regional Workshop at Villavicencio, and d). Mr. Felipe, CIAT/ICRISAT may be considered for training at IAC in 1997. We also reviewed the budget position at CIAT for the project.

Also, I met with Dr Triana, Director, Region 8, CORPOICA, Colombia. He expressed keen interest to have the selected forage materials transferred to them immediately. He also suggested that we should test and select materials for high-input (non acid) soil conditions as well.

AT Quilichao, some tillers were found infected from ergot. Mr. Gustavo, indicated further that the disease was wide spread and agreed to collaborate with ICRISAT on chemical and cultural control.

MAIN RECOMMENDATIONS: New introductions from Africa (Mali), introgression of INTSORMIL material into the populations and developing hybrids to exploit the heterosis were suggested as measures which enable us develop materials beating further the INTSORMIL materials. Activities are planned in all the three areas.

13. Acknowledgements

The staff wishes to acknowledge the help and encouragement received from ICRISAT, CORPOICA, and CIAT authorities in conducting the above trials. We also wish to acknowledge the grant received from International Bank to carryout the above research activities. We thank sincerely Mr K Prabhakar, Secretary, IAC for incorporating the corrections in the manuscript.

Annex 1. Chemical analysis of soils at Quilichao, lot E-10 lower end.

Element	Value	Quantity	Fertility
pH	3.9	acid	middle
P (Bray II)	4.8	middle	middle
K (meq 100 g)	0.13	middle	high
Mg (meq 100g)	0.58	very high	very high
Ca (meq 100g)	1.59	high	high
Sat Al (%)	55.00	middle	middle
Sat Ca (%)	30.87	high	high
Sat Mg (%)	11.26	high	high
Mn (ppm)	140.63	very high	low
Zn (ppm)	0.83	high	high
B (ppm)	0.22	low	low
S.O.M (%)	6.65	high	middle

Annex 2. General information for the evaluated lines at Quilichao, semester II, 1996.

R-LINES

S.No.	Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score
					Leaf	Internode			
1	213	ICSR 102	1.33	1.4	59.7	11.0	67	1.00	1.00
2	4	A 2267-2	2.33	1.5	64.0	12.0	80	2.33	1.00
3	654	ICSV 112	2.00	1.4	51.7	14.3	73	1.33	1.00
4	801	IS 30469-1187-2	2.00	1.7	55.0	19.7	72	2.00	1.00
5	818	IS 30469C-1518T-3	2.33	1.7	73.7	15.0	76	1.00	1.00
6	793	IS 18758C-710-3	1.33	1.8	60.0	16.5	72	2.50	1.00
7	852	ICSR-143	1.67	1.2	61.0	11.0	81	2.00	1.00
8	969	ICSV 95126	2.00	1.6	71.0	11.5	78	1.00	1.00
9	514	ICSV 95072	2.33	1.3	58.5	11.0	70	1.00	1.00
10	826	IS 30469C-1526-5	2.00	2.0	71.5	21.5	71	1.50	1.00
11	182	ICSR-74	2.00	1.2	62.0	9.5	82	1.50	1.00
12	519	ICSV 95084	3.00	1.5	68.0	15.0	71	1.00	1.00
13	804	IS 30469-1187-5	2.33	1.7	57.0	17.0	73	1.50	1.00
14	1	REAL 60	2.00	1.4	68.7	10.7	74	1.67	1.33
15	288	ICSR 194	1.33	1.8	69.7	18.3	74	1.67	1.33
16	303	ICSR 89012	1.33	1.5	66.3	16.3	66	1.67	1.33
17	806	IS 30469C-1508T-2	2.33	1.8	52.0	24.3	70	1.33	1.33
18	295	ICSR 89005	2.33	1.2	56.5	12.5	79	1.00	1.50
19	426	ICSR 91031	2.00	1.8	70.5	22.0	76	1.50	1.50
20	374	ICSR 90008	1.67	1.6	73.0	12.0	82	3.00	1.50
21	534	ICSV 95096	2.33	1.7	58.5	16.5	75	1.00	1.50
22	749	ICSV 95016	2.67	1.4	68.5	14.0	70	1.50	1.50
23	1065	GD 27669	2.00	1.5	75.5	13.0	74	1.00	1.50
24	178	ICSR 71	3.33	1.0	60.0	6.5	81	1.00	1.50
25	506	ICSV 93043	2.67	1.6	69.5	14.5	82	1.00	1.50
26	794	IS 18758C-710-4	3.00	1.6	65.5	12.0	76	1.50	1.50
27	816	IS 30469C-1518T-1	2.00	1.7	67.0	15.0	78	1.50	1.50
28	850	ICSR-102	2.00	1.2	55.0	11.5	81	1.00	1.50
29	309	ICSR 89019	2.67	1.2	59.5	11.0	78	1.00	1.50
30	222	ICSR 110	2.00	1.2	55.7	10.0	72	1.33	1.67
31	324	ICSR 89033	2.33	1.4	62.0	14.0	75	1.00	1.67
32	415A	ICSR 91020	1.00	1.2	68.3	11.7	79	2.00	1.67
33	478	ICSR 93033	2.00	1.5	67.0	20.3	72	1.67	1.67
34	369	ICSR 90004	1.33	1.5	61.5	14.0	71	2.00	2.00
35	403	ICSR 91008	1.33	1.4	53.5	16.5	81	2.50	2.00
36	395	ICSR 90027	2.33	1.2	71.7	9.3	81	1.33	2.00
37	415B	ICSR 91020	1.33	1.4	62.0	9.7	80	1.67	2.00
38	544	ICSV 112	2.00	1.5	69.3	16.7	72	2.00	2.00
39	880	IS 18758C-603	3.00	1.6	75.5	16.5	76	1.50	2.00
40	2	SBL 107	1.67	1.4	54.5	15.0	62	3.50	2.00
41	234	ICSR 121	2.00	1.2	63.5	9.5	72	3.00	2.00
42	803	IS 30469-1187-4	2.67	1.4	55.0	20.5	73	2.50	2.00
43	149	ICSR 45	2.33	1.0	62.5	8.5	78	2.00	2.00
44	168	ICSR 62	3.00	1.2	66.5	13.5	80	3.00	2.00
45	216	ICSR-105	2.67	1.4	62.0	13.0	70	1.50	2.00

46	388	ICSR 90021	3.67	1.2	56.5	15.0	82	1.00	2.00
47	407	ICSR 91012	2.00	1.3	52.0	16.5	76	1.50	2.00
48	504	ICSV 93042	2.33	1.3	63.5	13.0	78	1.00	2.00
49	533	ICSV 95095	3.00	1.2	51.0	9.0	80	1.00	2.00
50	639	ICSV 93075	2.00	1.3	52.5	9.5	79	2.00	2.00
51	138	ICSR-35	3.67	1.3	91.0	10.0	81	1.00	2.00
52	134	ICSR-31	3.67	1.3	60.7	17.7	78	1.33	2.33
53	205	ICSR 95	2.33	1.3	56.0	10.3	72	1.33	2.33
54	364B	ICSR 89075	2.67	1.1	53.3	9.0	80	1.00	2.33
55	306	ICSR 89015	3.33	1.4	63.0	11.0	71	1.00	2.50
56	445	ICSR 92016	3.00	1.4	54.0	19.0	80	2.00	2.50
57	704	ICSV 95046	2.00	1.4	49.7	11.3	72	2.00	2.67
58	331	ICSR 89042	2.67	1.0	58.0	9.0	71	1.00	3.00
59	146	ICSR-42	1.33	1.2	60.0	11.0	75	1.67	3.00
60	364A	ICSR 89075	2.00	1.1	50.0	10.3	77	1.33	3.00
61	433	ICSR 92003	3.00	1.2	53.3	13.3	78	2.00	3.00
62	781	IS 30469C-140-2	2.67	1.1	51.0	14.3	68	3.67	3.00
63	147	ICSR-43	3.00	1.0	66.0	9.0	87	3.00	3.00
64	528	ICSV 95091	3.00	1.5	47.0	14.0	69	1.00	3.00
65	101	ICSR 1	2.67	1.2	54.7	14.7	74	1.00	3.33
66	3	IS 18442	2.33	1.8	71.5	20.5	60	6.00	3.50
67	766	ICSV 95031	2.33	0.9	58.0	12.0	78	2.00	3.50
68	7	CSH 9	2.33	1.2	65.0	17.0	70	2.00	3.67
69	5	SPRU 94008	4.00	1.0	65.0	10.0	83	2.00	4.00
70	839	IS 18758C-603	4.33	.	.	.	.	.	4.50

B-LINES

S.No	Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm) Leaf	Length (cm) Internode	Days to flowering	Green leaf area	Agronomic score
1	1614	SPA2 94013	1.00	1.5	61.3	16.7	76	2.00	1.00
2	1117	ICSB 38	1.67	1.2	69.3	10.0	71	1.00	1.33
3	1142	ICSB 73	1.67	1.2	53.0	12.0	82	2.00	1.33
4	1154	ICSB 93	2.67	1.2	60.3	14.0	81	2.33	1.33
5	1178	ICSB 89002	2.67	0.9	64.3	9.3	79	1.67	1.67
6	1234	SPMD 94004	2.67	1.4	61.5	11.0	79	1.50	1.67
7	1236	SPMD 94006	2.00	1.3	60.3	11.7	76	1.67	1.67
8	1251	SPMD 94019	2.33	1.1	56.5	9.0	81	1.00	1.67
9	1269	SPMD 94036	1.33	1.1	63.3	9.7	75	2.00	1.67
10	1503	SPAN 94008	2.33	1.4	58.0	12.7	80	1.33	1.67
11	1	REAL 60	3.33	1.4	68.7	14.3	80	3.00	2.00
12	1108	ICSB 30	1.33	1.4	60.3	11.0	72	2.33	2.00
13	1279	SPMD 94050	1.67	1.5	60.5	10.5	79	1.50	2.00
14	1643	SPA2 94039	2.67	1.3	53.5	13.5	83	1.00	2.00
15	3	ICARAVAN	2.33	1.6	60.3	14.0	78	2.67	2.00
16	1148	ICSB 81	3.67	1.5	45.0	10.0	91	2.00	2.33
17	1271	SPMD 94037	2.33	1.0	60.7	9.0	79	2.00	2.33
18	1275	SPMD 94045	2.67	0.9	54.0	9.0	80	1.00	2.33
19	1517	SPAN 94046	1.67	1.6	56.0	17.0	78	2.50	2.33
20	1531	SPLB 94009	3.00	1.1	50.0	13.7	73	3.00	2.33
21	1623	SPA2 94021	1.33	1.4	63.5	14.0	74	3.50	2.33
22	4	A 2267-2	2.67	1.7	63.0	11.5	81	2.00	2.33
23	1152	ICSB 89	1.33	1.1	52.7	12.3	74	4.00	2.67
24	1159	ICSB 102	2.00	1.1	51.7	9.0	75	3.00	2.67
25	1160	ICSB 88001	2.67	1.2	52.3	9.3	76	2.00	2.67
26	1162	ICSB 88004	3.00	1.1	60.0	9.0	81	1.00	2.67
27	1180	ICSB 89004	1.67	1.2	55.7	9.0	82	3.33	2.67
28	1191	ICSB 91001	1.67	1.2	73.0	11.0	80	3.00	2.67
29	1296	SPHB 94006	1.67	1.1	59.7	11.0	76	4.67	2.67
30	1304	SPHB 94013	1.67	1.3	65.7	12.7	74	3.00	2.67
31	1624	SPA2 94022	2.00	1.3	60.3	14.3	80	2.67	2.67
32	2	SBL 107	2.67	1.1	53.3	15.3	72	2.67	2.67
33	1100	ICSB 23	2.67	0.9	52.0	8.0	78	2.00	3.00
34	1101	ICSB 24	2.67	0.8	44.0	8.5	82	1.50	3.00
35	1126	ICSB 47	2.67	1.0	55.5	9.0	72	3.00	3.00
36	1156	ICSB 94	2.67	1.0	54.0	12.5	81	4.50	3.00
37	1181	ICSB 90001	2.33	1.1	58.0	10.0	81	2.00	3.00
38	1182	ICSB 90002	3.00	1.2	61.0	9.0	77	1.00	3.00
39	1212	SPSFR 94002	3.33	0.9	49.0	9.5	82	1.50	3.00
40	1453	SPDM 94061	2.33	1.2	59.0	9.0	75	2.00	3.00
41	1505	SPAN 94010	1.67	1.0	54.7	7.0	76	1.67	3.00
42	1534	SPLB 94012	3.00	1.1	59.5	10.5	84	2.50	3.00
43	1538	SPLB 94016	3.00	1.4	42.5	8.0	92	1.50	3.00
44	1616	SPA2 94015	2.00	1.4	59.0	14.5	76	3.00	3.00
45	1617	SPA2 94016	1.33	1.0	53.3	10.7	73	2.67	3.00
46	1084	ICSB 9	3.00	0.9	48.0	8.0	78	3.50	3.33
47	1088	ICSB 12	2.00	1.1	61.5	8.5	74	2.00	3.33

48	1094	ICSB 18	3.00	1.1	55.5	11.0	74	3.00	3.33
49	1106	ICSB 28	2.33	1.1	43.5	14.5	79	3.50	3.33
50	1141	ICSB 70	2.00	0.9	67.0	7.0	77	6.00	3.33
51	1153	ICSB 90	3.33	1.2	61.0	15.0	77	3.00	3.33
52	1197	ICSB 91006	2.33	1.2	42.0	8.0	92	2.00	3.33
53	1221	SPSFR 94013	2.33	1.0	52.0	6.0	81	2.00	3.33
54	1249	SPMD 94018	2.00	1.0	56.0	11.0	78	2.50	3.33
55	1252	SPMD 94020	2.33	0.8	63.0	10.0	81	3.00	3.33
56	1298	SPHB 94008	3.33	1.1	55.5	9.0	75	5.00	3.33
57	1302	SPHB 94011	3.00	0.9	54.0	12.0	84	1.00	3.33
58	1427	SPDM 94037	3.00	0.8	54.0	8.0	82	3.50	3.33
59	1478	SPGM 94031	2.33	0.9	55.0	10.0	71	4.00	3.33
60	1481	SPGM 94050	1.00	1.7	66.0	18.0	75	4.33	3.33
61	1521	SPLB 94001	2.33	1.0	58.0	7.5	78	3.00	3.33
62	1523	SPLB 94003	2.33	1.1	65.0	13.0	82	2.50	3.33
63	1557	SPRU 94009	3.33	1.1	66.0	10.0	75	2.00	3.33
64	1635	SPA2 94032	1.00	0.9	48.3	8.7	71	4.00	3.33
65	7	CSH 9	2.67	1.1	52.7	9.0	74	3.67	3.33
66	1266	SPMD 94033	2.67	0.9	49.5	11.0	79	5.00	3.67
67	1451	SPDM 94059	3.33	1.2	63.0	6.0	75	4.00	3.67
68	1615	SPA2 94014	2.00	1.0	55.0	9.7	77	4.67	3.67
69	1632	SPA2 94029	1.67	1.1	51.0	11.3	72	4.33	3.67
70	1639	SPA2 94036	4.00	1.0	45.0	11.0	89	1.00	3.67
71	1090	ICSB 14	4.33	1.1	52.5	9.0	79	2.00	4.00
72	1104	ICSB 27	3.33	0.8	43.0	8.0	76	6.00	4.00
73	1173	ICSB 88015	4.00	.	.	.	.	.	4.00
74	1177	ICSB 89001	2.33	1.0	59.0	10.0	82	2.50	4.00
75	1193	ICSB 91003	2.67	1.2	56.0	7.0	81	1.00	4.00
76	1274	SPMD 94044	3.00	.	.	.	.	.	4.00
77	1299	SPHB 94009	3.00	.	.	.	.	.	4.00
78	1416	SPDM 94024	4.00	1.5	32.0	4.0	84	3.00	4.00
79	1426	SPDM 94036	3.67	0.9	61.0	7.0	81	4.00	4.00
80	1491	SPGM 94066	3.67	.	.	.	.	.	4.00
81	1537	SPLB 94015	4.00	.	.	.	.	.	4.00
82	1602	SPA2 94002	3.00	1.1	66.0	12.0	81	2.50	4.00
83	1634	SPA2 94031	2.33	.	.	.	.	.	4.00
84	5	SPRU 94008	3.00	0.9	54.0	7.5	85	4.00	4.00
85	1454	SPDM 94062	3.67	0.6	53.0	9.0	81	4.00	4.33
86	1626	SPA2 94024	3.33	.	.	.	.	.	4.33
87	1083	ICSB 8	2.33	0.8	54.0	8.0	79	4.00	4.67
88	1263	SPMD 94030	4.67	.	.	.	.	.	4.67
89	1293	SPHB 94004	3.33	.	.	.	.	.	4.67
90	1402	SPDM 94006	4.00	.	.	.	.	.	4.67
91	1492	SPGM 94067	3.67	.	.	.	.	.	4.67
92	1245	SPMD 94014	4.00	.	.	.	.	.	5.00
93	1526	SPLB 94005	3.33	.	.	.	.	.	5.00

FORAGE

S.No	Line	Pedigree	Vigour	Plant Ht.	Length (cm)		Days to	Green leaf	Agronomic	Forage
				(m)	Leaf	Internode	flowering	area	score	weight
1	1064	GD 27668	1.67	2.0	61.7	25.0	78	4.33	1.00	5.47
2	879	IS 31496	2.67	1.9	73.0	22.5	87	1.00	1.00	7.60
3	471	ICSR 93024	2.00	2.4	78.0	23.3	80	5.00	1.33	5.66
4	896	IS 32811	1.67	2.0	70.0	24.0	71	2.33	1.67	4.17
5	897	IS 13868	1.33	2.2	68.3	21.7	71	2.33	1.67	14.18
6	6	SIKUANI	1.00	2.0	68.0	13.7	61	1.00	2.00	15.20
7	981	GD 47818	2.00	2.3	75.0	25.5	80	4.50	2.00	3.89
8	913	IS 31446	2.33	.	.	.	.	.	2.33	2.50
9	883	IS 19667	4.00	.	.	.	.	.	3.33	.
10	899	IS 19669	2.67	1.8	70.0	23.0	79	3.00	3.33	2.78
11	466	ICSR 93011	3.00	1.8	59.0	15.0	81	3.00	4.00	3.06
12	7	CSH 9	3.33	1.0	54.0	9.0	75	2.00	4.00	.
13	472	ICSR 93026	4.00	1.1	68.0	16.0	83	6.00	4.33	.
14	975	GD 47805	4.00	.	.	.	.	.	4.67	.

Annex 3. Chemical analysis of soils at La Libertad, lot Loma 8.

Element	Value	Quantity	Fertility
pH	4.84	acid	middle
P (Bray II)	17.20	high	middle
K (meq 100 g)	0.08	low	low
Mg (meq 100g)	0.18	low	low
Ca (meq 100g)	0.55	middle	middle
Sat Al (%)	66.00	very high	low
Sat Ca (%)	22.35	low	middle
Sat Mg (%)	7.31	low	middle
Mn (ppm)	4.26	low	high
Zn (ppm)	0.54	middle	middle
B (ppm)	0.15	low	low
S.O.M (%)	2.68	low	low

Annex 4. General information for the evaluated lines at La Libertad, semester II, 1996.

R-LINES

S.No	Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score
					Leaf	Internode			
1	222	ICSR 110	2.00	1.1	61.3	10.0	76	4.00	1.00
2	288	ICSR 194	1.67	1.9	59.0	17.0	66	3.33	1.00
3	303	ICSR 89012	1.33	1.6	62.0	12.0	67	2.67	1.00
4	415A	ICSR 91020	1.33	1.4	52.0	9.3	84	4.00	1.00
5	514	ICSV 95072	2.00	1.4	67.7	10.0	78	3.67	1.00
6	654	ICSV 112	1.67	1.5	45.7	10.3	76	4.00	1.00
7	793	IS 18758C-710-3	1.33	2.0	63.7	19.7	66	2.67	1.00
8	801	IS 30469-1187-2	1.67	1.4	65.0	16.0	74	3.50	1.00
9	182	ICSR-74	2.00	1.4	55.0	7.3	80	3.50	1.00
10	534	ICSV 95096	2.67	1.3	61.7	12.0	66	4.00	1.00
11	816	IS 30469C-1518T	2.00	1.9	62.5	13.0	76	4.33	1.00
12	168	ICSR 62	1.67	1.6	70.3	12.3	78	4.00	1.33
13	369	ICSR 90004	1.33	1.6	77.0	16.0	65	2.67	1.33
14	407	ICSR 91012	2.00	1.3	66.0	11.7	80	3.67	1.33
15	415B	ICSR 91020	1.00	1.3	59.7	11.0	84	5.00	1.33
16	504	ICSV 93042	2.00	1.5	68.7	10.3	80	3.50	1.50
17	1065	GD 27669	2.33	1.3	60.0	14.3	65	4.33	1.50
18	178	ICSR 71	2.67	1.1	60.0	6.0	74	4.50	1.50
19	324	ICSR 89033	2.67	1.6	77.5	11.0	85	5.00	1.50
20	519	ICSV 95084	2.67	1.3	54.7	8.7	73	4.33	1.50
21	803	IS 30469-1187-4	2.67	1.5	64.5	13.0	80	4.50	1.50
22	544	ICSV 112	1.67	1.5	74.0	13.5	83	4.50	1.50
23	806	IS 30469C-1508T	3.00	1.5	47.0	12.0	75	3.50	1.50
24	213	ICSR 102	2.33	1.2	61.0	15.7	78	4.33	1.67
25	295	ICSR 89005	2.00	1.4	48.7	6.0	75	3.33	1.67
26	309	ICSR 89019	2.00	1.3	70.0	8.7	83	3.33	1.67
27	331	ICSR 89042	3.00	1.1	62.0	6.3	66	4.33	1.67
28	388	ICSR 90021	2.67	1.6	67.3	10.3	79	4.00	1.67
29	7	CSH 9	3.00	1.5	62.0	13.0	70	4.50	1.67
30	818	IS 30469C-1518T	2.33	1.4	52.7	12.3	71	3.00	1.67
31	850	ICSR-102	2.33	1.1	54.3	11.0	73	3.67	1.67
32	969	ICSV 95126	1.33	1.7	59.0	11.7	82	4.67	1.67
33	403	ICSR 91008	3.00	1.3	48.7	8.7	79	5.00	2.00
34	804	IS 30469-1187-5	3.00	1.7	64.0	13.0	80	4.50	2.00
35	1	REAL 60	2.00	1.5	52.7	14.7	70	3.33	2.00
36	364A	ICSR 89075	2.67	1.5	63.3	13.7	81	4.33	2.00
37	506	ICSV 93043	2.67	1.5	60.7	14.0	78	4.00	2.00
38	639	ICSV 93075	2.33	1.1	61.0	6.7	77	4.67	2.00
39	826	IS 30469C-1526-	2.33	1.7	65.7	12.0	78	4.00	2.00
40	852	ICSR-143	2.67	1.3	59.0	8.0	81	4.00	2.00
41	374	ICSR 90008	2.33	2.0	56.0	12.5	73	5.00	2.00
42	101	ICSR 1	3.67	1.4	53.0	14.0	69	4.50	2.00
43	4	A 2267-2	2.67	1.3	48.0	9.0	86	4.00	2.00
44	445	ICSR 92016	1.67	1.5	72.7	14.7	67	4.00	2.33
45	478	ICSR 93033	1.33	1.4	49.5	6.5	75	3.50	2.50
46	216	ICSR-105	2.67	1.3	58.7	8.0	67	4.00	2.50
47	426	ICSR 91031	2.67	1.7	57.5	13.5	73	4.50	2.50

48	528	ICSV 95091	2.33	1.4	48.7	9.0	81	5.00	2.50
49	749	ICSV 95016	3.00	1.2	57.0	9.5	73	4.50	2.50
50	2	SBL 107	2.00	1.3	58.3	12.0	59	2.67	2.67
51	234	ICSR 121	2.00	1.2	69.3	8.0	79	4.33	2.67
52	364B	ICSR 89075	3.00	1.2	56.7	9.3	79	4.00	2.67
53	766	ICSV 95031	2.00	1.3	54.3	9.3	79	4.33	2.67
54	781	IS 30469C-140-	2.67	0.9	72.0	11.0	78	4.67	2.67
55	533	ICSV 95095	3.67	1.7	59.0	10.0	67	4.00	3.00
56	146	ICSR-42	3.00	.	61.0	13.0	71	3.00	3.00
57	3	IS 18442	1.67	1.5	54.7	14.0	66	5.00	3.00
58	395	ICSR 90027	2.67	1.6	61.0	11.0	76	4.67	3.00
59	5	SPRU 94008	2.33	1.0	56.3	7.0	72	4.00	3.00
60	134	ICSR-31	3.33	1.3	53.5	10.0	83	4.50	3.00
61	205	ICSR 95	2.00	1.0	54.3	7.0	83	5.50	3.33
62	306	ICSR 89015	3.00	1.4	53.7	11.3	86	3.50	3.33
63	794	IS 18758C-710-	3.67	1.4	64.0	9.0	82	5.00	3.33
64	138	ICSR-35	2.33	.	80.0	7.0	74	5.00	3.50
65	147	ICSR-43	3.33	1.0	44.5	5.0	83	5.00	3.50
66	433	ICSR 92003	3.00	1.3	64.5	11.5	86	4.50	3.50
67	704	ICSV 95046	2.33	1.2	46.3	9.7	77	5.00	3.67
68	149	ICSR 45	2.33	0.9	54.0	5.0	80	6.00	4.00
69	839	IS 18758C-603	2.67	1.2	51.0	8.3	75	5.00	4.00
70	880	IS 18758C-603	2.67	1.2	56.0	12.5	80	4.00	4.00

B-LINES

S.No.	Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm) Leaf	Length (cm) Internode	Days to flowering	Green leaf area	Agronomic score
1	1212	SPSFR 94002	2.67	.	.	.	75	4.00	.
2	1537	SPLB 94015	3.00	.	.	.	.	.	.
3	1142	ICSB 73	2.33	1.0	45.3	10.3	70	3.60	1.00
4	1156	ICSB 94	2.00	0.7	57.7	13.3	73	3.60	1.00
5	1269	SPMD 94036	1.33	1.0	71.0	9.3	73	4.60	1.00
6	1271	SPMD 94037	2.67	1.0	55.7	8.3	67	3.60	1.00
7	1623	SPA2 94021	2.00	1.0	63.0	11.0	76	4.00	1.00
8	1632	SPA2 94029	1.67	1.0	57.3	10.3	68	4.00	1.00
9	1643	SPA2 94039	2.67	1.0	49.5	10.5	80	3.60	1.00
10	1177	ICSB 89001	2.00	1.0	70.5	7.0	81	4.00	1.00
11	1180	ICSB 89004	2.67	1.0	56.5	8.5	77	3.00	1.00
12	1517	SPAN 94046	1.67	1.0	59.0	11.5	81	3.60	1.00
13	1101	ICSB 24	3.00	0.0	36.0	6.0	67	3.00	1.00
14	1234	SPMD 94004	3.00	1.0	54.0	12.0	79	4.00	1.00
15	1154	ICSB 93	3.33	1.0	41.0	9.0	83	5.00	1.00
16	1197	ICSB 91006	3.00	1.0	67.0	9.0	78	5.00	1.00
17	1538	SPLB 94016	3.00	1.0	44.0	8.0	87	5.00	1.00
18	1614	SPA2 94013	1.33	1.0	59.3	14.7	73	3.00	1.33
19	1617	SPA2 94016	2.00	1.0	55.3	7.7	71	4.30	1.33
20	1624	SPA2 94022	2.00	1.0	58.3	12.3	77	4.00	1.33
21	3	ICARAVAN	2.33	1.0	68.3	11.0	66	3.00	1.33
22	1	REAL 60	3.67	1.0	71.5	11.0	72	3.60	1.50
23	1162	ICSB 88004	2.00	0.5	42.0	9.0	83	3.50	1.50
24	1106	ICSB 28	3.00	1.0	56.0	11.5	65	4.00	1.50
25	1181	ICSB 90001	2.33	1.0	43.5	9.0	80	4.00	1.50
26	1193	ICSB 91003	3.00	1.0	33.0	5.0	78	4.00	1.50
27	1236	SPMD 94006	3.33	1.0	43.5	10.5	68	3.00	1.50
28	1302	SPHB 94011	3.00	1.0	49.0	8.0	74	3.50	1.50
29	1453	SPDM 94061	4.00	1.0	62.0	14.0	84	4.50	1.50
30	1634	SPA2 94031	2.33	1.0	55.0	7.5	81	3.00	1.50
31	1090	ICSB 14	4.00	1.0	53.0	9.5	63	4.00	1.67
32	1100	ICSB 23	1.67	0.7	52.3	8.0	71	4.30	1.67
33	1159	ICSB 102	2.00	1.0	42.3	13.7	72	4.00	1.67
34	1173	ICSB 88015	2.67	1.0	43.5	7.0	79	4.00	1.67
35	1251	SPMD 94019	3.67	1.0	51.0	9.0	78	4.30	1.67
36	1275	SPMD 94045	3.67	1.0	49.0	8.0	76	4.50	1.67
37	2	SBL 107	2.67	1.0	48.3	13.0	66	3.30	1.67
38	1084	ICSB 9	2.67	1.0	54.0	10.0	69	5.00	2.00
39	1117	ICSB 38	1.67	1.0	52.7	7.3	71	4.60	2.00
40	1153	ICSB 90	2.33	1.0	45.3	7.3	82	4.00	2.00
41	1178	ICSB 89002	3.00	1.0	47.0	8.7	72	4.00	2.00
42	1182	ICSB 90002	2.33	1.0	44.0	7.3	77	4.60	2.00
43	1221	SPSFR 94013	3.00	1.0	47.5	6.5	82	4.50	2.00
44	1245	SPMD 94014	3.00	0.5	71.0	7.5	82	4.50	2.00
45	1263	SPMD 94030	3.33	.	.	.	.	.	2.00
46	1296	SPHB 94006	2.33	1.0	55.0	12.0	66	3.60	2.00
47	1402	SPDM 94006	4.33	0.5	46.5	10.5	82	3.50	2.00
48	1427	SPDM 94037	3.33	0.5	53.0	5.5	81	4.00	2.00
49	1454	SPDM 94062	3.00	0.5	42.5	5.5	79	4.50	2.00

50	1478	SPGM 94031	2.33	1.0	57.3	9.7	74	3.60	2.00
51	1503	SPAN 94008	3.33	1.0	50.5	12.5	75	4.00	2.00
52	1505	SPAN 94010	2.00	1.0	54.5	7.5	81	5.00	2.00
53	1521	SPLB 94001	2.33	1.0	42.5	7.5	76	4.00	2.00
54	1526	SPLB 94005	2.33	0.0	58.5	5.5	81	4.00	2.00
55	7	CSH 9	3.33	1.0	57.0	12.0	81	5.00	2.00
56	1249	SPMD 94018	2.33	1.0	42.5	9.5	73	4.50	2.00
57	1266	SPMD 94033	2.67	1.0	.	.	80	4.00	2.00
58	1304	SPHB 94013	3.00	0.0	34.0	9.0	78	4.00	2.00
59	1088	ICSB 12	1.67	1.0	47.3	9.0	70	4.30	2.33
60	1274	SPMD 94044	2.33	1.0	40.0	7.0	80	4.00	2.33
61	1293	SPHB 94004	2.33	0.7	56.7	9.0	75	4.00	2.33
62	1299	SPHB 94009	3.33	0.0	59.0	6.0	82	4.00	2.33
63	1416	SPDM 94024	3.33	1.0	45.5	11.0	81	4.00	2.33
64	1531	SPLB 94009	2.67	1.0	56.7	9.3	70	4.60	2.33
65	4	A 2267-2	2.67	1.0	52.3	14.0	83	4.30	2.33
66	1108	ICSB 30	2.00	1.0	45.5	10.0	69	3.60	2.50
67	1148	ICSB 81	2.67	1.0	48.0	9.5	85	4.30	2.50
68	1094	ICSB 18	3.00	0.5	50.0	7.0	78	4.00	2.50
69	1126	ICSB 47	3.00	1.0	44.0	6.5	79	4.50	2.50
70	1426	SPDM 94036	3.00	1.0	49.0	6.5	82	4.50	2.50
71	1523	SPLB 94003	2.33	1.0	51.5	6.0	79	3.50	2.50
72	1615	SPA2 94014	2.33	0.5	46.0	7.5	67	3.50	2.50
73	1252	SPMD 94020	2.33	0.5	40.5	9.0	83	4.00	2.50
74	1616	SPA2 94015	1.67	1.0	61.0	10.0	79	4.00	2.50
75	1639	SPA2 94036	4.00	1.0	58.5	7.5	81	3.00	2.50
76	5	SPRU 94008	2.33	0.5	61.0	8.0	68	5.00	2.50
77	1141	ICSB 70	2.33	1.0	65.5	10.0	80	5.00	2.67
78	1191	ICSB 91001	2.00	0.0	53.7	7.7	84	4.00	2.67
79	1298	SPHB 94008	3.00	1.0	55.5	11.0	78	4.00	2.67
80	1451	SPDM 94059	4.00	1.0	37.0	10.0	82	5.00	2.67
81	1534	SPLB 94012	3.00	0.7	57.7	6.7	78	4.00	2.67
82	1626	SPA2 94024	2.67	.	.	.	65	5.00	3.00
83	1104	ICSB 27	3.00	1.0	49.0	7.0	82	5.00	3.00
84	1491	SPGM 94066	3.00	1.0	46.5	10.0	65	3.00	3.00
85	1083	ICSB 8	2.67	0.0	48.0	4.0	83	4.00	3.00
86	1160	ICSB 88001	2.67	.	.	.	77	5.00	3.00
87	1279	SPMD 94050	2.33	0.5	42.0	7.5	78	5.00	3.00
88	1481	SPGM 94050	2.33	1.0	57.7	14.0	70	3.30	3.00
89	1557	SPRU 94009	3.67	0.0	41.0	7.0	76	4.00	3.33
90	1635	SPA2 94032	2.00	0.3	51.3	6.0	66	4.00	3.33
91	1492	SPGM 94067	4.00	.	.	.	.	.	3.67
92	1602	SPA2 94002	2.33	0.0	61.0	9.0	78	5.00	4.00
93	1152	ICSB 89	2.33	0.0	43.0	14.0	80	4.00	4.00

FORAGE

S.No.	Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Agronomic score	Forage weight
					Leaf	Internode			
1	879	IS 31496	2.00	1.9	65.7	18.3	78	1.33	4.90
2	897	IS 13868	1.33	2.0	64.3	16.7	62	1.33	2.00
3	913	IS 31446	1.67	2.2	66.0	18.0	78	1.33	7.00
4	896	IS 32811	2.00	2.0	65.3	21.0	66	1.67	5.00
5	883	IS 19667	2.67	2.2	77.5	23.5	71	2.00	4.60
6	471	ICSR 93024	3.00	1.9	67.3	13.0	83	2.33	5.95
7	981	GD 47818	3.00	1.8	48.7	19.0	71	2.33	3.80
8	1064	GD 27668	2.00	1.6	66.7	19.0	73	2.67	3.10
9	466	ICSR 93011	3.00	2.0	73.5	23.0	76	3.00	2.20
10	472	ICSR 93026	3.67	1.6	60.0	9.5	66	3.00	3.80
11	899	IS 19669	2.67	1.7	61.3	15.3	76	3.00	2.10
12	975	GD 47805	3.67	1.9	58.0	17.0	.	3.00	.
13	6	SIKUANI	1.00	1.8	75.7	16.7	54	3.33	2.93
14	7	CSH 9	2.67	1.2	64.0	12.3	76	4.00	5.63

Annex 5. Chemical analysis of soils at Carimagua, lot La Reserva.

Element	Value	Quantity	Fertility
pH	4.23	acid	middle
P (Bray II)	2.80	middle	middle
K (meq 100 g)	0.05	low	low
Mg (meq 100g)	0.13	low	low
Ca (meq 100g)	0.46	middle	middle
Sat Al (%)	71.00	very high	low
Sat Ca (%)	22.00	low	low
Sat Mg (%)	6.01	low	low
Mn (ppm)	1.59	low	low
Zn (ppm)	0.49	high	high
B (ppm)	0.29	low	low
S.O.M (%)	3.40	high	middle

Annex 6. General information for the evaluated lines at Carimagua, semester II, 1996.

R-LINES

S.No.	Line	Pedigree	Vigour	Plant Ht. (m)	Length (cm)		Days to flowering	Green leaf area	Agronomic score
					Leaf	Internode			
1	1065	GD 27669	1.67	1.4	64.7	11.7	65	1.00	1.00
2	182	ICSR-74	1.67	1.3	69.0	12.3	79	1.33	1.00
3	2	SBL 107	1.33	1.4	58.7	17.7	65	2.00	1.00
4	303	ICSR 89012	1.00	1.8	80.0	14.7	68	1.00	1.00
5	403	ICSR 91008	2.00	1.8	71.0	14.0	69	1.00	1.00
6	407	ICSR 91012	2.33	1.2	65.0	10.0	83	1.00	1.00
7	415B	ICSR 91020	1.67	1.2	66.0	11.0	76	1.00	1.00
8	478	ICSR 93033	1.67	1.8	79.7	19.0	65	1.00	1.00
9	504	ICSV 93042	2.67	1.8	76.0	14.7	75	1.00	1.00
10	514	ICSV 95072	2.33	1.4	61.0	11.0	81	1.00	1.00
11	528	ICSV 95091	2.33	1.6	62.3	11.0	70	1.00	1.00
12	801	IS 30469-1187-2	2.67	1.6	78.3	16.3	80	1.33	1.00
13	803	IS 30469-1187-4	1.67	1.4	60.0	16.0	75	1.33	1.00
14	804	IS 30469-1187-5	2.67	1.6	68.3	15.7	76	1.33	1.00
15	1	REAL 60	2.33	1.8	55.7	11.7	68	2.67	1.33
16	138	ICSR-35	2.33	1.2	74.7	7.3	79	1.33	1.33
17	178	ICSR 71	2.67	1.0	76.3	8.3	76	1.00	1.33
18	213	ICSR 102	1.67	1.5	71.3	11.7	67	1.00	1.33
19	222	ICSR 110	2.33	1.2	57.0	10.3	68	1.00	1.33
20	306	ICSR 89015	3.00	1.5	59.7	11.7	73	1.00	1.33
21	369	ICSR 90004	1.33	1.4	80.0	19.0	67	1.33	1.33
22	639	ICSV 93075	1.67	1.1	57.7	8.3	72	1.00	1.33
23	806	IS 30469C-1508T-2	3.00	1.7	73.0	24.3	71	1.00	1.33
24	850	ICSR-102	2.67	1.3	71.0	13.7	74	1.00	1.33
25	295	ICSR 89005	2.33	1.2	68.3	10.0	81	1.00	1.67
26	415A	ICSR 91020	1.33	1.3	73.7	10.3	80	1.00	1.67
27	519	ICSV 95084	2.67	1.7	67.7	14.3	73	1.00	1.67
28	654	ICSV 112	1.00	1.6	64.0	11.0	69	1.00	1.67
29	749	ICSV 95016	2.00	1.5	79.0	13.0	73	1.00	1.67
30	793	IS 18758C-710-3	1.00	1.7	77.3	21.3	69	1.67	1.67
31	818	IS 30469C-1518T-3	2.00	1.9	69.3	17.0	76	1.67	1.67
32	852	ICSR-143	1.67	1.2	79.3	11.3	80	1.33	1.67
33	101	ICSR 1	3.00	1.3	58.0	7.3	71	1.00	2.00
34	168	ICSR 62	1.67	1.6	69.3	17.0	75	1.33	2.00
35	288	ICSR 194	1.67	2.2	88.3	22.3	69	1.33	2.00
36	309	ICSR 89019	2.00	1.4	59.3	10.0	76	1.00	2.00
37	324	ICSR 89033	2.67	1.6	72.0	10.3	68	1.00	2.00
38	374	ICSR 90008	2.33	1.7	72.0	13.0	74	1.00	2.00
39	4	A 2267-2	2.67	1.9	67.3	16.7	82	1.00	2.00
40	445	ICSR 92016	2.00	1.9	70.7	21.0	68	2.00	2.00
41	544	ICSV 112	1.67	1.7	77.3	13.0	69	1.00	2.00
42	794	IS 18758C-710-4	2.33	1.5	71.0	16.3	70	1.00	2.00
43	826	IS 30469C-1526-5	2.33	2.0	62.3	18.3	80	1.67	2.00
44	969	ICSV 95126	2.00	2.0	75.0	17.0	81	1.00	2.00

45	134	ICSR-31	2.33	1.6	54.0	14.0	69	1.00	2.33
46	388	ICSR 90021	3.33	1.6	61.0	15.0	71	1.00	2.33
47	426	ICSR 91031	3.00	1.5	81.0	15.0	74	1.33	2.33
48	506	ICSV 93043	2.67	1.8	76.0	12.3	81	1.00	2.33
49	781	IS 30469C-140-2	2.33	1.2	71.0	10.0	67	1.00	2.33
50	146	ICSR-42	2.33	1.0	74.7	11.7	69	1.00	2.67
51	149	ICSR 45	2.00	1.1	51.0	8.0	70	1.33	2.67
52	234	ICSR 121	1.33	1.3	78.0	9.7	74	1.33	2.67
53	3	IS 18442	2.33	1.8	71.3	22.3	64	2.67	2.67
54	433	ICSR 92003	1.67	1.6	67.3	12.0	68	1.33	2.67
55	534	ICSV 95096	2.00	1.8	68.7	11.0	64	1.67	2.67
56	7	CSH 9	2.33	1.5	69.0	12.0	68	1.00	2.67
57	816	IS 30469C-1518T-1	1.33	1.6	58.7	12.3	76	1.00	2.67
58	839	IS 18758C-603	2.33	1.5	77.7	11.7	77	1.00	2.67
59	205	ICSR 95	1.33	1.4	58.0	10.3	76	1.33	3.00
60	216	ICSR-105	2.00	1.4	77.0	9.7	67	1.33	3.00
61	331	ICSR 89042	2.33	1.2	53.7	9.3	67	1.33	3.00
62	364A	ICSR 89075	3.00	1.1	75.3	11.0	81	1.00	3.00
63	364B	ICSR 89075	3.00	1.2	73.3	11.0	82	1.33	3.00
64	395	ICSR 90027	1.33	1.3	62.7	9.0	68	1.33	3.00
65	880	IS 18758C-603	3.00	1.6	82.7	13.7	77	1.00	3.00
66	704	ICSV 95046	2.00	1.3	58.3	10.7	68	1.00	3.33
67	766	ICSV 95031	2.33	1.3	59.3	15.0	68	2.00	3.33
68	533	ICSV 95095	2.00	1.4	64.7	13.7	67	1.00	3.67
69	147	ICSR-43	2.67	1.3	73.0	12.3	71	2.33	4.00
70	5	SPRU 94008	2.33	1.0	64.0	11.0	64	2.00	4.00

B-LINES

S.No.	Line	Pedigree	Vigour	Plant Ht.	Length (cm)		Days to	Green leav	Agronomic
				(m)	Leaf	Internode	flowering	area	score
1	1142	ICSB 73	2.67	1.1	58.0	8.00	75	1.00	1.00
2	1152	ICSB 89	2.33	1.5	57.3	13.7	66	1.33	1.00
3	1154	ICSB 93	2.33	1.4	69.0	12.3	69	1.00	1.00
4	1156	ICSB 94	2.00	1.3	59.7	10.3	72	1.33	1.00
5	1173	ICSB 88015	2.00	1.3	70.0	10.0	71	1.67	1.00
6	1178	ICSB 89002	2.67	1.1	65.3	8.30	72	1.00	1.00
7	2	SBL 107	2.00	1.4	59.7	12.0	63	1.67	1.00
8	3	ICARAVAN	2.33	1.6	70.7	13.3	70	1.67	1.00
9	1	REAL 60	3.00	1.8	86.3	15.3	68	2.00	1.33
10	1153	ICSB 90	2.33	1.3	69.7	10.0	76	1.67	1.33
11	1159	ICSB 102	2.33	1.2	64.3	12.7	70	1.33	1.33
12	1162	ICSB 88004	2.00	1.1	48.7	6.30	79	1.67	1.33
13	1212	SPSFR 94002	2.67	0.9	63.3	7.70	77	1.00	1.33
14	1234	SPMD 94004	2.00	1.3	63.0	8.70	76	1.00	1.33
15	1251	SPMD 94019	2.67	1.1	65.0	8.00	73	1.33	1.33
16	1275	SPMD 94045	2.00	1.2	60.0	10.0	68	1.67	1.33
17	1296	SPHB 94006	2.00	1.3	71.7	17.7	66	1.00	1.33
18	1416	SPDM 94024	3.33	1.0	60.3	7.00	79	1.67	1.33
19	1503	SPAN 94008	2.33	1.4	61.0	11.3	77	1.00	1.33
20	1614	SPA2 94013	1.33	1.4	64.0	11.0	76	1.00	1.33
21	1632	SPA2 94029	1.33	1.5	59.7	14.3	70	1.00	1.33
22	1643	SPA2 94039	1.67	1.4	62.7	10.3	77	1.00	1.33
23	1126	ICSB 47	2.67	1.1	60.3	12.0	66	1.00	1.67
24	1148	ICSB 81	2.67	1.5	64.3	11.7	79	1.33	1.67
25	1177	ICSB 89001	2.33	0.9	63.7	5.30	82	1.67	1.67
26	1221	SPSFR 94013	2.33	1.0	60.3	5.30	79	1.33	1.67
27	1252	SPMD 94020	2.00	1.0	65.0	9.30	74	1.33	1.67
28	1266	SPMD 94033	2.33	0.9	65.3	8.00	78	1.67	1.67
29	1274	SPMD 94044	2.33	1.0	65.0	7.30	79	1.67	1.67
30	1453	SPDM 94061	4.00	0.9	58.3	7.70	82	2.33	1.67
31	1454	SPDM 94062	3.00	0.9	70.0	7.00	79	2.00	1.67
32	1602	SPA2 94002	1.67	1.3	63.7	9.30	76	1.67	1.67
33	1616	SPA2 94015	2.00	1.4	70.3	11.0	75	1.00	1.67
34	1623	SPA2 94021	2.00	1.2	75.3	12.7	77	1.00	1.67
35	4	A 2267-2	2.33	1.5	70.7	14.3	77	1.00	1.67
36	1084	ICSB 9	2.33	1.1	59.3	8.00	69	1.00	2.00
37	1088	ICSB 12	1.67	1.4	62.7	8.70	68	1.00	2.00
38	1100	ICSB 23	1.67	1.1	61.7	7.00	68	1.00	2.00
39	1101	ICSB 24	1.67	1.0	61.7	5.30	65	1.00	2.00
40	1104	ICSB 27	2.00	1.2	54.3	8.30	66	1.33	2.00
41	1141	ICSB 70	2.67	1.0	66.7	9.70	77	1.33	2.00
42	1193	ICSB 91003	3.00	1.0	55.7	7.00	76	1.67	2.00
43	1249	SPMD 94018	1.67	1.0	67.0	8.30	69	1.33	2.00
44	1293	SPHB 94004	2.00	1.2	65.3	11.0	70	1.00	2.00
45	1304	SPHB 94013	1.33	1.2	74.3	10.0	71	1.33	2.00

46	1426	SPDM 94036	3.00	0.9	71.0	6.30	82	2.00	2.00
47	1478	SPGM 94031	2.33	1.2	59.3	9.70	64	1.00	2.00
48	1505	SPAN 94010	3.67	0.9	60.3	7.00	74	1.00	2.00
49	1538	SPLB 94016	2.33	0.9	49.3	7.70	82	1.67	2.00
50	1639	SPA2 94036	2.67	1.2	60.3	10.0	77	1.67	2.00
51	1083	ICSB 8	2.33	1.0	47.3	5.70	66	1.00	2.33
52	1094	ICSB 18	2.00	1.3	62.3	11.0	67	1.33	2.33
53	1106	ICSB 28	2.67	1.3	57.7	11.7	65	1.67	2.33
54	1180	ICSB 89004	2.67	1.0	59.0	9.00	79	1.67	2.33
55	1181	ICSB 90001	2.33	1.1	64.0	8.70	79	1.67	2.33
56	1191	ICSB 91001	3.00	0.9	61.0	10.0	84	2.67	2.33
57	1236	SPMD 94006	2.67	1.2	67.0	10.7	75	1.33	2.33
58	1263	SPMD 94030	4.00	1.0	69.0	6.70	73	1.00	2.33
59	1302	SPHB 94011	2.00	1.0	59.0	8.00	71	1.00	2.33
60	1402	SPDM 94006	4.33	0.7	52.3	7.70	85	2.67	2.33
61	1451	SPDM 94059	2.67	0.9	63.3	9.00	77	1.00	2.33
62	1491	SPGM 94066	2.00	1.3	63.7	11.3	65	1.33	2.33
63	1534	SPLB 94012	2.33	1.2	71.3	8.30	79	1.67	2.33
64	1617	SPA2 94016	1.33	1.3	76.0	7.70	71	1.33	2.33
65	1626	SPA2 94024	2.67	0.9	66.7	7.00	76	1.33	2.33
66	1090	ICSB 14	4.00	1.1	62.0	6.70	65	1.67	2.67
67	1197	ICSB 91006	2.00	1.0	71.7	9.00	82	2.00	2.67
68	1245	SPMD 94014	2.67	1.1	66.7	7.70	69	1.67	2.67
69	1427	SPDM 94037	2.33	1.0	58.3	9.00	76	2.00	2.67
70	1517	SPAN 94046	1.67	1.6	70.3	12.0	79	2.00	2.67
71	1521	SPLB 94001	2.00	1.3	61.3	7.30	75	1.67	2.67
72	1615	SPA2 94014	2.33	1.0	59.0	9.30	68	1.00	2.67
73	1624	SPA2 94022	2.67	1.4	71.3	10.0	79	1.67	2.67
74	7	CSH 9	2.67	1.3	73.7	10.0	71	1.00	2.67
75	1182	ICSB 90002	2.00	0.9	64.3	5.70	71	1.33	3.00
76	1271	SPMD 94037	2.67	1.2	72.3	11.7	66	1.00	3.00
77	1279	SPMD 94050	2.00	1.1	62.7	9.00	82	1.00	3.00
78	1298	SPHB 94008	2.67	1.0	53.0	8.70	69	1.00	3.00
79	1299	SPHB 94009	3.00	0.6	41.7	7.00	82	2.00	3.00
80	1531	SPLB 94009	2.00	1.3	62.3	10.0	66	2.00	3.00
81	1635	SPA2 94032	1.67	1.1	64.3	8.00	66	1.00	3.00
82	1108	ICSB 30	2.00	1.2	66.7	12.7	72	1.00	3.33
83	1117	ICSB 38	3.00	1.0	65.7	8.70	76	1.33	3.33
84	1160	ICSB 88001	3.00	1.0	55.3	9.30	72	1.00	3.33
85	1269	SPMD 94036	1.67	1.2	71.0	7.00	70	1.00	3.33
86	1537	SPLB 94015	3.67	0.8	56.3	6.00	83	1.67	3.33
87	1557	SPRU 94009	2.33	1.2	60.0	10.7	66	2.00	3.33
88	1634	SPA2 94031	1.67	1.0	60.0	6.70	79	1.00	3.33
89	1492	SPGM 94067	3.00	0.7	48.0	5.70	84	2.67	3.67
90	1523	SPLB 94003	2.67	0.7	62.3	7.70	79	2.00	3.67
91	1526	SPLB 94005	2.00	0.9	63.7	7.00	82	2.33	3.67
92	1481	SPGM 94050	2.33	1.5	59.3	15.7	66	1.33	4.00
93	5	SPRU 94008	2.67	0.9	52.0	7.30	65	2.00	4.00

FORAGE

S.No.	Line	Pedigree	Vigour	Plan Ht.	Length (cm)		Days to	Green leaf	Agronomic	Forage
				(m)	Leaf	Internode	flowering	area	score	Weight
1	879	IS 31496	3.00	1.7	69.0	20.3	84	1.33	1.00	20.57
2	913	IS 31446	2.00	1.4	60.7	15.0	84	1.00	1.00	21.87
3	883	IS 19667	2.00	2.1	75.7	20.3	79	1.00	1.33	11.23
4	471	ICSR 93024	2.00	1.4	73.7	13.7	84	1.33	1.67	9.80
5	896	IS 32811	2.33	2.0	63.3	21.3	74	1.00	2.00	7.87
6	975	GD 47805	3.00	1.5	63.0	17.7	77	1.33	2.00	7.97
7	981	GD 47818	2.00	1.6	57.0	20.3	77	1.67	2.00	9.30
8	899	IS 19669	1.67	1.8	69.3	18.7	72	1.67	2.33	6.03
9	1064	GD 27668	1.33	1.7	69.3	17.7	73	1.00	3.00	9.43
10	466	ICSR 93011	2.33	1.5	65.7	16.7	73	1.33	3.00	7.57
11	472	ICSR 93026	3.00	1.6	61.0	16.0	72	2.67	3.33	6.40
12	897	IS 13868	1.33	2.0	73.7	18.0	77	1.00	3.33	12.07
13	6	SIKUANI	1.00	.	.	.	.	.	4.00	.
14	7	CSH 9	2.67	1.5	73.3	14.3	71	1.00	4.00	5.43

Annex 7. General information for the selected millet lines at Quilichao, semester II, 1996.

Line	Plot	Pedigree	Vigour	Plant Ht (m)	Length (cm)		Days to flowering	Agronomic score
					Leaf	Internode		
Population	3	ICMV 87001	2	1.50	51	19	55	1
Population	8	ICMP 89410	1	1.57	70	21	55	1
Population	9	ICMP 92853	1	2.29	74	22	49	1
Population	12	ICMS 7703	1	1.64	65	26	49	1
Population	15	ICMV 85404	3	1.81	61	25	62	1
Population	17	ICMV 91123	2	2.00	57	26	57	1
Population	18	ICMV 91773	1	1.82	67	20	49	1
Population	19	ICMV 93751	1	1.89	67	24	57	1
Population	20	ICMV-IS 85321	1	1.64	63	19	53	1
Population	26	IP 18378	1	2.11	83	21	59	1
Population	28	SOSAT-C 28	1	1.75	66	22	55	1
Population	29	LHGP	1	2.00	56	27	55	1
Population	30	TGP	1	2.13	57	29	55	1
A-line	31	A KM	1	0.80	39	10	49	1
B-line	32	B KM	2	0.80	41	12	49	1
A-line	36	841 A	1	0.90	27	18	57	1
B-line	37	841 B	2	1.00	45	13	57	1
A-line	38	842 A	3	1.00	26	17	59	2
B-line	39	842 B	3	1.10	31	17	59	2
A-line	50	ICMA A 91777	2	0.80	46	17	59	1
B-line	51	ICMA B 91777	2	0.97	54	10	59	1
Pollinator	57	IPC 0501	2	1.65	47	18	55	2
Pollinator	67	ICMR 312	1	1.65	57	18	55	1