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FIRST AFRICAN BEAN YIELD AND ADAPTATION NURSERY (AFBYAN I): PART I. PERFORMANCE IN INDIVIDUAL ENVIRONMENTS

J.B. Smithson

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GLOSSARY

Abbreviations

Environments

MEL 87	Melkassa, 1987
FIF 88	Antsirabe, 1988
KAC 7F	Kachwekano, first season, 1987
KAW 6S	Kawanda, second season, 1986
KAW 7F	Kawanda, first season, 1987
KIS 7F	Kisindi, first season, 1987
MUL 7F	Mulungu, first season, 1987
MSK 87	Msekera, 1987
MSK 88	Msekera, 1988
MBA 88	Mbala, 1988
SEL 89	Selian, 1989
SEL 89B	Selian, inoculated, 1989
IRE 89	Irente, 1989

Plant characters

CH	Canopy height (cm)
CW	Canopy width (score)
DFF	Days to 50% flowering
DM	Days to 85% maturity
STH	Stand at harvest
PM2	Pods/m^2
SPP	Seeds/pod
SW	Weight of 100 seeds (g)
SY	Seed yield (kg/ha)

Diseases

Anth	Anthracnose
ALS	Angular leaf spot
ALT	Alternaria blight
AB	Ascochyta blight
RR	Root rots
WB	Web blight
FLS	Floury leaf spot
WM	White mould
CBB	Common bacterial blight
HB	Halo blight
BCMV	Bean common mosaic
BR	Black root
PSB	Pod sucking bugs

INTRODUCTION

The African Bean Yield and Adaptation Nursery (AFBYAN) was composed in 1986 with various objectives. These were:

1. to establish the basis of a regional nursery network,

2. to facilitate exchange of promising materials,

3. to aid in classification of ecological zones, and

4. to interpret variation in performance of genotypes in terms of physical and biotic factors.

In order to achieve objectives 3 and 4, collaborators were requested to collect and provide data on various plant and environmental characters as well as seed yields. For the original entry set (AFBYAN I), we now have data from trials in 14 environments. Much of them are incomplete, but their summary and analysis are described herein. Part 1 comprises the results and analyses of individual location data and Part 2 various combined analyses aimed at classifying environments and explaining variation in performance of entries across environments.

MATERIALS AND METHODS

Entries

The entries in AFBYAN I are listed in Table 1, together with their countries of origin and seed and plant types. Some were "fillers" due to problems of providing adequate amounts of seed of all the proposed entries.

Several were 'Calima' types, determinate with medium to large red seed with cream flecks. Some (Mbala local, Ikinimba, Nain de Kyondo and BAC 76) were not included in all trials and were omitted from some of the combined analyses.

Environments

The environments from which data have been obtained are listed in Table 2, together with some environmental features considered to be important for bean growth, development and yield.

Rainfall and temperature data during the vegetative (sowing to mid-flower) and reproductive (mid-flower to maturity) periods and rainfall during one month prior to sowing are given in Table 3. Except for Fifamanor, Mulungu, Msekera in 1987 and the two trials at Selian in 1989, these data are based on long term means. We hope to replace most of these with data from the actual environments for the final analysis.

Experimental design and layout

The experimental design and layout are shown in Appendix 1, reproduced from the actual field book.

Data

The data requested are listed in Appendix 2, again reproduced from the field book. In addition to these, in the trials at Selian and Irente, the pod samples were assessed for insect damage.

In the interests of expedition the data were not transformed. This will be done in due course and may affect some of the conclusions.

Analysis

Analyses of variance were computed for data from individual environments. The multiple regressions of yield on other plant characters and disease reactions were also computed using values predicted from the substitution of dummy variables for replicates and entries. This reduces the effects of character association specific to these variables.

RESULTS

Entry means

Mean values for agronomic and yield data and disease, pest and other scores for the entries in individual locations are shown in Tables 4 to 31. The probabilities of the differences among entries being real are indicated by asterisks at the base of each column.

Melkassa. Pod samples were not taken (Table 4). There were significant differences among entries in canopy height, days to flowering and maturity, stand at harvest and seed yields. G 13671 (938 kg/ha) and G 2816 (926 kg) produced the heaviest yields and G 2470 and Ikinimba were the poorest. The only diseases were a root rot and CBB (Table 5). Root rot incidence was recorded only on two replicates. A 197, Kabanima and BAC 76 showed least incidence and Black Dessie, T-3, Kirundo and Mulungu were worst. CBB ranged from 2.67 to 5.00 but differences among entries were not significant.

Antsirabe All agronomic and yield data were recorded (Table 6). There were significant differences among entries for all characters. Seed yields were excellent, ranging from 1531 to 3545 kg/ha. The heaviest yielders were Ikinimba and Rubona 5

(3132 kg/ha). Anthracnose was the only disease recorded (Table 7) but was not severe and most entries had no or very mild symptoms. The local check was worst affected (score 4.67).

Kachwekano. All agronomic and yield data were recorded (Table 8). Seed yields ranged from 917 to 2617 kg/ha. There were significant differences among entries for all but ground cover. Ikinimba and Rubona 5 (2325 kg/ha) again produced the heaviest yields. Disease pressures were more severe than in other environments (Table 9). ALS was worst followed by AB, CBB and rust. Anthracnose was mild and HB was moderate on some entries. Carioca and Muhinga showed the lowest disease levels over all with neither anthracnose nor rust and low to moderate scores for the other diseases.

Kawanda. Two trials were grown at Kawanda, one in the second season of 1986 and the other in the first season of the following year.

In 1986, all agronomic and yield data were recorded except days to maturity (Table 10). There were significant differences among entries for all characters except ground cover. Seed yields ranged from 817 to 2275 kg/ha. G 13671 and Urubonobono were the heaviest yielding entries. ALS, CBB and rust were the most prominent disease problems (Table 11). There were entries free of anthracnose, rust and BCMV. BAC 76 and Nain de Kyondo had lower disease scores than the other entries.

In 1987, all agronomic and yield data were recorded (Table 12). Seed yields exhibited a very wide range, from 271 to 2176 kg/ha. The heaviest yield was produced by Carioca, which was significantly better than all other entries. Notably, the poorest yielder in both seasons was K-20, bred at Kawanda and now fairly generally cultivated in Uganda. Diseases were not recorded in the 1987 trial.

Kisindi. Only ground cover and stand at harvest were recorded among agronomic data (Table 13). There were significant differences among entries for ground cover, seeds per pod and seed size. Seed yields were very poor, ranging from 354 to 900 kg/ha. BAC 76 and Urubonobono produced the heaviest yields. CBB was moderate and there were traces of anthracnose, ALS, rust, FLS and BCMV (Table 14). BAC 76, PVA 880 and A 197 were virtually disease-free.

Rubona. The only data returned were seed yields (Table 15). These ranged from 1252 to 2400 kg/ha. The heaviest yield was produced by K-20, which gave the lowest yields in both seasons in Kawanda.

Mulungu. Pod samples were not taken (Table 16). There were significant differences among entries for all other agronomic and yield data. Seed yields varied widely from 22 to 2543 kg/ha and the CV was very high. G 2816 was significantly better yielding than all other entries. Beanfly was reported to be the main reason for the poor performance of many entries. Diseases rated included anthracnose, ALS, AB and rust (Table 17). ALS and AB showed the highest scores and rust and anthracnose were slight.

Msekera. Trials were grown in 1987 and 1988.

In 1987, all agronomic and yield data were recorded (Table 18). There were significant differences among entries for all characters. Seed yields were variable, ranging from 464 to 2049 kg/ha. BAC 76 was significantly better yielding than all other entries except K-20. BCMV was severe (up to 7.33 in Red Wolaita) in susceptible entries (Table 19). CBB was moderate and no other diseases were observed.

In 1988, all agronomic and yield data were recorded except days to maturity (Table 20). There were significant differences among entries for all other characters. Seed yields were very poor due to waterlogging, ranging from 59 to 853 kg/ha. Again the heaviest yield was produced by BAC 76, significantly better than all other entries. Disease problems were much greater than in 1987 (Table 21). WB was most severe followed by ALS, alternaria and CBB. BCMV mosaic was again severe in susceptible entries. (Red Wolaita and T-3). Pod sucking bug damage was very severe in some entries, especially G 13671.

Mbala. All agronomic and yield data were recorded except days to maturity (Table 22). There were significant differences among entries for all other characters. Seed yields were extremely poor (115-448 kg/ha). A 197 and Ikinimba were the heaviest yielders. Ascochyta blight, ALS, BCMV and scab were all rated up to severe on susceptible entries and traces of rust and CBB were recorded (Table 23). Nain de Kyondo had generally lower disease reactions than other entries.

Selian. Two trials were grown at Selian in 1989. The seeds of the central rows of one of them were inoculated with *Rhizobium*.

In the other, there were significant differences among entries for all agronomic and yield characteristics (Table 24). Seed yields were excellent ranging from 2611 to 4663 kg/ha. The heaviest yields were produced by Carioca and BAC 76. These heavy seed yields were obtained in spite of severe ALS, rust, CBB and WM, which reached levels of 6 to 7 on susceptible entries (Table 25). PVA 272, Carioca and BAC 76 exhibited generally low disease reactions. Ratings for beanfly and pod and seed damage were rather too variable to be meaningful but there were significant differences among entries for pod and seed damage (Table 26).

Calima and Rubona 5 had less pod borer damage than other entries and Canadian Wonder and Kilyumukwe had less seed damage (pod sucking bugs?).

In the inoculated trial, canopy heights and days to maturity were not recorded but there were significant differences among entries for other agronomic and yield data (Table 27). Seed yields were again excellent, ranging up to 4290 kg/ha. Ikinimba and again BAC 76 (4009 kg/ha) were the heaviest yielders. Disease reactions were not rated. Pod and seed damage ratings were again very variable but there were significant differences among entries in percentages of clean and eaten seeds (Table 28). Rubona 5 had the smallest percentage of seeds eaten by pod borers.

Irente. Canopy heights and days to flowering and maturity were not recorded and there were significant differences among entries for all other characters except stand at harvest. Growth was poor and there was general interveinal leaf mottling perhaps due to potash deficiency. Seed yields were not good (344 to 1306 kg/ha) (Table 29). G 12470 produced the heaviest yield, not significantly better than G 2816 (1193 kg), Rubona 5 (1151), Urubonobono (1107) and T-3 (1022) and some other entries. Disease reactions ranged up to 4 to 5 for ALS, FLS and CBB and there were lower levels of AB and rust (Table 30). There were significant differences among entries in percentages of clean and shrivelled seeds (Table 31). G 13671 (91.3%), G 2816 (84.4%), Carioca (71.1%) and BAC 76 (69.5%) had significantly greater percentages of shrivelled seeds and fewer clean seeds than all other entries.

Relationships among characters.

Correlation and regression methods were used to examine relationships among characters.

Correlations. Correlations between seed yields and predicted values of other agronomic characters, disease reactions and yield components are shown in Table 32.

Canopy widths were negatively correlated with seed yields except at Msekera in 1987, where the correlation was positive, and at Kachwekano. Canopy heights were positively correlated with seed yields in four environments out of twelve. The correlation was negative in one case and non-significant in the others.

Days to flowering and to maturity were both positively correlated with seed yields in three environments and negatively in one. Stand at harvest was positively correlated with seed yields in seven environments.

Among diseases, CBB was recorded most frequently (nine environments) but correlations with seed yields were negative in only two. ALS was recorded in eight environments and was negatively correlated with seed yields in three with a significant positive correlation in one case. Rust was positively correlated with seed yields in one environment and negatively in another, in the seven environments where it was recorded. BCMV was negatively correlated with seed yields in one case out of five; and halo blight, web blight, alternaria and scab were all negatively associated with seed yields in the single environments where they were recorded. Ascochyta blight, white mould and floury leaf spot were never negatively associated with seed yields. Indeed ascochyta blight and floury leaf spot each showed positive correlations with seed yields in two environments.

Among components of yield, pod number was always positively correlated with seed yields and, in all but two environments, with seeds per pod. There were significant negative correlations between seed size and seed yields in only two cases.

Multiple regression analysis. The predicted values of other agronomic characters and disease scores accounted for 15 to 66% of the variation in seed yields in individual environments (Table 33). Seed yields increased by up to 817 kg/ha for each unit decrease in canopy width and the regression coefficients were significantly less than zero in six out of twelve environments. There were increases in seed yields of up to 24 kg/ha for each additional stand at harvest but the regression of seed yields on canopy heights and days to flowering and maturity were inconsistent and only rarely differed significantly from zero.

Significant negative regressions of seed yields on disease scores were recorded: thrice for ALS; once for anthracnose, rust, CBB, BCMV, FLS, alternaria, web blight and scab; and not at all for ascochyta and halo blights.

Yield components accounted for between 42 and 86% of the variation in seed yields in individual environments. The regression coefficients for pod number, seeds/pod and seed size were always positive and significant. Seed yields increased by: 5.0 to 15.8 kg/ha for every additional pod per m^2; by 55.4 to 581.2 kg/ha for each additional seed per pod and 7.3 to 63.6 kg/ha for each g increase in weight of 100 seeds.

DISCUSSION

Two purposes of the AFBYAN are to aid in classification of ecological zones and to elucidate the factors causing variation in bean performance across environments. These features will be examined in Part II of this report.

In Part I we present the data returned from 14 environments in which the AFBYAN I was grown. This is a very inadequate sample of

the environments in which beans are produced in Africa. There are also many gaps in the data. Only seed yields were recorded in all environments. Other characters were recorded in only eleven of the environments.

In addition, only 21 of the entries were common to all environments. BAC 76 was replaced by a local check at Antsirabe in Madagascar; Nain de Kyondo by Canadian Wonder in the inoculated trial at Selian and Irente in Tanzania; and Mbala local by Masai Red in all three Tanzanian trials. But, while this complicates the conduct and interpretation of combined analyses, it does not affect the analyses of individual environments that we describe here.

The features recorded were chosen as a compromise between comprehensiveness and feasibility. They all can be expected to be associated with seed yields, either directly (such as stand count and yield components) or indirectly, through the adaptation of genotypes to environments (crop growth, time to flowering and maturity and disease reactions).

Canopy heights were measured and ground cover rated to provide an easily recorded estimate of crop growth, as an alternative to vigour scores, which are not readily comparable across environments. Since canopy width was rated on a 1-9 scale (where 1 indicates complete ground cover and 9, less than about 10% ground cover), if better growth produces heavier yields, relationships will be negative. This indeed proved to be the situation in nine of the eleven environments where ground cover was rated. Canopy height was a less good predictor of seed yields being positive and significant in only a few cases.

Relationships between times to flowering and maturity and seed yields are expected to be inconsistent. In long growing seasons, later maturing genotypes will be favoured and the relationship with seed yields should be positive. In short growing seasons, later maturing genotypes will be penalised and relationships with seed yield should be negative. In seasons of intermediate length, neither may have particular advantage. Relationships did in fact behave thus, being positive in three cases, negative in one and not significantly different from zero in the rest.

Plant stands were positively related with seed yields in 7 environments, so seed yields were poorer where plant density was reduced. Significant differences among entries in plant stand were observed in 10 of the 12 environments in which they were recorded. These can arise in various ways, for example, small seeds emerge better in adverse conditions, or merely through differences in seed quality related perhaps to source of seed. So differences in stand count must be considered in the interpretation of yield data from breeding trials and other field experiments.

Disease reactions (measured on a 1-9 scale, where 1 indicates no disease; and 9, near total defoliation or mortality) are expected to exhibit negative associations with seed yields. Surprisingly this occurred only rarely. Assuming that the absence of scores for some diseases in trials where other diseases were rated indicates the absence of the diseases, negative associations were observed in only 10 cases out of 132, suggesting that diseases were not such important causes of crop loss as is generally supposed.

The yield components, pods per m^2, seeds per pod and seed size should account completely for seed yields. They did not, presumably due to inaccurancies in sampling, but they did account for up to 86% of the variation in seed yields in individual environments. Pod number was positively correlated with seed yields in every environment and seeds per pod in most. These and seed size mostly showed significant positive regression coefficients in multiple regression analyses.

SUMMARY

Data are presented from AFBYAN I in 14 environments. They included time to flower and mature, canopy heights and widths, stands at harvest and grain yield and its components. Significant differences among entries were recorded for most characters in most environments. Canopy width, as an indicator of crop vigour, pod number, seeds/pod and seed size accounted for much of the variation in grain yields in individual environments. Associations between grain yield and other plant characters were inconsistent or small. There were very few cases of significant associations between disease reactions and grain yields. Various forms of combined analysis will be considered in Part 2.

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The efforts of all those who allocated precious time and resources to conduct the trials reported in this document are gratefully acknowledged. The names and addresses of their institutions are listed in Appendix 3.

Acknowledgements are also due to Mr. Thadeus Chikoti for his assistance with data analysis and table preparation and to Ms. Eva Ngalo for other word processing.

Table 1. Contributing countries, sources and characteristics of entries in AFBYAN 1 between 1986 and 1989.

Entries	Other identities	Contributing countries	Sources	Seed types: Sizes	Seed types: Colours	Plant type
Black Dessie	-	Ethiopia	Ethiopia	S	Black	3b
Red Wolaita	-	Ethiopia	Ethiopia	S	Red	3b
PVA 1272	-	Rwanda	CIAT	L	Red/white fleck	1
G 13671	Japones	Rwanda	Mexico	L	Cream/black fleck	3
G 2816	Flor de Mayo	Rwanda	Mexico	S	Cream	3
T 3	-	Tanzania	Tanzania	S	Red	3b
T 23	Lyamungu 85	Tanzania	Tanzania	L	Red/white fleck	1
Kabanima	-	Uganda	Uganda	L	Red/white fleck	1
K 20	-	Uganda	Uganda	L	Red/white fleck	1
ZPV 292	Gayaza 8	Zambia	Uganda	L	Purple mottle	3b
Carioca	-	Zambia	Brazil	S	Brown/cream striped	2b
Mbala local	-	Zambia	Zambia	L	Yellow-white mixed	4a
Urubonobono	-	Burundi	Burundi	S	White/black fleck	3
Kirundo	-	Burundi	Burundi	L	Yellow	3
Calima	-	Burundi	Colombia	L	Red/cream fleck	1
Rubona 5	-	Rwanda	Colombia	M	Red/cream fleck	1
Ikinimba	-	Rwanda	Rwanda	M	Black	3
Kilyumukwe	-	Rwanda	Rwanda	L	Purple	2
A 197	-	Rwanda	CIAT	L	Cream	1
Nain de Kyondo	-	Zaire	Zaire	S	White	3
Muhinga	-	Zaire	Zaire	M	White/black striped	3
PVA 880	-	Rwanda	CIAT	M	Red/white fleck	1
PVA 563	-	Rwanda	CIAT	M	Red/white fleck	1
G 12470	Peru 14-2	Rwanda	Ecuador	L	Purple/white fleck	1
BAC 76	XAN 76	Rwanda	CIAT	S	Cream	2

S, M and L indicates weight of seeds/100 g less than 25, 25-40 and greater than 40, respectively

Table 2. Environments in which AFBYAN I was grown between 1986 and 1989.

Environments	Countries	Latitudes	Altitudes (masl)	Soil class	Sowing date	Day length (hours) At sowing	Day length (hours) Change first month
MEL87	Ethiopia	8°25'	1550	4	30 Jun	12.60	-0.12
FIF88	Madagascar	19°	1500	3	1 Mar	12.48	-0.53
KAC7F	Uganda,	1°14'	2123	3	25 Apr	12.08	+0.02
KAW6S	Uganda	0°34'	1196	6	mid Oct	12.10	0
KAW7F	Uganda	0°34'	1196	6	9 Apr	12.12	+0.02
KIS7F	Uganda	0°25'	1146	5	mid Mar	12.12	0
RUB7F	Rwanda	2°29'	1706	4	8 Oct	12.15	+0.05
MUL7F	Zaire	2°18'	1731	3	mid Oct	12.15	+0.07
MSK87	Zambia	13°39'	1025	5	8 Jan	12.88	-0.27
MSK88	Zambia	13°39'	1025	5	10 Jan	12.87	-0.27
MBA88	Zambia	8°51'	1673	8	13 Jan	12.58	-0.18
SEL89A	Tanzania	3°20'	1387	1	30 Mar	12.08	-0.08
SEL89B	Tanzania	3°20'	1387	1	4 Apr	12.07	-0.08
IRE89F	Tanzania	4°50'	1400	9	15 Apr	12.02	-0.15

Table 3 Rainfall and temperature data for environments where AFBYAN I was grown between 1986 and 1989.

Environments	Rainfall (mm)				Temperature °C								
					Maximum			Minimum			Mean		
	Pre-sowing	Veg. period	Reprod. period	Total	Veg. period	Reprod. period	Full season	Veg. period	Reprod. period	Full season	Veg. period	Reprod period	Full season
MEL87	80	300	200	580	22.0	26.0	24.0	15.4	15.0	15.2	20.4	20.0	20.2
FIF88	166	139	39	345	27.3	23.5	25.4	8.1	3.8	6.0	17.7	14.6	16.2
KAC7F	150	120	40	310	-	-	-	-	-	-	15.1	15.0	15.1
KAW6S	110	200	150	460	27.3	27.5	27.4	16.2	16.0	16.1	21.7	21.6	21.6
KAW7F	115	230	70	415	26.8	26.0	26.4	16.7	16.0	16.4	21.8	20.8	21.3
KIS7F	100	230	170	500	28.5	28.0	28.3	17.5	17.3	17.4	23.1	22.6	22.9
RUB7F	110	180	160	450	25.0	25.0	25.0	13.9	13.9	13.9	18.5	19.0	18.8
NUL7F	123	371	267	761	24.6	24.0	24.3	13.4	13.6	13.5	18.0	18.8	18.9
MSK87	242	229	202	673	28.8	28.8	28.8	18.4	17.3	17.8	23.6	23.1	23.4
KSK87	280	360	190	730	27.0	27.6	27.3	18.0	17.0	17.5	21.8	21.6	21.7
MBA88	240	340	300	860	23.0	24.2	23.6	14.6	14.8	14.7	17.9	18.2	18.1
SEL89A	142	369	48	559	24.2	21.8	24.2	16.0	13.7	14.8	20.1	17.8	19.0
SEL89B	142	376	35	553	22.9	21.7	22.3	16.0	13.6	14.8	19.5	17.0	18.7
IRE89	85	190	60	335	24.5	22.0	23.2	13.5	10.5	12.0	18.5	16.0	17.2

Table 4. Agronomic and yield data for entries in AFBYAN I at Melkassa in 1987.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	43.3	3.00	40.0	67.7	44.3				509
Red Wolaita	43.3	2.67	38.3	62.7	59.3				815
PVA 1272	36.7	4.33	36.3	63.0	55.3				613
G 13671	48.3	2.33	39.0	71.0	45.7				938
G 2816	45.0	2.33	35.3	65.7	44.0				926
T-3	43.3	4.33	38.7	63.7	35.7				399
T-23	43.3	3.00	36.0	69.3	56.3				690
Kabanima	38.3	4.33	39.0	71.0	48.0				369
K-20	40.0	2.33	39.3	70.0	50.7				430
ZPV-292	43.3	4.33	39.7	68.7	59.7				679
Carioca	45.0	2.67	41.3	67.3	57.3				742
Mhala Local	40.0	3.67	32.7	66.0	40.7				503
Urubonobo	45.0	3.00	38.0	70.3	41.7				810
Kirundo	40.0	3.67	36.3	71.7	41.3				333
Calima	40.0	3.67	30.0	66.0	62.7				855
Rubona 5	46.7	2.67	35.3	70.0	54.7				807
Ikinimba	40.0	3.33	33.7	69.0	41.7				553
Kilyumukwe	40.0	3.67	31.0	66.0	46.7				452
A 197	43.3	3.33	34.3	70.0	51.3				421
Nain de Kiyondo	41.7	2.67	41.7	72.7	44.7				593
Muhinga	45.0	4.67	32.7	69.7	44.3				343
PVA 880	45.0	2.67	39.3	69.7	40.7				570
PVA 563	45.0	3.67	37.7	71.3	55.3				536
G 2470	46.7	2.67	38.0	71.3	43.0				298
BAC 76	40.0	2.67	42.7	69.7	57.7				716
Mean	42.7	3.26	37.1	68.5	48.9				596
S.E. ±	1.98	0.60	2.08	1.46	3.71				104.3
C.V. (%)	8.1	31.8	9.7	3.7	13.1				30.3
Significance	*	NS	**	***	***				***

Table 5. Disease and pest scores of entries in AFBYAN I at Melkassa in 1987.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie					9.00				4.00				
Red Wolaita					4.00				4.00				
PVA 1272					6.00				3.33				
G 13671					4.00				3.00				
G 2816					4.00				2.67				
T-3					8.00				4.33				
T-23					4.00				3.33				
Kabanima					3.00				4.00				
K-20					5.00				3.00				
IPV-292					6.00				4.00				
Carioca					3.00				3.33				
Mbala Local					7.00				5.00				
Urubonobono					6.00				3.33				
Kirundo					8.00				3.00				
Calima					5.00				3.67				
Rubona 5					5.00				3.00				
Ikinimba					7.00				4.33				
Kilyuouku					7.00				3.00				
A 197					2.00				2.67				
Nain de Kiyondo					9.00				3.67				
Muhinga					8.00				3.00				
PVA 880					4.00				3.00				
PVA 563					5.00				3.33				
G 2470					7.00				3.00				
BAC 76					3.00				3.33				
Mean					5.56				3.45				
S.E. ±					1.054				0.550				
C.V. (%)					32.8				27.6				
Significance					NS				NS				

Table 6. Agronomic and yield data for entries in AFBYAN I at Antsirabe in 1988.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m²	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	31.7	2.00	58.7	133.0	42.0	209.0	5.27	0.200	2204
Red Wolaita	35.0	2.33	53.7	118.0	42.0	152.0	5.10	0.249	1961
PVA 1272	38.3	1.67	52.3	118.0	61.7	128.1	3.31	0.520	2243
G 13671	41.7	1.67	54.7	120.0	58.7	169.6	4.26	0.407	2902
G 2816	28.3	1.67	54.0	125.7	65.0	133.5	3.96	0.400	2104
T-3	33.3	2.33	54.7	118.0	50.7	174.8	5.42	0.238	2256
T-23	41.7	2.33	53.3	118.0	58.7	149.8	2.93	0.567	2502
Kabanima	36.7	2.00	55.0	121.7	56.7	157.5	3.06	0.484	2321
K-20	38.3	2.00	54.7	121.7	59.3	146.0	3.43	0.472	2356
ZPV-292	41.7	1.67	54.0	116.0	56.3	110.0	4.10	0.497	2241
Carioca	30.0	1.33	58.7	133.0	50.0	267.1	5.54	0.201	2989
Mbala Local	35.0	2.00	52.7	116.7	52.0	148.9	4.92	0.273	1981
Urubonobono	35.0	1.67	52.3	118.0	55.0	171.5	4.16	0.350	2500
Kirundo	41.7	2.33	53.0	116.0	51.0	100.3	3.43	0.537	1852
Calima	41.7	2.67	52.3	116.0	63.7	118.2	3.17	0.642	2423
Rubona 5	41.7	1.33	51.7	118.0	63.0	184.6	3.40	0.499	3132
Ikinimba	31.7	1.67	50.7	116.7	61.7	181.3	4.53	0.428	3545
Kilyumukwe	35.0	3.00	52.0	114.3	58.3	70.3	3.56	0.609	1552
A 197	43.3	2.33	52.7	122.0	59.7	88.0	3.41	0.630	1908
Main de Kiyondo	35.0	1.00	59.0	147.0	46.3	166.1	5.17	0.242	2049
Muhinga	30.0	2.33	51.7	120.0	46.0	109.0	3.09	0.468	1569
PVA 880	36.7	2.67	53.0	120.0	59.3	113.5	3.16	0.551	2030
PVA 563	43.3	1.67	54.3	123.7	62.7	101.0	3.56	0.557	2003
G 2470	41.7	1.67	54.7	125.7	58.0	108.8	3.47	0.588	2231
BAC 76	33.3	3.33	50.3	114.3	49.7	93.3	3.21	0.513	1531
Mean	36.9	2.03	53.8	121.3	55.5	142.1	3.94	0.445	2255
S.E. ±	2.66	0.363	0.54	2.2	4.2	18.6	0.151	0.0183	272.3
C.V. (%)	12.5	31.0	1.7	3.1	13.2	22.8	6.6	6.1	20.9
Significance	***	**	***	***	**	***	***	***	***

Table 7. Disease and pest scores of entries in AFBYAN I at Antsirabe in 1988.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie	1.00												
Red Kolaita	1.00												
PVA 1272	1.33												
G 13671	1.33												
G 2816	1.33												
Y-3	1.00												
Y-23	1.67												
Kabanima	1.33												
K-20	1.33												
ZPV-292	1.33												
Carioca	1.00												
Mbala Local	1.33												
Urubonobono	1.00												
Kirundo	1.67												
Calima	2.33												
Rubona 5	1.33												
Ikiniaba	1.33												
Kilyusukwe	0.92												
A 197	1.00												
Nain de Kiyondo	1.00												
Muhinga	1.00												
PVA 880	1.67												
PVA 563	2.00												
G 2470	1.00												
Local check	4.67												
Mean	1.43												
S.E. ±	0.286												
C.V. (%)	34.6												
Significance	***												

Table 8. Agronomic and yield data for entries in AFBYAN I at Kachwekano in first season 1987.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	31.7	3.00	66.0	89.0	131.7	130.4	3.83	0.322	1567
Red Wolaita	36.0	3.00	61.0	91.0	130.3	95.1	4.14	0.428	1517
PVA 1272	45.0	5.00	54.0	88.0	100.3	127.9	2.90	0.422	1500
G 13671	33.3	3.67	66.0	90.7	111.0	154.1	4.22	0.344	2167
G 2816	31.7	5.00	65.0	93.3	103.7	111.5	3.96	0.364	1550
T-3	36.7	1.67	63.7	90.0	122.3	155.2	4.93	0.192	1454
T-23	48.3	3.00	58.7	90.0	95.7	130.4	3.38	0.525	2150
Kabanima	37.3	3.67	59.7	91.3	113.0	144.8	3.29	0.349	1575
K-20	46.0	2.33	57.7	91.0	87.0	78.2	4.06	0.585	1842
IPV-292	38.3	5.00	60.0	91.0	111.3	113.3	3.44	0.420	1617
Carioca	33.3	4.33	70.0	91.0	117.0	131.5	4.86	0.253	1575
Mbala Local	31.7	4.33	64.7	90.0	91.3	63.0	3.87	0.373	917
Urubonobono	35.0	3.67	59.7	86.0	112.7	141.9	4.37	0.377	2292
Kirundo	41.7	3.67	58.3	90.0	90.7	124.6	3.64	0.485	2117
Calima	38.3	4.33	57.3	89.0	112.7	103.3	3.53	0.521	1867
Rubona 5	43.3	1.67	58.3	90.0	92.0	162.8	3.77	0.383	2325
Ikinimba	33.3	1.67	61.0	90.0	95.7	149.0	4.58	0.411	2617
Kilyumukwe	41.7	3.67	55.0	87.0	102.0	97.5	3.67	0.549	1950
A 197	43.3	3.67	58.7	93.3	76.0	110.8	3.44	0.529	1933
Nain de Kiyondo	33.3	4.33	68.7	91.0	110.0	88.8	5.01	0.271	1133
Muhinga	36.7	4.33	59.7	87.0	90.3	102.6	3.91	0.384	1533
PVA 880	41.7	4.33	55.0	93.3	104.3	99.6	3.58	0.493	1675
PVA 563	40.0	4.33	58.7	91.3	124.3	84.6	3.50	0.506	1467
G 2470	50.0	3.00	61.0	92.7	119.7	75.5	3.57	0.533	1433
BAC 76	35.0	1.00	69.0	92.7	151.0	140.0	5.47	0.224	1717
Mean	38.6	3.51	61.1	90.4	107.8	116.7	3.96	0.410	1740
S.E. ±	2.06	0.913	2.07	1.34	12.19	19.6	0.337	0.0408	173.4
C.V. (%)	9.3	45.1	5.9	2.6	19.6	29.1	14.8	17.8	17.3
Significance	***	NS	***	*	*	*	***	***	***

Table 9. Disease and pest scores of entries in AFBYAN I at Kachwekano in first season 1987.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie	1.00	7.33		3.67		1.67			4.33	1.00			
Red Wolaita	1.67	6.33		4.33		7.00			4.00	1.67			
PVA 1272	2.00	5.33		3.67		1.00			2.00	4.33			
G 13671	1.00	4.67		6.67		3.33			6.67	1.00			
G 2816	1.00	5.67		5.67		4.67			6.33	1.00			
T-3	1.00	6.67		4.67		7.33			5.33	1.33			
T-23	1.67	6.67		2.67		1.00			3.00	2.00			
Kabanima	1.00	6.67		3.67		1.00			4.00	1.67			
K-20	1.00	7.33		4.00		2.33			4.00	1.00			
ZPV-292	2.00	7.00		2.67		3.67			3.00	3.00			
Carioca	1.00	4.67		3.33		1.00			3.67	2.00			
Mbala Local	1.00	7.00		4.00		4.33			3.67	2.00			
Urubonobono	1.00	7.00		5.00		3.67			3.00	1.00			
Kirundo	1.00	7.00		4.33		2.33			3.00	3.67			
Calima	3.33	7.00		6.33		1.00			2.33	1.67			
Rubona 5	1.00	6.67		4.33		1.00			2.33	2.00			
Ikinimba	1.00	7.00		4.67		9.00			3.33	1.00			
Kilyumukwe	1.00	5.33		2.33		2.00			4.00	1.67			
A 197	1.00	6.67		4.67		1.00			3.33	3.00			
Nain de Kiyondo	1.67	5.67		3.33		4.00			3.00	1.00			
Muhinga	1.00	4.67		4.00		1.00			3.33	1.00			
PVA 880	2.33	6.33		6.33		1.00			4.67	1.67			
PVA 563	1.67	7.33		4.67		1.00			6.00	1.00			
G 2470	1.00	6.33		3.67		1.67			2.00	5.00			
BAC 76	1.00	4.67		4.33		5.00			5.33	2.00			
Mean	1.33	6.28		4.28		2.88			3.83	1.91			
S.E. ±	0.547	0.663		0.690		0.682			0.721	0.671			
C.V. (%)	71.1	18.3		27.9		41.0			32.6	60.9			
Significance	NS	*		**		***			***	***			

Table 10. Agronomic and yield data for entries in AFBYAN I at Kawanda in second season 1986.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m²	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	35.0	3.67	38.7		125.0	132.9	4.31	0.329	1633
Red Wolaita	36.7	4.00	38.3		168.3	110.7	5.21	0.277	1600
PVA 1272	45.0	4.67	37.0		111.7	79.2	3.87	0.409	1150
G 13671	35.0	2.33	36.7		147.3	149.3	4.36	0.360	2275
G 2816	38.3	5.00	36.3		129.3	153.2	3.23	0.329	1650
T-3	40.0	3.00	38.0		111.0	144.1	4.56	0.282	1700
T-23	43.3	4.67	35.7		122.3	92.8	2.70	0.465	1125
Kabanima	40.0	4.33	37.7		121.7	160.5	3.36	0.348	1475
K-20	40.0	5.33	38.0		98.7	58.0	3.33	0.435	817
ZPV-292	45.0	3.00	36.7		146.0	91.3	4.63	0.393	1642
Carioca	38.3	4.33	42.0		120.7	160.4	4.52	0.254	1692
Mbala Local	41.7	3.33	36.0		107.3	108.4	3.78	0.283	1125
Urubonobono	38.3	2.67	33.7		146.3	146.7	3.39	0.456	2192
Kirundo	46.7	4.00	34.3		126.3	80.2	3.89	0.375	1150
Calima	40.0	4.33	34.3		134.3	93.0	2.66	0.549	1400
Rubona 5	40.0	4.67	35.7		115.3	112.5	3.72	0.390	1483
Ikinimba	36.7	3.67	34.7		110.3	122.7	2.99	0.464	1617
Kilyumukwe	48.3	4.33	34.0		125.0	103.0	3.49	0.508	1750
A 197	41.7	5.00	34.3		124.0	97.9	2.80	0.583	1575
Nain de Kiyondo	38.3	4.67	42.3		115.3	113.4	4.77	0.291	1567
Muhinga	41.7	3.67	32.7		103.0	102.6	3.20	0.378	1200
PVA 880	43.3	4.67	37.7		106.0	80.8	3.30	0.493	900
PVA 563	45.0	4.00	37.3		123.3	68.8	3.43	0.547	1292
G 2470	45.0	3.67	37.7		119.3	73.0	3.39	0.537	1317
BAC 76	31.7	6.00	42.0		124.0	184.0	4.83	0.225	1908
Mean	40.6	4.12	36.9		123.3	112.8	3.75	0.398	1489
S.E. ±	2.17	0.758	0.63		9.59	24.55	0.402	0.0483	246.5
C.V. (%)	9.2	31.9	2.9		13.5	37.7	18.6	20.6	28.7
Significance	***	NS	***		**	*	***	***	*

Table 11. Disease and pest scores of entries in AFBYAN I at Kawanda in second season 1986.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie	1.33	7.67				2.00			5.67		1.33		
Red Wolaita	1.67	5.67				4.67			6.00		1.67		
PVA 1272	1.00	4.33				3.00			3.33		1.00		
G 13671	1.67	4.67				2.33			5.00		1.00		
G 2816	1.67	7.00				3.00			6.00		1.00		
T-3	2.00	4.00				2.33			5.67		2.00		
T-23	1.00	5.67				4.00			5.00		1.00		
Kabanima	1.33	7.67				3.33			6.33		1.00		
K-20	1.00	5.67				5.00			5.00		1.00		
ZPV-292	1.33	5.33				3.67			5.00		1.33		
Carioca	1.33	4.00				2.33			4.33		1.33		
Mbala Local	1.33	5.33				2.67			5.33		1.67		
Urubonobono	1.33	7.00				3.67			6.67		1.67		
Kirundo	1.00	6.67				3.00			5.33		1.00		
Calima	1.00	6.00				3.00			5.00		1.00		
Rubona 5	1.00	6.67				2.67			5.00		1.33		
Ikinimba	1.33	6.33				7.00			6.33		1.00		
Kilyumukwe	1.33	5.00				2.67			5.00		1.00		
A 197	1.33	5.33				5.00			3.33		1.00		
Main de Kiyondo	1.67	2.67				1.00			2.33		2.33		
Muhinga	1.67	5.67				3.00			4.67		1.00		
PVA 880	1.67	6.67				4.33			3.o7		1.00		
PVA 563	1.33	5.00				2.67			3.67		1.00		
C 2470	1.00	4.67				2.67			4.00		1.00		
BAC 76	1.00	1.67				1.67			3.33		1.00		
Mean	1.33	5.45				3.23			4.84		1.23		
S.E.±	0.267	0.541				0.641			0.595		0.221		
C.V. (%)	34.8	17.2				34.4			21.3		31.1		
Significance	NS	***				***			***		**		

Table 12. Agronomic and yield data for entries in AFBYAN I at Kawanda in first season 1987.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	41.7	1.00	37.3	73.3	60.0	177.4	4.97	0.157	1363
Red Wolaita	35.0	2.00	37.3	73.3	50.0	84.2	5.37	0.230	1018
PVA 1272	41.7	4.00	35.0	70.3	95.0	70.2	3.01	0.398	845
G 13671	36.7	3.00	36.7	75.0	65.0	61.7	4.74	0.294	845
G 2816	30.0	5.00	37.3	74.3	55.0	78.6	4.19	0.279	908
T-3	36.7	1.33	37.7	73.3	66.3	73.6	5.07	0.229	836
T-23	43.3	4.00	37.0	70.0	49.0	46.8	3.31	0.396	615
Kabanima	47.7	2.00	36.7	73.0	53.0	33.3	3.17	0.326	345
K-20	41.7	4.67	35.0	68.7	93.0	17.3	3.70	0.421	271
ZPV-292	41.7	4.00	36.3	71.0	60.0	29.4	4.07	0.377	440
Carioca	40.0	1.67	39.0	76.3	56.0	226.1	4.91	0.197	2176
Mbala Local	35.0	3.00	36.7	74.0	52.7	74.3	3.47	0.260	668
Urubonobono	35.0	3.67	36.7	73.0	58.3	79.0	4.22	0.268	888
Kirundo	43.3	3.33	36.7	70.0	55.0	63.7	3.80	0.386	967
Calima	41.7	4.67	36.3	72.0	56.3	63.9	2.90	0.510	931
Rubona 5	43.3	3.33	36.7	71.7	70.3	55.8	3.63	0.357	738
Ikinimba	30.0	3.33	35.0	71.7	39.0	43.3	4.38	0.321	598
Kilyumukwe	35.0	4.67	36.0	70.7	86.7	27.3	3.80	0.473	488
A 197	50.0	3.00	36.7	74.0	52.0	76.5	3.18	0.463	1118
Nain de Kiyondo	41.7	1.33	39.0	78.0	35.7	88.4	3.64	0.181	577
Muhinga	35.0	4.33	34.7	72.3	86.3	97.1	3.69	0.293	928
PVA 880	45.0	3.67	36.7	74.3	41.7	35.3	4.04	0.368	515
PVA 563	46.7	2.33	37.7	77.0	44.0	51.8	3.61	0.411	778
G 2470	48.3	3.33	37.3	75.0	49.0	45.7	3.80	0.342	593
BAC 76	33.3	4.00	38.7	74.7	53.0	133.1	4.88	0.170	1093
Mean	40.0	3.23	36.8	73.1	59.3	73.3	3.98	0.324	822
S.E. ±	2.83	0.715	0.33	0.93	8.07	15.12	0.242	0.0183	148.9
C.V. (%)	12.3	38.4	1.6	2.2	23.6	35.7	10.6	11.2	31.4
Significance	***	**	***	***	***	***	***	***	***

Table 13. Agronomic and yield data for entries in AFBYAN I at Kisindi in 1987.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m²	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Bessie		2.33			82.3	71.8	4.67	0.239	738
Red Molaita		2.00			83.7	43.8	4.88	0.243	502
PVA 1272		3.33			53.7	31.5	3.36	0.538	550
G 13671		2.67			68.7	48.9	4.49	0.350	767
G 2816		4.67			59.3	31.7	4.36	0.338	467
T-3		2.33			64.7	41.9	4.89	0.227	403
T-23		6.00			67.7	34.8	2.79	0.543	525
Kabanima		3.67			74.3	54.3	3.14	0.454	771
K-20		4.67			74.7	32.9	3.58	0.589	688
ZPV 292		5.33			62.3	46.8	4.29	0.341	671
Carioca		1.67			47.3	51.7	5.33	0.189	521
Mbala Local		2.67			56.3	36.4	4.29	0.326	504
Urubonobono		2.33			78.0	58.3	4.06	0.381	900
Kirundo		4.33			59.3	40.3	3.67	0.424	621
Calima		3.67			66.3	56.6	3.16	0.524	817
Rubona 3		4.00			67.0	55.7	3.47	0.439	842
Kilyumukwe		4.33			68.7	62.7	3.23	0.459	888
A 197		4.67			69.0	27.0	2.64	0.526	354
Main de Kiyonto		1.67			60.0	38.1	4.20	0.257	417
Muhinga		4.33			67.7	30.7	3.47	0.475	500
PVA 880		3.00			61.0	40.6	3.59	0.505	729
PVA 563		2.67			54.3	27.5	3.82	0.415	433
G 12470		3.33			58.7	40.5	3.64	0.413	617
BAC 76		2.33			80.0	93.9	4.48	0.215	900
Mean		3.42			66.0	45.8	3.89	0.392	630
S.E. ±		1.163			9.58	12.44	0.260	0.0408	134.0
C.V. (%)		33.8			25.1	47.1	11.6	17.3	36.8
Significance		***			NS	NS	***	***	NS

Table 14. Disease and pest scores of entries in AFBYAN I at Kisindi in 1987.

Entry	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie	1.33	1.67				1.33		1.67	2.33		1.33		
Red Wolaita	1.67	1.33				1.33		1.33	3.67		2.33		
PVA 1272	1.67	1.67				2.00		1.00	2.67		1.33		
G 13671	1.00	1.00				1.33		2.00	2.33		1.67		
G 2816	1.67	3.33				1.67		2.00	3.33		1.00		
T-3	1.67	1.33				1.33		1.00	3.33		2.33		
T-23	1.00	1.00				2.00		1.00	2.67		1.67		
Kabanima	1.00	1.00				1.33		1.00	2.00		1.33		
K-20	1.67	1.67				1.67		3.33	2.00		1.33		
IPV 292	1.00	1.67				1.00		1.67	3.33		1.33		
Carioca	1.00	1.00				1.00		1.00	1.67		1.00		
Mbala Local	1.00	1.00				1.00		1.33	4.67		4.67		
Urubonobono	1.33	2.33				1.33		1.33	3.67		2.33		
Kirundo	1.33	2.33				1.33		2.33	2.33		1.67		
Calima	1.33	1.67				1.67		2.00	1.33		2.67		
Rubona 5	1.00	1.00				1.00		1.67	3.00		1.00		
Kilyumukwe	1.00	1.33				1.67		3.33	4.00		2.00		
A 197	1.00	1.00				1.00		1.67	1.00		1.33		
Nain de Kiyondo	1.33	1.00				1.00		1.33	4.67		2.67		
Muhinga	1.00	1.67				3.00		1.67	2.67		2.00		
PVA 880	1.33	1.00				1.00		1.67	1.00		1.67		
PVA 563	1.33	1.00				1.33		1.00	2.67		1.67		
G 12470	1.33	1.00				1.33		1.00	2.00		2.67		
BAC 76	1.00	1.00				1.00		1.67	1.00		1.00		
Mean	1.25	1.42				1.40		1.63	2.64		1.83		
S.E. ±	0.242	0.340				0.367		0.456	0.546		0.476		
C.V. (%)	33.5	41.5				45.3		48.7	35.8		45.0		
Significance	NS	***				NS		*	***		***		

Table 15. Agronomic and yield data for entries in AFBYAN I at Rubona in first season 1987.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie									1252
Red Wolaita									1265
PVA 1272									1730
G 13671									1484
G 2816									1828
T-3									1362
T-23									1600
Kabanima									2008
K-20									2400
ZPV-292									1954
Carioca									1362
Mbala Local									1506
Urubonobono									1852
Kirundo									1815
Calima									2152
Rubona 5									1887
Ikinimba									1697
Kilyumukwe									1830
A 197									1812
Nain de Kiyondo									1282
Muhinga									1528
PVA 880									1626
PVA 563									1820
G 2470									2165
BAC 76									1572
Mean									1711
S.E. ±									171.1
C.V. (%)									17.3
Significance									***

Table 16. Agronomic and yield data for entries in AFBYAN I at Mulungu in first season 1987.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	27.7	5.00	49.0	90.0	56.0				603
Red Wolaita	40.3	4.33	51.0	88.3	68.0				399
PVA 1272	25.7	7.00	49.0	85.0	63.3				242
G 13671	33.0	6.33	51.0	89.0	60.7				313
G 2816	45.3	3.00	47.0	90.0	70.0				2543
T-3	35.0	5.00	47.0	85.0	62.3				509
T-23	15.7	8.33	49.0	89.0	54.7				34
Kabanima	12.7	8.33	49.0	89.0	30.3				22
K-20	16.3	8.33	49.0	89.0	40.0				43
ZPV-292	17.7	7.67	49.0	89.0	47.0				76
Carioca	36.3	5.00	53.0	97.3	59.0				703
Mbala Local	33.7	6.33	44.0	89.0	50.3				281
Urubonobono	27.7	7.00	39.0	89.0	55.7				280
Kirundo	23.7	7.00	42.0	85.3	65.3				223
Calima	22.0	6.33	42.0	85.0	64.0				323
Rubona 5	22.7	7.00	49.0	89.0	44.7				231
Ikinimba	36.3	5.00	38.7	85.0	67.7				1058
Kilyumukwe	30.0	6.33	34.0	85.0	56.3				165
A 197	21.7	6.33	42.0	89.0	63.3				661
Main de Kiyondo	65.7	3.00	51.0	98.7	60.7				1564
Muhinga	27.0	7.67	34.0	85.0	53.0				72
PVA 880	21.3	6.33	47.0	89.0	63.0				297
PVA 563	21.3	6.33	47.0	89.7	60.7				308
G 2470	37.7	4.33	47.0	90.0	63.0				653
BAC 76	28.3	6.33	52.0	100.0	55.0				543
Mean	29.0	6.15	46.1	89.2	57.8				478
S.E. ±	5.93	0.88	0.93	1.02	6.57				185.2
C.V. (%)	35.4	24.9	3.5	2.0	19.7				67.1
Significance	***	***	***	***	*				***

Table 17. Disease and pest scores of entries in AFBYAN I at Mulungu in first season 1987.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie	2.67	5.67		3.33		1.67							
Red Wolaita	2.67	7.00		3.00		2.67							
PVA 1272	1.67	5.67		3.33		2.33							
G 13671	2.00	3.67		5.00		2.00							
G 2816	2.00	5.33		6.00		3.00							
T-3	1.67	5.67		3.00		2.67							
T-23	2.33	5.00		3.00		4.00							
Kabanima	1.67	4.33		2.00		2.00							
K-20	1.33	4.67		2.33		1.67							
IPV-292	2.33	5.00		2.33		3.00							
Carioca	2.00	5.67		5.67		1.67							
Masai Red	1.33	5.67		3.00		3.67							
Urubonobono	1.67	5.33		3.00		2.33							
Kirundo	1.33	5.33		2.33		2.00							
Calima	1.33	6.00		2.67		3.33							
Rubona 5	1.67	5.67		3.33		3.00							
Ikinimba	2.00	5.33		4.67		3.67							
Kilyumukwe	1.33	5.67		3.00		3.00							
A 197	2.00	5.33		3.00		2.00							
Nain de Kiyondo	1.00	6.00		3.33		4.33							
Muhinga	1.33	5.00		3.00		3.00							
PVA 880	2.00	5.00		3.33		1.67							
PVA 563	2.00	6.00		3.00		2.00							
G 12470	3.00	5.67		3.67		3.33							
BAC 76	2.33	3.67		6.67		2.33							
Mean	1.87	5.33		3.48		2.65							
S.E. ±	0.481	0.429		0.365		0.459							
C.V. (%)	44.6	13.9		18.2		30.0							
Significance	NS	*		NS		NS							

Table 18 Agronomic and yield data for entries in AFBYAN I at Msekera in 1987.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m²	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	26.7	5.00	39.0	71.0	86.3	117.7	4.40	0.185	957
Red Kalaita	25.0	1.33	38.0	69.0	86.3	62.1	4.24	0.234	614
PVA 1272	40.0	5.67	36.0	83.3	79.0	101.7	2.88	0.432	1257
G 13671	26.7	1.00	51.7	87.0	91.3	56.5	3.02	0.352	553
G 2816	21.7	5.00	33.3	68.0	78.3	82.6	3.57	0.317	928
T-3	28.3	3.67	37.7	55.7	86.0	86.2	4.23	0.226	823
T-23	43.3	4.33	36.7	62.3	82.0	82.9	2.86	0.432	1046
Kabanima	35.0	6.33	38.3	69.0	77.0	70.8	2.86	0.342	685
K-20	41.7	4.33	37.3	72.3	87.3	140.4	2.92	0.373	1580
IPV-292	35.0	3.67	34.7	76.7	74.0	91.2	4.43	0.351	1397
Carioca	35.0	2.33	40.3	66.3	80.7	101.3	5.07	0.229	1175
Mbala Local	26.7	3.33	32.7	68.3	85.7	71.0	3.76	0.254	687
Urubonobono	33.3	2.00	34.0	78.7	86.7	55.9	3.58	0.294	584
Kirundo	30.0	4.33	32.0	67.3	79.7	82.2	4.09	0.333	1093
Calima	36.7	6.00	34.7	87.0	79.0	91.8	3.29	0.447	1333
Rubona 5	38.3	5.33	38.3	68.0	83.0	87.9	3.27	0.387	1109
Ikinimba	21.7	2.33	33.0	77.7	87.0	68.3	3.90	0.338	878
Kilyumukwe	28.3	5.67	32.3	72.7	80.7	81.0	3.54	0.393	1122
A 197	43.3	5.67	34.7	84.7	80.0	78.9	3.11	0.493	1196
Main de Kiyondo	36.7	1.00	43.7	64.7	88.7	93.1	3.97	0.208	799
Muhinga	33.3	5.67	32.0	86.3	74.0	69.7	3.88	0.282	762
PVA 880	41.7	6.33	38.3	77.0	82.0	86.1	3.10	0.394	1025
PVA 563	43.3	5.33	38.7	93.3	81.0	71.8	3.28	0.373	869
G 2470	53.3	2.00	40.3	93.0	92.0	44.4	2.34	0.446	464
BAC 76	35.0	2.33	38.7	67.0	81.3	198.5	5.12	0.201	2049
Mean	34.4	4.00	37.1	82.8	74.7	87.0	3.63	0.333	999
S.E.±	2.26	0.722	0.31	1.30	5.61	15.10	0.279	0.0183	186.0
C.V. (%)	11.4	31.3	1.5	2.7	13.0	30.1	13.3	6.9	32.2
Significance	***	***	***	***	***	***	***	***	***

Table 19. Disease and pest scores of entries in AFBYAN I at Msekera in 1987.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie									2.33		5.33		
Red Wolaita									2.33		7.33		
PVA 1272									1.67		2.67		
G 13671									2.00		5.67		
G 2816									2.67		4.33		
T-3									2.67		6.67		
T-23									1.67		3.33		
Kabanima									2.00		3.67		
K-20									2.00		3.33		
ZPV-292									2.33		1.00		
Carioca									1.00		3.33		
Mbala Local									3.33		6.33		
Urubonobono									2.00		6.33		
Kirundo									2.33		3.33		
Calima									1.67		3.00		
Rubona 5									1.33		3.00		
Ikinimba									1.67		3.33		
Kilyumukwe									3.00		3.33		
A 197									1.33		1.33		
Nain de Kiyondo									2.33		2.33		
Muhinga									2.00		3.00		
PVA 880									1.33		4.00		
PVA 563									1.67		4.33		
G 2470									1.67		3.33		
BAC 76									1.00		3.00		
Mean									1.97		3.87		
S.E. ±									0.436		0.504		
C.V. (%)									38.3		22.6		
Significance									*		***		

20. Agronomic and yield data for entries in AFBYAN I at Msekera in 1988.

[illegible]es	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
[illegible]ssie	21.7	4.67	37.3		70.0	49.4	3.5	0.151	260
[illegible]ita	21.7	5.00	36.7		53.0	16.7	4.3	0.168	121
PVA 12[illegible]	25.0	7.67	35.0		56.0	28.5	2.7	0.276	216
[illegible]1	18.3	4.67	41.7		57.3	22.0	1.9	0.277	114
[illegible]	21.7	5.33	34.0		76.7	44.9	3.5	0.243	355
T-3	20.0	5.33	36.0		40.7	21.0	3.4	0.173	125
T-23	26.7	7.00	35.3		58.7	28.6	2.4	0.342	243
Tabaniman	21.7	8.00	35.3		20.3	16.5	1.7	0.253	71
[illegible]	26.7	7.00	35.7		37.7	16.9	2.1	0.259	97
IPV-2[illegible]	23.3	5.67	32.3		54.7	34.5	3.8	0.239	289
Carioca	25.0	5.33	37.3		32.0	17.5	4.1	0.162	116
Mbala Local	20.0	5.00	33.0		71.3	20.9	2.5	0.225	115
Urubonobono	25.0	3.67	34.7		107.7	24.2	3.5	0.251	210
Kirundo	25.0	5.33	31.0		50.7	22.7	2.9	0.251	167
Calima	20.0	8.00	35.0		37.7	14.7	2.1	0.273	84
Rubona 5	26.7	6.33	35.7		72.3	34.5	3.2	0.276	311
Ikinimba	20.0	4.33	32.7		61.7	18.7	3.3	0.251	164
Kilyumukwe	25.0	6.33	31.0		33.7	18.8	1.6	0.312	109
A 197	26.7	6.67	33.0		75.3	31.7	3.2	0.375	375
Nain de Kiyondo	28.3	3.33	40.3		125.0	39.7	4.0	0.172	250
Muhinga	18.3	7.33	31.0		21.3	13.9	3.1	0.196	86
PVA 880	20.0	7.67	36.7		53.3	13.0	2.6	0.266	90
PVA 563	20.7	8.33	37.0		29.0	11.4	1.8	0.269	60
G 2470	26.7	6.67	37.7		21.3	9.9	1.8	0.259	59
BAC 76	30.0	2.67	37.3		73.7	19.1	4.6	0.158	853
	23.4	5.89	35.3		55.6	27.6	2.9	0.243	198
	1.95	0.433	0.38		9.66	7.03	0.37	0.0193	46.6
[illegible]	14.5	12.7	1.9		30.1	44.1	21.9	6.2	40.9
Significance	***	***	***		***	***	***	***	***

Table 21. Disease and pest scores of entries in AFBYAN I at Maekera in 1988.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	PSB
Black Dessie		3.33	3.00				2.67		3.00		2.33		6.00
Red Wolaita		5.33	2.67				3.33		4.33		5.67		5.67
PVA 1272		2.33	3.33				4.00		2.67		1.00		3.67
G 13671		5.33	3.67				3.33		2.67		1.67		8.67
G 2816		4.33	3.33				2.67		4.67		3.00		2.67
T-3		5.67	3.33				5.00		4.33		6.00		5.00
T-23		3.00	3.33				3.33		2.67		1.00		3.33
Kabanima		4.33	4.00				6.33		4.00		1.00		6.00
K-20		4.33	3.67				5.00		3.33		1.00		3.00
ZPV-292		2.00	4.33				5.00		3.67		1.00		3.00
Carioca		2.00	3.00				4.67		2.67		3.00		5.33
Masai Red		3.33	3.00				3.00		4.67		2.33		5.00
Urubonobono		4.33	3.00				3.00		2.67		1.67		4.33
Kirundo		3.00	3.33				4.67		3.67		1.00		3.00
Calima		4.67	4.00				6.00		3.33		1.00		5.00
Rubona 5		3.00	4.00				2.33		2.67		1.33		4.67
Ikinimba		4.33	2.33				4.33		3.67		1.67		3.00
Kilyumukwe		2.67	3.00				6.33		3.33		1.00		4.33
A 197		4.67	3.00				4.00		2.00		1.00		3.67
Nain de Kiyondo		1.67	3.67				3.00		3.33		1.00		3.33
Muhinga		2.00	3.33				6.67		2.00		1.00		3.33
PVA 880		4.67	3.33				5.00		1.67		1.67		4.67
PVA 563		4.67	3.00				5.67		3.00		1.00		4.33
G 12470		4.00	5.33				3.67		2.67		2.67		6.33
BAC 76		1.00	2.00				2.33		3.00		1.67		4.33
Mean		3.60	3.36				4.21		3.19		1.87		4.47
S.E. ±		0.718	0.479				0.782		0.497		0.721		1.17
C.V. (%)		34.6	24.7				32.1		27.0		66.9		45.6
Significance		***	*				***		**		***		NS

Table 22. Agronomic and yield data for entries in AFBYAN I at Mbala in 1988.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m²	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	15.0	6.00	49.3		154.7	74.1	2.21	0.161	242
Red Wolaita	21.7	5.67	45.0		150.7	42.8	3.77	0.190	292
PVA 1272	21.7	7.33	43.0		161.7	59.3	1.19	0.354	255
G 13671	18.3	5.00	49.3		133.0	41.6	2.34	0.268	264
G 2816	16.7	6.33	44.7		172.7	75.0	1.28	0.231	221
T-3	20.0	5.67	45.0		148.0	33.8	4.34	0.183	267
T-23	20.0	6.33	42.3		174.3	66.6	1.16	0.402	309
Kabanima	18.3	6.33	44.0		162.3	53.0	1.50	0.292	236
K-20	18.3	6.33	44.7		163.0	67.9	1.05	0.322	218
ZPV-292	18.3	5.67	44.3		142.0	47.4	1.80	0.279	226
Carioca	21.7	5.33	50.0		173.0	66.4	3.07	0.199	395
Mbala Local	15.0	6.33	42.0		134.3	45.0	2.32	0.233	224
Urubonobono	20.0	5.33	40.0		146.0	45.2	1.71	0.285	212
Kirundo	20.0	6.00	40.0		184.7	67.3	1.57	0.299	305
Calima	21.7	6.67	42.0		177.0	53.4	1.65	0.367	343
Rubona 5	21.7	6.33	42.3		180.7	50.3	2.00	0.332	325
Ikinimba	13.3	6.00	39.0		128.0	59.5	2.70	0.288	445
Kilyumukwe	18.3	6.33	40.0		156.0	59.3	1.34	0.376	298
A 197	20.0	6.33	43.3		172.7	60.0	1.98	0.383	448
Main de Kiyondo	20.0	5.00	50.3		162.7	40.5	5.07	0.230	439
Muhinga	13.3	6.00	40.0		176.3	48.2	2.00	0.230	217
PVA 880	18.3	7.00	44.7		148.7	31.2	2.24	0.301	209
PVA 563	20.0	6.67	44.7		169.0	35.3	1.31	0.292	115
G 2470	20.0	6.00	45.0		94.7	19.7	4.18	0.402	277
BAC 76	16.7	5.67	49.7		161.3	53.3	4.29	0.178	400
Mean	18.7	6.07	44.2		157.1	51.9	2.32	0.283	287
S.E. ±	1.44	0.312	0.27		11.5	8.59	0.364	0.0183	44.2
C.V. (%)	13.3	8.9	1.1		12.7	28.7	27.2	5.4	26.6
Significance	***	***	***		***	**	***	***	***

Table 23. Disease and pest scores of entries in AFBYAN I at Mbala in 1988.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	Scab
Black Dessie		3.67		2.33		1.00			1.00		2.33		1.00
Red Wolaita		4.00		4.00		1.33			1.00		6.00		1.00
PVA 1272		2.00		5.00		1.33			1.67		1.00		4.67
G 13671		5.67		3.67		1.00			1.67		3.67		1.00
G 2816		5.67		3.33		1.00			1.33		4.33		1.00
T-3		2.67		4.33		2.67			1.67		7.33		1.00
T-23		3.00		3.33		2.00			1.67		3.00		2.33
Kabanima		3.00		4.33		1.00			2.00		2.33		2.33
K-20		2.33		4.33		1.00			2.33		1.33		4.00
ZPV-292		3.67		1.67		1.67			2.33		1.00		5.67
Carioca		3.33		4.33		1.00			1.00		2.00		1.00
Masai Red		5.33		4.00		3.00			1.67		2.00		1.67
Urubonobono		6.00		3.00		1.00			1.00		2.00		1.00
Kirundo		2.67		5.33		1.00			2.00		3.33		4.00
Calima		3.00		4.00		1.00			1.67		1.00		1.67
Rubona 5		3.00		4.67		1.00			2.00		2.00		1.67
Ikinimba		2.33		3.67		1.33			1.00		1.67		1.00
Kilyumukwe		2.67		3.67		1.00			1.33		1.00		4.00
A 197		3.00		5.00		1.33			1.00		1.00		3.33
Nain de kiyondo		2.67		2.67		1.00			2.33		1.00		1.00
Muhinga		4.00		4.00		1.00			1.00		1.67		3.33
PVA 880		2.67		5.33		1.00			1.67		2.33		1.67
PVA 563		2.67		5.00		1.33			2.67		3.33		5.00
G 12470		2.00		3.67		1.00			2.67		1.67		1.00
BAC 76		2.00		4.33		2.33			1.67		2.00		1.00
Mean		3.32		3.96		1.33			1.65		2.41		2.25
S.E. ±		0.616		0.488		0.463			0.588		0.803		0.637
C.V. (%)		32.2		21.3		60.1			61.6		57.6		49.0
Significance		***		***		NS			NS		***		***

Table 24. Agronomic and yield data for entries in AFBYAN I at Selian in 1989.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie	33.3	3.67	43.3	101.7	33.7	358.1	4.43	0.225	3542
Red Wolaita	33.3	4.00	43.0	101.7	32.7	275.0	4.41	0.259	3125
PVA 1272	43.3	5.33	40.0	94.7	38.0	290.0	2.15	0.472	2929
G 13671	31.7	4.00	43.0	104.3	39.3	270.6	3.61	0.443	4001
G 2816	30.0	3.67	41.0	100.7	35.0	287.1	3.90	0.398	4360
T-3	31.7	5.00	44.3	100.0	35.3	235.7	5.01	0.228	2686
T-23	43.3	4.00	41.0	94.0	38.7	268.4	2.08	0.536	2922
Kabanima	35.0	4.67	42.0	99.7	33.0	217.8	2.67	0.517	2965
K-20	45.0	3.67	41.7	100.7	35.7	311.7	2.27	0.499	3533
IPV-292	38.3	5.00	40.3	93.0	33.0	203.6	3.77	0.446	3307
Carioca	36.7	6.33	48.0	104.3	31.3	390.5	4.98	0.243	4663
Masai Red	33.3	4.67	42.7	98.7	36.7	252.2	4.41	0.237	2611
Urubonobono	35.0	5.33	41.0	102.0	36.7	260.2	3.99	0.380	3837
Kirundo	38.3	4.33	39.0	97.7	34.7	234.5	2.67	0.556	3374
Calima	41.7	5.33	39.3	96.0	35.3	226.7	2.11	0.672	3141
Rubona 5	45.0	4.00	40.0	99.3	34.7	237.1	2.60	0.589	3591
Ikinimba	31.7	3.67	41.0	102.7	31.0	221.8	3.93	0.497	4203
Kilyumukwe	36.7	5.00	39.0	102.3	31.7	276.4	2.65	0.580	3597
A 197	41.7	4.33	39.7	100.3	32.7	192.4	2.85	0.638	3415
Canadian Wonder	41.7	5.00	40.0	93.0	37.3	194.0	2.47	0.564	2638
Muhinga	36.7	4.33	41.0	101.7	34.3	280.6	3.43	0.335	2908
PVA 880	45.0	5.00	41.7	102.0	32.0	252.2	2.75	0.521	3563
PVA 563	43.3	4.33	41.7	100.7	34.7	221.1	2.86	0.567	3474
G 12470	48.3	4.00	43.0	104.3	36.7	174.5	3.46	0.579	3446
BAC 76	40.0	6.00	46.7	103.3	38.0	471.3	4.51	0.227	4636
Mean	38.4	2.32	41.7	99.9	34.9	251.6	3.36	0.448	3285
S.E. ±	1.82	0.389	0.83	1.24	1.35	32.98	0.393	0.0408	238.8
C.V. (%)	8.2	29.1	3.5	2.2	6.7	22.7	20.3	15.6	12.6
Significance	***	***	***	***	***	***	***	***	***

Table 25. Disease scores of entries in AFBYAN I at Selian in 1989.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR	WM
Black Dessie		3.67				3.00			1.67				5.00
Red Wolaita		5.67				6.33			1.67				4.67
PVA 1272		2.67				2.67			1.67				1.67
G 13671		1.00				1.00			2.33				5.33
G 2816		1.67				1.00			3.33				4.67
T-3		4.67				5.00			1.67				6.67
T-23		5.67				7.00			1.00				1.00
Kabanima		3.67				2.67			2.67				4.33
K-20		2.67				2.00			2.00				3.67
ZPV-292		3.00				5.00			2.00				3.33
Carioca		1.00				1.00			2.00				2.33
Masai Red		5.00				6.00			1.00				6.00
Urubonobono		5.33				1.67			2.67				3.33
Kirundo		7.00				3.00			1.33				1.67
Calima		6.33				2.00			1.33				1.33
Rubona 5		6.33				1.33			1.00				2.33
Ikinimba		2.33				5.67			1.67				4.00
Kilyumukwe		4.67				2.67			3.00				3.67
A 197		6.67				3.00			6.67				1.00
Canadian Wonder		5.00				6.33			1.00				1.00
Muhinga		3.67				3.33			2.33				4.67
PVA 880		6.00				2.67			1.33				2.67
PVA 563		4.67				2.33			2.33				3.00
G 12470		2.00				3.67			2.00				2.33
BAC 76		1.67				1.00			1.67				3.33
Mean		4.08				3.25			2.05				3.32
S.E. ±		0.527				0.511			0.523				0.509
C.V. (%)		22.4				27.2			44.2				26.5
Significance		***				***			***				***

Table 26. Pest damage scores of entries in AFBYAN I at Selian in 1989.

Entry names	Beanfly score	Damage	Per cent pods holed	Holes /pod	Per cent clean seeds	Per cent shrivelled seeds	Per cent eaten seeds
Black Dessie	0.00	1.00	28.0	0.37	88.3	7.0	4.7
Red Wolaita	1.67	1.33	30.0	0.42	86.1	6.7	7.2
PVA 1272	0.33	1.33	16.0	0.25	82.6	14.5	2.9
G 13671	0.33	1.00	9.3	0.10	76.2	20.5	3.2
G 2816	0.67	1.00	12.0	0.13	88.0	10.1	1.9
T-3	0.67	1.33	30.0	0.40	88.2	5.4	6.4
T-23	0.33	1.00	18.7	0.25	85.0	10.1	4.9
Kabanima	1.67	1.00	10.0	0.11	89.3	9.2	1.5
K-20	1.00	1.00	10.0	0.10	86.9	10.7	2.4
ZPV-292	0.00	1.00	20.0	0.36	91.3	6.3	2.4
Carioca	1.00	1.00	24.0	0.40	88.6	7.9	3.4
Masai Red	0.67	1.67	32.7	0.44	84.4	8.5	7.1
Urubonobono	0.00	1.33	12.0	0.16	81.3	16.4	2.2
Kirundo	0.00	1.00	15.3	0.17	88.6	9.6	1.8
Calima	1.00	1.33	3.3	0.03	89.2	9.3	1.5
Rubona 5	1.33	1.00	4.0	0.04	92.7	6.3	1.0
Ikinimba	1.00	1.00	31.3	0.41	88.9	3.6	7.5
Kilyumukwe	0.67	1.33	20.8	0.24	92.4	4.0	3.6
A 197	1.00	1.33	18.0	0.23	86.8	7.2	6.0
Canadian Wonder	0.00	1.00	9.3	0.11	95.2	2.7	2.1
Muhinga	0.33	1.00	18.7	0.24	84.7	9.1	6.2
PVA 880	1.00	1.33	12.7	0.20	91.5	4.4	4.1
PVA 563	0.00	1.33	12.0	0.15	94.9	3.6	1.6
G 12470	0.67	1.00	30.0	0.51	89.5	7.3	3.2
BAC 76	0.67	1.00	13.3	0.19	84.7	13.0	2.3
Mean	0.64	1.15	17.7	0.24	87.8	8.5	3.6
S.E. ±	0.525	0.212	5.67	0.077	3.02	2.45	1.33
C.V. (%)	142.0	32.0	55.6	56.0	6.0	49.7	63.1
Significance	NS	NS	**	***	*	***	**

Table 27. Agronomic and yield data for entries in AFBYAN (Inoculated) at Selian in 1989.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m²	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie		3.67	42.3		61.0	315.4	4.94	0.231	3587
Red Wolaita		4.00	44.0		54.3	235.2	4.49	0.315	3293
PVA 1272		5.33	42.7		55.0	171.7	2.66	0.546	2407
G 13671		4.00	41.7		59.7	208.7	3.20	0.593	3548
G 2815		3.67	44.0		52.7	213.0	4.21	0.436	3896
T-3		5.00	45.7		53.3	199.9	5.80	0.289	3324
T-23		4.00	40.0		55.7	140.1	2.75	0.663	2498
Kabanira		4.67	43.7		53.3	206.2	2.84	0.483	2681
K-20		3.67	43.3		63.0	273.9	2.84	0.414	2924
ZPV-292		5.00	44.3		60.7	148.3	4.15	0.599	3615
Carioca		6.33	43.0		43.7	280.9	4.67	0.307	3777
Masai Red		4.67	41.3		61.0	214.2	4.49	0.343	3178
Urubonobono		5.33	40.3		55.0	212.5	3.93	0.407	3344
Kirundo		4.33	42.3		55.0	150.6	3.82	0.522	2989
Calima		5.33	38.0		53.7	115.5	2.86	0.679	2238
Rubona 5		4.00	39.7		63.0	218.9	2.84	0.547	3366
Ikiniaba		3.67	35.0		62.3	247.1	2.97	0.605	4290
Kilyumukwe		5.00	35.7		47.0	166.5	2.45	0.655	2655
A 197		4.33	39.7		55.7	138.5	2.78	0.709	2685
Canadian Wonder		5.00	35.7		47.3	112.6	3.05	0.263	2096
Muhinga		4.33	38.0		62.3	187.3	3.27	0.419	2532
PVA 880		5.00	38.7		52.7	129.8	3.24	0.550	2292
PVA 563		4.33	44.3		61.3	150.1	3.36	0.588	2954
G 12470		4.00	43.0		62.3	140.3	3.02	0.769	3074
BAC 76		6.00	43.7		62.7	339.0	5.22	0.230	4009
Mean		4.59	41.2		56.5	196.7	3.59	0.503	3090
S.E. ±		0.920	2.08		3.51	20.14	0.348	0.0606	178.1
C.V. (%)		19.6	8.7		10.7	17.7	16.8	20.7	10.0
Significance		*	*		**	***	***	***	***

Table 28. Pest damage scores of entries in AFBYAN (Inoculated) at Selian in 1989.

Entry names	Per cent pods holed	Holes /pod	Per cent clean seeds	Per cent shrivelled seeds	Per cent eaten seeds
Black Dessie	16.7	0.20	94.8	3.5	1.6
Red Wolaita	23.3	0.26	88.1	8.0	3.9
PVA 1272	16.0	0.24	90.1	7.1	2.9
G 13671	23.0	0.36	86.9	9.9	3.2
G 2816	13.3	0.13	92.1	6.2	1.8
T-3	15.3	0.17	92.9	4.5	2.6
T-23	13.3	0.17	97.1	1.5	1.4
Kabanima	29.3	0.31	92.9	3.0	4.1
K-20	18.7	0.21	88.9	7.7	3.4
ZPV-292	41.3	0.63	94.5	2.6	2.9
Carioca	17.3	0.26	90.7	5.4	3.9
Masai Red	18.0	0.25	90.6	4.2	5.2
Urubonobono	21.7	0.27	79.8	14.8	5.4
Kirundo	20.1	0.20	91.6	4.3	4.1
Calima	16.2	0.19	96.2	1.6	2.2
Rubona 5	15.6	0.18	93.3	5.8	0.9
Ikinimba	22.7	0.38	79.7	12.5	7.8
Kilyumukwe	23.8	0.32	92.6	3.1	4.4
A 197	24.8	0.25	90.7	2.0	7.3
Canadian Wonder	14.7	0.17	85.5	7.3	7.2
Muhinga	36.0	0.48	89.9	3.2	6.9
PVA 880	17.3	0.20	96.3	1.9	1.8
PVA 563	17.9	0.23	89.8	5.3	4.9
G 12470	16.4	0.23	91.2	6.0	2.8
BAC 76	10.6	0.11	95.5	2.7	1.9
Mean	20.1	0.26	90.9	5.4	3.8
S.E. ±	6.02	0.089	2.67	2.60	1.31
C.V. (%)	51.8	60.3	5.1	83.9	60.0
Significance	NS	NS	**	NS	**

Table 29. Agronomic and yield data for entries in AFBYAN I at Irente in 1989.

Entry names	Canopy height (cm)	Canopy width	DFF	DM	Stand at harvest	Pods/ m^2	Seeds/ pod	Seed size (g/seed)	Seed yield (kg/ha)
Black Dessie		7.00			101.0	104.5	4.33	0.174	778
Red Wolaita		4.00			108.3	85.8	3.77	0.222	713
PVA 1272		6.33			118.3	81.8	1.78	0.572	822
G 13671		2.00			120.7	78.8	3.01	0.393	939
G 2816		5.00			111.0	106.4	3.03	0.351	1193
T-3		3.67			108.0	100.6	4.72	0.215	1022
T-23		4.00			88.3	69.9	2.33	0.566	920
Kabanima		5.00			108.7	82.5	2.01	0.459	766
K-20		5.67			108.7	59.5	2.43	0.522	756
ZPV-292		7.67			101.7	36 9	2.25	0.392	344
Carioca		3.00			117.3	73.7	3.31	0.227	528
Masai Red		2.67			118.7	95.3	3.71	0.255	897
Urubonobono		3.00			119.3	92.8	2.91	0.405	1107
Kirundo		6.67			111.0	44.4	2.35	0.465	488
Calima		6.00			131.0	54.3	2.99	0.521	826
Rubona 5		3.33			115.7	72.5	2.98	0.622	1151
Ikinimba		7.33			112.3	53.4	4.36	0.380	878
Kilyumukwe		6.33			106.0	51.8	2.35	0.643	789
A 197		6.00			105.7	57.8	2.95	0.480	732
Canadian Wonder		5.33			113.0	54.8	2.11	0.514	618
Muhinga		5.00			109.0	52.8	2.45	0.469	607
PVA 880		5.67			114.3	55.3	2.47	0.553	766
PVA 563		5.67			109.3	52.7	2.65	0.578	811
G 12470		2.00			116.0	63.4	2.45	0.812	1306
BAC 76		8.67			116.3	70.9	2.87	0.349	640
Mean		5.08			111.6	70.1	2.90	0.446	816
S.E. ±		0.993			9.33	13.25	0.370	0.0483	169.8
C.V. (%)		33.9			14.5	32.7	22.1	18.7	36.1
Significance		***			NS	**	***	***	*

Table 30. Disease scores of entries in AFBYAN I at Irente in 1989.

Entry names	Anth	ALS	Alt	AB	RR	Rust	WB	FLS	CBB	HB	BCMV	BR
Black Dessie		3.67		1.00		1.00		3.00	4.00			
Red Wolaita		5.00		1.67		1.33		4.33	2.67			
PVA 1272		4.00		1.33		1.00		3.00	3.67			
G 13671		3.00		2.33		1.00		3.67	2.67			
G 2816		2.00		1.33		1.00		4.00	3.33			
T-3		4.67		1.00		2.33		3.00	3.33			
T-23		4.67		1.33		1.33		3.00	3.67			
Kabanima		3.00		1.00		1.00		2.33	2.67			
K-20		4.00		1.00		1.00		2.33	3.00			
IPV-292		4.67		1.00		1.00		2.33	4.00			
Carioca		3.33		1.00		1.00		4.00	2.33			
Masai Red		4.67		1.00		2.00		4.00	3.67			
Urubonobono		3.67		1.33		1.00		3.33	3.00			
Kirundo		4.00		2.33		1.00		3.67	4.00			
Calima		5.00		3.00		1.00		3.67	4.00			
Rubona 5		4.00		1.00		1.00		3.67	3.67			
Ikinimba		4.33		1.00		1.00		3.33	4.00			
Kilyumukwe		4.00		1.33		1.00		3.67	4.00			
A 197		4.67		3.67		1.00		3.67	3.00			
Canadian Wonder		4.67		1.33		1.00		3.67	4.33			
Muhinga		4.00		1.00		1.00		3.33	3.33			
PVA 880		4.33		1.33		1.00		3.33	2.67			
PVA 563		3.67		1.00		1.00		3.00	3.00			
G 12470		4.00		1.00		1.00		4.00	2.67			
BAC 76		2.67		1.00		1.00		4.00	2.33			
Mean		3.99		1.41		1.12		3.41	3.32			
S.E. ±		0.314		0.317		0.160		0.499	0.515			
C.V. (%)		13.6		38.8		24.7		25.3	26.9			
Significance		***		***		***		NS	NS			

Table 31. Pest damage scores of entries in AFBYAN I at Irente in 1989.

Entry names	Per cent pods holed	Holes /pod	Per cent clean seeds	Per cent shrivelled seeds	Per cent eaten seeds
Black Dessie	2.0	0.02	66.2	33.0	0.8
Red Wolaita	0.7	0.01	83.0	17.0	0.0
PVA 1272	2.7	0.03	83.4	15.0	1.6
G 13671	0.7	0.01	8.7	91.3	0.0
G 2816	3.3	0.03	15.2	84.4	0.4
T-3	0.0	0.00	82.1	17.9	0.0
T-23	2.0	0.02	85.1	14.1	0.8
Kabanima	0.0	0.00	79.7	20.3	0.0
K-20	1.1	0.02	85.6	14.0	0.4
ZPV-292	0.7	0.01	83.5	16.2	0.3
Carioca	1.3	0.01	28.3	71.1	0.6
Masai Red	2.7	0.03	76.9	22.3	0.8
Urubonobono	2.0	0.02	86.0	13.0	1.0
Kirundo	0.0	0.00	78.2	21.8	0.0
Calima	0.0	0.00	89.8	10.2	0.0
Rubona 5	3.3	0.03	85.4	13.8	0.8
Ikinimba	3.3	0.04	84.2	15.2	0.6
Kilyumukwe	5.3	0.05	84.5	13.2	2.3
A 197	2.0	0.03	87.4	11.9	0.8
Canadian Wonder	2.0	0.02	68.6	30.6	0.8
Muhinga	3.3	0.04	93.6	5.6	0.8
PVA 880	1.3	0.01	84.7	14.8	0.6
PVA 563	1.3	0.01	92.5	7.0	0.5
G 12470	1.3	0.01	90.3	9.7	0.0
BAC 76	1.3	0.01	30.5	69.5	0.0
Mean	1.8	0.02	73.3	26.1	0.5
S.E. ±	1.35	0.018	5.68	5.69	0.44
C.V. (%)	133.2	137.6	13.4	37.8	140.2
Significance	NS	NS	***	***	NS

Table 32. Correlation coefficients ($x10^{-2}$) between predicted values of plant characters and seed yields in AFBYAN I between 1986 and 1989.

	NEL 87	FIF 88	KAC 7F	KAW 6S	KAW 7F	KIS 7F	NUL 7F	NSK 87	NSK 88	NBA 88	SEL 89	SEL 89B	IRE 89
Plant characters and disease reactions													
Canopy height	22*	40**	16	-38**	-9	-	66**	13	50**	10	-14	5	-
Canopy width	-45**	-64**	-17	-28*	-28*	-10	-73**	22*	-50**	-28*	-29*	-67**	-
DFF	8	-1	-46**	9	41**	35**	11	-15	6	12	36**	31**	-
Stand (harvest)	43**	31**	-15	43**	-8	-	40**	-12	46**	10	-20	25*	-
PM	-18	13	-6	-	31**	-	31**	-32**	-	-	53**	-	-
Anthracnose	-	-13	5	20	-	-10	-2	-	-	-	-	-	-
ALS	-	-	23*	-15	-	1	20	-	-43**	-31**	-48**	-	-16
Rust	-	-	9	-19	-	-5	24*	-	-	2	-55**	-	15
CBB	-10	-	-10	18	-	-17	-	-28*	4	-14	18	-	-218
BCMV	-	-	-	15	-	-12	-	-39**	-11	-17	-	-	-
AB	-	-	34**	-	-	-	51**	-	-	-2	-		-14
WM	-	-	-	-	-	-	-	-	-	-	-	-	29**
FLS	-	-	-	-	-	23*	-	-	-	-	-4	-	-
HB	-	-	-3	-	-	-	-	-	-	-	-	-	-
ALT	-	-	-	-	-	-	-	-	-35**	-	-	-	-
WB	-	-	-	-	-	-	-	-	-53**	-	-	-	-
Sclh	-	-	-	-	-	-	-	-	-	-30*	-	-	-
Components of yield													
Pods/m^2	-	62**	59**	53**	80**	54**	-	71**	90**	21*	49**	66**	42**
Seeds/pod	-	26*	7	27*	39**	-6	-	28*	56**	38**	30**	51**	23*
Seed size	-	-13	11	-18	-36**	7	-	6	-14	3	-15	-42**	18

Table 33. Multiple regression coefficients for predicted values of plant characters and seed yields in AFBYAN I between 1986 and 1989.

	MEL 87	FIF 88	KAC 7F	KAW 6S	KAW 7F	KIS 7F	MUL 7F	MSK 87	MSK 88	MBA 88	SEL 89	SEL 89B	IRE 89
Plant characters and disease reactions													
CH	17.8	-12.4	-13.7	-40.1*	-12.4	-	-28.7*	-5.0	16.2*	7.0	-20.7	-7.4	-
CW	-118.5***	-817.5***	-161.0*	-74.3	-52.1	-48.0	-473.2***	27.4	-37.2	-74.9***	196.1	-432.2***	-
DFF	-6.0	55.3	-42.5**	-33.9	169.1**	-	6.1	-5.1	-1.9	-2.1	-78.1	13.9	-
STH	11.0***	14.7	-3.3	9.4**	7.4*	7.2*	4.7	-9.0	-78.5	59.9	-44.1	24.3*	-
DH	-19.5	-39.0*	-20.7	-	14.9	-	4.1	-7.2	-	-	47.3	-	-
Anth	-	110.2	-106.7	152.0	-	-239.2	-335.3**	-	-	-	-	-	-
ALS	-	-	-24.2	-91.5	-	55.1	-237.8*	-	-21.0	-38.9**	-104.0*	-	-61.5
Rust	-	-	-7.5	-62.6	-	-13.7	213.9**	-	-	31.0	-169.3***	-	151.0
CBD	42.6	-	-47.5	49.5	-	-22.7	-	-188.4	-8.9	-64.4**	-56.2	-	-40.8
BCMV	-	-	-	-105.4	-	-16.4	-	-79.0	-8.3	-26.3***	-	-	-
AB	-	-	141.5*	-	-	-	65.8	-	-	8.2	-	-	-61.8
WM	-	-	-	-	-	-	-	-	-	-	-	-	-
FLS	-	-	-	-	-	91.3	-	-	-	-	-248.3***	-	132.6*
HB	-	-	-38.5	-	-	-	-	-	-	-	-	-	-
ALT	-	-	-	-	-	-	-	-	-75.2**	-	-	-	-
WR	-	-	-	-	-	-	-	-	-50.9**	-	-	-	-
Scab	-	-	-	-	-	-	-	-	-	-21.0*	-	-	-
R^2 (x10²)	40***	50***	43***	37***	24***	23*	66***	26**	43***	50***	57***	51***	15*
Components of yield													
PM2	-	15.5***	15.6***	11.4***	9.4***	11.7***	-	10.1***	6.9***	5.0***	9.7***	11.4***	10.4**
SPF	-	376.8**	365.8***	362.4***	135.8*	142.7	-	253.9**	55.4**	86.9***	816.2***	582.4***	290.7**
SW	-	5693.9***	[illegible]	2400.7***	2005.4**	1584.1**	-	3000.0***	947.9***	728.9***	6622.1***	4533.0***	1812.9**
R^2 (x10²)	-	51***	69***	43***	72***	42***	-	64***	86***	51***	59***	67***	50***

APPENDIX 1

DESIGN AND LAYOUT

Design: 5 x 5 triple lattice

No. of varieties or treatments: 25

No. of reps: 3

Plot size: 4 rows x 4 m

Spacing: according to local practice

Paths: paths across the rows from 50 to 100 cm wide according to convenience - do not leave empty rows between plots

Discards: plant at least one row of your local variety along each edge of the trial

Crop management - sowing dates; fertilizers; disease, pest and weed control; harvesting - should be according to local practice.

APPENDIX 2

PLANT CHARACTER DATA

Records should be taken on every plot. Columns are provided on the data sheets for all the data we are requesting. They are:

Vegetative growth.

1. Plant height = Sheet A Column 3. Measure plant height to the nearest 10 cm at flowering. This can be done simply by resting one end of a meter rule or stick marked every 10 cm on the ground in a part of each plot with average growth for that plot and recording the height to the top of the plant canopy. Note - avoid disturbing the plant canopy during measuring - it is not necessary to pull out the branches to measure their actual length - we merely wish to obtain a rough estimate of growth.

2. Ground cover = Sheet A Column 4. Record the extent of ground cover by the plant canopy in each plot as follows:

Score	Ground cover %
1	100
3	75
5	50
7	25
9	less than 25

Days to 50% flowering = Sheet A Column 5

Record the number of days from emergence to when 50% of the plants in the center two rows of each plot have reached flowering.

Stand count = Sheet A Column 6

Just before harvest, count the number of plants in the center two rows of each plot.

Days to maturity = Sheet A Column 7

Record the number of days from emergence to when approximately 90% of all pods have dried i.e. changed colour completely from green to yellow.

Pod sample - Sheet B

Before final harvest, take a sample of 30 pods from the two center rows of each plot. Sample from all parts of the rows and from bottom to top of the plants. Proceed as follows with each sample:

1. Dry the pods
2. Weigh the pods (to nearest gram) - Sheet B Column 3.
3. Thresh the pods
4. Weigh the seeds (to nearest gram) - Sheet B Column 4.
5. Count the seeds - Sheet B Column 5.

Total plot yield - Sheet B Column 6

Harvest all four rows of each plot. Dry, thresh and weigh to nearest gram.

Diseases and insect scores - Sheet C Columns 3 to 9

Record the symptoms of all the diseases, pests and other conditions observed in the trial on each plot. These should be done when it is considered that their expressions are most clear.

For conditions which result in individual plants being affected or killed while others escape damage (for example root and stem rots or beanfly), count the number of affected plants in the two center rows of each plot.

For conditions where parts of plants are affected with varying degrees of severity, score the damage on a scale of 1 to 9, where 1 means no symptoms and 9 means death or total defoliation.

Enter the names of the diseases, pests and other conditions in the blank spaces at the heads of the columns in data sheet C. CIAT staff will visit each trial during the season to assist with identification of and rating for disease and pest problems.

ENVIRONMENTAL DATA

Please enter the following environmental records on Sheets D.

1. Location
2. Planting date
3. Latitude
4. Altitude
5. Soil depth - please give an estimate of soil depth on the experimental site.
6. Daily rainfall - from one month prior to sowing to harvest.
7. Daily maximum temperature - from sowing to harvest.
8. Daily minimum temperature - from sowing to harvest.

9. Soil sample - just before sowing, take a soil sample of about 1 kilogram from the area of the experiment as follows. Take 5 samples from each replicate (i.e. one from each sub block) from the top 25-50 cm of soil. Dry, mix and take the amount of 1 kg. Retain the sample in a dry place. The address to which the sample should be sent will be provided in due course.

The following determinations are intended as routine:

Permanent wilting point
Soil water potential
Soil texture - clay, sand, silt
Soil pH
Cation exchange capacity
Macronutrients - N, P, K.
Minor elements - Ca, Mg, S
Micronutrients - B, Zn, Al, Mn

If you are interested in any other analyses, please indicate when you send the soil sample.

APPENDIX 3

List of collaborating institutions - AFBYAN I

Melkassa	I.A.R. Station, Melkassa, P.O. Box 103, Nazret, Ethiopia.
Fifamanor	Fifamanor, B.P. 198, Antsirabe 110, Madagascar.
Kachwekano, Kawanda, Kisindi	Kawanda Research Station, P.O. Box 7065, Kampala, Uganda.
Rubona	ISAR Station, Rubona, B.P. 138, Butare, Rwanda.
Mulungu	INERA, Mulungu, DS Bukavu, Kivu, Zaire.
Msekera, Mbala	EPAD Project, Msekera Regional Research Station, P.O. Box 510069, Chipata, Zambia.
Selian, Irente	TARO Station, Lyamungu, P.O. Box 3004, Moshi, Tanzania.