COWPEA BREEDING IN SENEGAL : RECENT DEVELOPMENTS[1]

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I - INTRODUCTION

Plant breeding has been defined as the current phase of crop evolution where artificial selection is predominant (Simmonds, 1979). There are many choices to be made in a breeding program. An important one is the choice of parental germplasm to include in the program. As a result of crop evolution and of plant breeding, local adaptation is always present. Rapid and more reliable progress can be achieved working with locally adapted parental material. This will include; Strains which, from performance in collection offer local adaptation or specific desired characters, and locally successful varieties. Selection of parents cornes after the first decisions which are definition of objectives. Objectives are defined on the basis of knowledge of the environment or the group of similar environnient of interest and of the genetic features of the crop.

From a collection made in the fifties and subsequent yield trials, very adapted and high yielding materials have been identified ; Among these, are 58-57 and "Pout" a photosensitive line (Sene, 1971 ; Cisse, 1985a) the former has been released as a variety and was used to develop "Ndiambour", while the latter has mainly served to create another successful variety ; "Mougne".

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II - OBJECTIVES

2.1 - Drought resistance

Cowpea is grown mainly in the North central area of Senegal this correspond to the Louga, and part of Diourbel regions. Rainfall has varied between 151 to 381 mm from 1970 to 1985 with 13 years out of 16 averaging below 300 mm and 4 not reaching 200 mm (Dancette, 1984). Along with the low rainfall, the length of the wet season has become as low as 45-60 days. Drought is then prevalent in the area where 70 % of cowpea acreage and 60 % of the production are realized.

Obtaining drought resistant varieties has evidently been considered as a high priority objectiv (Cisse, 1985b, 1986). Appropriate adaptation of crop varieties to the modal length of the period available for growth, wether determined by climate or by cultural practices, is of the greatest importance (Bunting, 1985). Biochemical or biophysical attributes which enable plants to withstand the consequences of diurnal or Longer periods of water shortage are important also, but the attributes relating to time and space are still more important according to Bunting. The relativ success of the 1985 CB5 program in Senegal, appeared to support this view (Mersch, 1985). Rainfall totalled 208 mm in the Louga station and was recorded between July 20 and September 15. The program success was essentially due to the short cycle of the variety CB5 (60 days). Yield trials have previously shown that earliness confers better adaptation in the semi-arid zones (Cisse, 1985).

Regression techniques (Finlay & Wilkinson 1963), when applied to the "CILSS project" 4 years yield trial data have shown, that 58-57, Mougne, TN 88-63, gorom gorom are stable varieties in Senegal with high yield potential but are medium to late maturing (Cisse, 1985).

One of the breeding program objectives was to improve 58-57 and Mougne for earliness ; several crosses were then made. Some of the early parents used are Bambey 21, CB5, IT82E-60, KVU69, and TVU 1174.

2.2 - Insects resistance

Bruchids (Callosobruchus maculatus) is the most important storage pest of cowpea. The damage is done by larvae feeding inside the seed. It is cstimated that up to 30 per cent loss in weight with up to 70 per cent of the infested seed becoming unfit for consumption can be enregistred in a 6 month storage period (Singh, 1985).

The released varieties (58-57', Mougne, Ndiambour, CB5) are all susceptible to bruchid. The pest is also continuously present in all the cowpea production area and is the single most limiting factor in successful storage. Resistance in these conditions may then afford significant advantages.

From 1984 a breeding program was initiated to improve 58-57 and Mougne for bruchid resistance. The line IT81D-1037 has been used as resistance source. Yhe germplasm collection at Bambey was screened for resistance to this pest, none of the accessions did have an acceptable reaction.

Three insect species can cause important damage to cowpea in the field (Amsacta, Aphids, Thrips).

Hairy caterpillar (Amsacta moloneyi) which is specific to Senegal can completely destroy seedlings of cowpea, but causes little economic damage to older plants. A germpiasm accessions (58-53) has been reported as having some field resistance to this pest (Sene, 1971). This has not been confirmed and any other source of resistance has not been identified due to unadequate screening techniques.

Aphids (Aphis craccivora) were observed for the first time in 1984, and have become important the following years. Aphids primarily infest seed-lings, at a later stage pods can also be infested. Large populations can reduce yield, and in extreme cases the plant dies (Singh & Jackai, **1985).**

The reported aphid resistant germplasm has been tested against the local pest population. Two lines (TVU 3000, IT83-742-13) are used as resistant parents in crosses with the susceptible local varieties (58-57, Mougne, B21, CB5).

Flower thrips (TaenioThrips sjostedti) damage was observed every year at the Nioro area, in the wetter part of Senegal. Much less damage due to flower thrips has been observed in the drier parts (Bambey.- Louga area). The germplasm collection was screened for resistance to flower thrips mainly at Nioro. The screening method consists of sowing guard rows 10-15 days earlier and around the test plots, this is intended to build up flower thrips population, and the experiment is unsprayed. Resistance is evaluated based upon the relative number of pods produced and upon the thrips population dynamics. Known resistance source (TVX **3236)** is also used in cross with local susceptible varieties.

2.3 - Diseases resistance

Survey of diseases, in the main cowpea production area has shown that are prevalent ; mosaic viruses (cowpea Aphid borne mosaic and cucumber mosaic), bacterial blight (caused by Xanthomonas campestris pv. Vignicola) ; bacterial pustule (a strain of the bacterial blight organism), cercospora leaf spot (cercospora cruenta) ashy stem blight (Macrophomina phaseolina) lamb's Tail pod rot (Choanephora cucurbitarum), powdery mildew (Erysiphe polygoni), web blight (Rhizoctonia solani) (Patel, 1984-85-86-88, Gaikwad, 1987).

Mosaic are very widespread and most severe in the principal variety (58-57) while Bambey 21 and TVX 3236 are consistently free of mosaic for the last 4-5 years. Mougne and Ndiambour show mild mosaic symptoms. Yield loss due to virus diseases was estimated at 20 % (Gaikwad, 1988).

Bacterial blight is most severe in B21 and CB5, but field resistant Ndiambour and 58-57 show some blight in leaves. Yield loss due to bacterial blight on Bambey 21 and CB5 can be up to 40 % (Gaikwad, 1988).

Bacterial pustule disease is observed on all varieties CB5, B21, Ndiambour, Mougne, 58-57.

Striga (Striga gesneroides) previously restricted to small areas, is now encountered in several villages.

Cercospora leaf spot is frequently encountered in the cowpea area while Ashy stem blight is more restricted and appears in places where plants suffer from some water stress (Patel, 1988).

Breeding activites have concerned particularly mosaic virus diseases and bacterial blight.

III - RESULTS

3.1. - Yield potential and crop adaptation

Selection has been done from the different crosses made to achieve the objectives defined. Up to now 456 lines have been yield tested. The procedure consist of running preliminary yield trials at one location ; Bambey. The experimental designs used are randomized complet blocks with 2 replications. High yielding lines (Better or as good as the local checks) with good agronomic attributes are afterwards introduced in advanced yield trials for 2 years. These trials are conducted in 4 stations and sub-stations (Bambey, Thilmakha, Louga, Ndiol) covering the main cowpea production area. Randomized complet hlock designs are also used but with 4 replications.

The 1986 and 1987 trials have shown that very high yielding lines have been obtained (Tables 1, 2, 3). This is confirmed by the 1988 results (Cisse, under press). Of particular interest is the line IS 86-275 which is as productive as the local variety 58-57 but is earlier, although the cross (58-57 x IT81D 1137) from which it is selected was intended to improve 58-57 for bruchid resistance. A nother high yielding and adapted line is IS86-283.

3.2 - Insect Resistance

The first objectiv of this topic, considered, was the improvement of the local varieties (58-57, Mougne, Bambey 21) for bruchid resistance. The resistant parents used were IT81D-1137 and IT81D-1032. The best promising lines obtained with bruchid resistance, as mentionned above are Is86-275, Is86-279, Is86-283 with respectively 21 %, 26,8 % and 36,4 % adult emergency. The variety 58-57 has 56,3 % adult emergency.

Lines with significantly lower thrips population than TVX 3236 have been identified from the germplasm collection (58-145, 58-1, 58-77) (Gahukar, 1986) and from crosses between 58-57, Mougne and TVX 3236 (Bal, 1987).

Several crosses with di'fferent combinaisons between 58-57, Mougne, Bambey 21, CB5 and aphid resistant lines (TVU 3000 ; IT83s-742-13 ; IT84E-1-108) have been obtained. About 382 F6, F5 single plants selection will next be screened for aphid resistance and yield tested.

3.3 - Disease resistance

The strategy so far followed is initial selection pressure for insect resistance and others superior agronomic traits and then screen the advanced lines against diseases. Generally large number of lines are retained for latter screening from crosses involving at least a known resistant parent to bacterial blight and/or aphid borne mosaic virus. This strategy has some drawbacks ; Among the three high yielding advanced breeding lines (F9 generation), Is 86-275 is a mixture of resistant and susceptible plants, IS86-279 was uniformly susceptible and IS86-283 is susceptible to moderately susceptible to virus disease. All the three promising lines have a heterogeneous reaction to bacterial blight. Single plant selection is made out of Is86-275 and Is 86-283 population. These plants are to be screened for bacterial blight, mosaic viruses and bruchid resistance.

It is clear that a more reliable approach is direct positive screening of segregating populations in early generations and continued at all generations (Patel, 1988).

Table 1 : Advanced yield trial 1.

Lines	Bambey - Thilmakha Seed (kg/ha)	Bambey - Thilmakha d.to Mat (j)	Bambey - Thilmakha Seed (kg/ha)	Bambey - Thilmakha d.to Mat (j)	Louga 100 seed weight (g)	Ndiol Seed (kg/ha)
IS86-239 N	1189.9	63.2	1393.3	65.2	15.3	132.5
58-57	1663.7	64.6	1371.6	67.b	12	390
IS86-283 N	1652.6	62.4	1280.9	67	22.7	
IS86-269 N	1616.4	64.2	1269.2	66.7	15.9	231.b 172.6
IS86-292 N	1596.6	64.2	1272.7	67.7	16.6	207.6
IS86-276 N	1542.9	62.9	1195.2	64.7	16	167.7
TVX 3236	1445.6	65.7	1105.4	62.8	11.6	102.5
IS86-310 N	1416.5	65	1161	67.6	18.5	119.3
IS86-245 N		66.5	1095.4	69	15.1	211.3
IS86-235 N	1399.31384.5	62.2	1052.2	64.4	18.3	145
IS86-247 N		66.6	1053.8	67.6	15.9	105.7
Mougne	1374.51332.5	62.2	1046.7	62.3	14.7	195
IS86-309 N	1297.9	63.2	1002.7	64.7	16.1	145
IS86-252 N	1279.4	61.2	1015.5	63.2	15.5	132.5
Mean ($\bar{x}$)	1485.2	63.9	1165.4	66.2	16	213.8
C.V. (%)	11.6	2.3	13.5	3.6	3.3	38.3
LSD 0,5	171.3	1.4	127.5	1.9	0.4	118.4

Table 2 : Advanced yield trial II.

Lines	Bambey-Thilmakha		Bambey-Thilmakha		Louga	Ndiémane			Ndiol
	Seed (kg/ha)	d.to Mat	Seed (kg/ha)	d.to Mat	100seed weight (g)	Seed (kg/ha)	d.to Mat	Dry Matter	Seed (kg/ha)
58-57	1394.2	64.6	1083.7	67.15	12.1	1075	65.2	3850	167.5
IS86-237N	1350.9	60.2	1025.6	61.;7	13.9	1250	59.5	2050	180.5
IS86-279N	1299.1	61.4	986.9	62.19	16.8	2081.9	58.5	2750	277.5
Mougne	1251.1	62.5	984.1	64.19	14.4	1110.5	59.5	3408	445
IS86-286N	1248.9	59.7	965.9	61.15	13.6	1550	60.2	2150	337.5
IS86- 299N	1239.5	62.1	943	63.;2	17.6	1218.61	56.9	3313.7	230
TVX 3236	1214.9	67.6	926.6	69.;2	11.3	1450	64	4350	323
IS86-259N	1205.6	63.2	937.6	65	20.9	1594.31	58.3	3430.9)	166.9
IS86-93 N	1129.6	65.1	919.7	65..1	20	1007.8,	60	3008.1	302.5
IS86-76 N	1094.6	64.5	833.9	65.1	14	778.41	60.5	3276.81	412.5
IS86-241N	1057.2	61.5	858.9	64.1	15.9	1000	60	3175	95
IS86-253N	11033	62.2	792.8	65	13.5	1500	58.7	2400	295
IS86-185N	1.009.6	57.6	785.6	60.3	10.6	i175	56.5	3025	382.5
IS86-217N	1007.7	55.4	813.5	57.5	13.5	1500	55.2	2900	315
IS86-114N	1006.5	58	779.3	60.5	12.3	1200	57.7	3375	185
IS86-2 N	945.9	57.4	768.1	59.7	14.6	1175	56.2	4025	172.5
IS86-168N	826.9	58.4	734.6	60.3	14.8	886.6	59.6	2821.3	237.5
IS86-224N	633.9	57.1	472.6	58.7	13.8	375	57	1725	110
Mean ($\bar{x}$)	1108.3	61	867.3	62.9	14.6	1392.3	66.5	3439.6	259
C.V. %	15.2	3.4	17.9	3.1	3.9	24.9	1.9	26.9	54.6
LSD 0.05	167.3	2	125.9	1.6	0.5	491.5	0.8	1321.4	200.8

Table 3 : Advanced yield trial III.

Lines	Bambey - Thilmakha		Bambey - Thilmakha - Louga		
	Seed (kg/ha)	d.to Matter	Seed (kg/ha)	d. to Mat.	100 seed weight (g)
IS86-275 N	1332	60.2	1196.3	61.6	16.6
58-57	1302.2	63.9	1105.6	65.4	12.1
TVX 3236	1281.9	64.5	1033.8	66	11.6
Mougne	1167.4	62.2	1019.9	63.8	14.9
IS86-63 N	1109.6	63	918.9	65	19.1
IS86-219 N	1080.9	56.1	845.6	58.9	13
IS86-248 N	1075.3	59.5	900.2	60.7 60.4	14.4
IS86-140 N	1036.2	59	965.8		12.3
IS86-191 N	1015.9	52.9	889.8	56.1	12.7
IS86-174 N	984.1	54.5	876.9	57.7	13.2
IS86-218 N	933.2	53.9	780.4	56.5	12.8
IS86-48 N	914.8	56.9			14.6
IS86-36 N Bambey 21	906.6	57.7	709.9 733.6	59.1 61.4	12.6
	726.6	58.9	626.1		18.1
IS86-121 N	703.9	56.6	527.6	59.4	11.4
IS86-170 N	619.6	55.2	496.4	58.7	14.1
Mean ($\bar{x}$)	**1011.9**	58.4	851.7	60.6	13.9
C.V. %	19.6	2.8	25.2	2.5	3.7
LSD 0.05	196.7	1.6	173.5	1.2	0.4

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