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Cowpea Variety Trials in Northwest Haiti

by

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REZIME

Rapò sa a se yon rezime kèk esèy ki te fè sou plizyè varyete pwa enkoni. Esèy yo te fèt nan Nòdwès peyi d Ayiti ant 1993 ak 1995 pa Pwojè PLUS la. Rezilta esèy sa yo montre ke ***plantè yo kapab ogmante rannman pwa enkoni anpil, e an menm tan ogmante tou kapasite konsèvasyon l. E yo ka fè sa, san yo pa sèvi ak pestisid, si yo chwazi yon varyete ki donnen byen epi ki gen rezistans a pès nou jwenn nan estokaj. Adopsyon varyete sa yo ka kontribye a yon ogmantasyon revni plantè yo epi yon amelyorasyon dirabilite sistèm pwodiksyon an.*** Varyete ki reziste a pès ensèk brich nan estokaj la ofri yon solisyon bon mache e san risk pou sante plantè ayisyen ki pa ka peye pou pestisid. USAID/Ayiti ak lòt bayè de fon yo ka fè yon kontribisyon enpòtan pou agrikilti dirab nan zòn ki pwodwi pwa enkoni an Ayiti, si bayè de fon yo apiye efò pou miltipliye ak distribye semans varyete pwa enkoni seleksyone, epi si yo apiye lòt esèy sou varyete pwa enkoni ak etid ki gen pou bi rezolisyon pwoblèm pès ensèk yo.

Pwa enkoni (*Vigna unguiculata*) se yon danre enpòtan pou zòn ki sèk yo an Ayiti, paske li ka tolere sechrès ak feblès sòl pi byen pase anpil lòt kalite pwa. Youn nan pi gwo pwoblèm ki genyen nan pwa enkoni, se jan l siseptib a pès ensèk, tankou brich ("bruche" an franse; yon egzanp se *Callosbruchus maculatus*) ki konn fin manje li nan estokaj. Ak varyete lokal ayisyen, brich se lakòz yon gwo pèt nan pwa enkoni ki estoke, ni pou manje ni pou semans. Enstiti Entènasyonal pou Agrikilti Twopikal (IITA) gen yon pwogram pou kwaze pwa enkoni pou bay li rezistans a brich ak lòt pès ensèk ak maladi. Nou te jwenn kèk varyete pwa enkoni nan IITA, epi nou te klase yo an gwoup: de gwoup varyete ki donnen bonnè anpil anpil, ak yon gwoup varyete ki donnen bonnè. Nou te teste tout varyete sa yo nan esèy sou teren nan Nòdwès Ayiti, ansanm ak youn ou de varyete lokal. Tout varyete te kiltive san aplikasyon ni angre ni ensektisid.

An jeneral, pwa enkoni yo pa t donnen byen, akòz sechrès ak lòt pwoblèm. Nan 10 esèy ki te demontre yon diferans estatistik enpòtan, varyete IITA te donnen pi byen pase varyete lokal yo nan senk esèy. Nan youn esèy IT87D-885 te donnen 900 kg ha^{-1}, preske 600 kg plis pase varyete lokal la. Nan kèk lòt esèy, varyete entwodwi yo te donnen pi byen pase varyete lokal la, men pa t gen yon diferans estatistik enpòtan. Pa t gen yon ka kote varyete lokal la te donnen pi byen pase tout varyete entwodwi yo yon fason estatistikman enpòtan.

Semans pwa ki te keyi nan de esèy te estoke nan sache papye sou yon etajè a Bab Panyòl pou teste rezistans yo a pès nou jwenn nan estokaj. Nan chak esèy, varyete lokal la te soufri pi plis donmaj (100% grenn yo te donmaje) ak pi plis pèt nan pwa grenn yo apre 6 mwa edmi estokaj. Nan varyete ki donnen bonnè anpil anpil yo, IT89D-374-57 te soufri mwens donmaj, epi pèt nan pwa grenn li yo te redwi a mwatye pèt varyete lokal la. Nan varyete ki donnen bonnè, IT89D-792 te soufri mwens pèt nan pwa grenn yo epi IT87D-670-2 te gen pi piti pousantaj grenn donmaje. Donmaj varyete lokal la te 15 fwa ak 20 fwa pi plis pase de varyete sa yo.

Nan Bonbadopolis, nou te mande kèk plantè evalye pèfòmans varyete nou te teste yo. Yo te chwazi kat varyete ki siperyè, sou kritè rannman, tan pou varyete a donnen, ak gwosè grenn yo:

IT87D-879-1, IT87D-885, CNCX252-IE ak IT86D-444. Plantè yo pa t gen tout varyete yo a dispozisyon yo pou evalyasyon.

Tab anba a bay enfòmasyon sou varyete ki te demontre pi bon pèfòmans. Varyete sa yo se sa yo ki te donnen pi byen pase varyete lokal la nan kondisyon anviwònman difisil ki genyen nan Nòdwès, sa ki te soufri mwens donmaj brich, ak sa ke plantè aysisyen yo te prefere akòz kalite grenn yo ak pèfòmans agrikòl. Malgre enfòmasyon nou an pa konplèt, nou kapab identifye kèk varyete ki genlè ap bon dapre kritè nou te bay isit yo. Kat varyete nan chak gwoup rekòt te eksepsyonnèl nan omwen de sou twa kritè yo.

Varyete pwa enkoni ki siperyè, dapre rannman, rezistans a pès, oubyen preferans plantè nan esèy nan Nòdwès Ayiti.				
Gwoup Rekòt	**Varyete**	**Rannman Siperyè†**	**Rezistans Siperyè a Pès nan Estokaj†**	**Preferans Plantè‡**
Donnen Bonnè Anpil Anpil	IT87D-885	X	X	X
	IT87D-879-1	X	PGE	X
	IT89KD-374-57	X	X	
	IT87KD-941-1	X	X	
	IT90K-77	X		PGE
	IT86D-719	X		PGE
	IT90-284-2	X		PGE
Donnen Bonnè	IT86D-444	X	X	X
	IT87D-670-2	X	X	PGE
	IT89KD-245-1	X	X	
	IT89KD-793	X	X	PGE
	IT89KD-391		X	
	IT89D-792		X	
	CNCX252-IE		PGE	X

†Ta dwè siperyè estatistikman a varyete lokal la nan omwen youn esèy. Si li pa gen yon "X", sa pa nesesèman vle di ke varyete a pa donnen byen.
‡Dapre yon entèvyou avèk plantè nan Bonbadopolis, 1994.
PGE. Pa gen enfòmasyon sou varyete sa a.
Note: Koulè gri endike varyete ki eksepsyonnèl yo. "X" fonse endike se li ki te pi bon nan omwen youn nan esèy yo.

Rekòmandasyon:

- Nou ta dwè miltipliye varyete pwa enkoni ki pi bon, epi distribye yo bay plantè nan Nòdwès, ansanm ak Ministè Agrikilti ak òganizasyon non-gouvènmantal (ONG) yo pou yo ka teste yo nan jaden nan lòt rejyon peyi d Ayiti.
- Nou ta dwè fè esèy estokaj sou varyete ki patko teste pou rezistans a brich nan estokaj, pou nou ka konplete enfòmasyon nou sou varyete sa yo.

- Nou ta dwè fè lòt esèy sou rannman, an patikilye kote movèz kondisyon kiltivasyon pa t pèmèt nou fè bon jan evalyasyon. Nou ta dwè fè esèy tou pou konpare varyete ki te pi bon nan touletwa gwoup yo, ansanm ak lòt varyete ki soti nan lòt kote ki kapab bon.
- Nou ta dwè ranmase enfòmasyon sou preferans konsomatè ayisyen vizavi pwa enkoni, epi sou evalyasyon konsomatè ak plantè sou varyete ki pi bon yo, pou nou ka pi byen fè rekòmandasyon pou plantè kliyan ak konsomatè.
- Yon moun ki fòme nan entomoloji (etid ti bèt) ta dwè etidye pwoblèm pès ensèk ki gen yon enpak sou rannman pwa enkoni an Ayiti, pou idantifye ki pès ki pi enpòtan, ki nivo enfestasyon ak donmaj, epi nan ki faz yo atake pwa enkoni. Lè kiltivasyon pwa enkoni ogmante, pès ensèk nan jaden ap vin pi gwo obstak a amelyorasyon rannman. Nou ta dwè devlope yon estrateji pou rezoud pwoblèm sa yo, yon estrateji ki baze sou konnesans ki kalite ensèk ki fè pi plis donmaj epi nan ki faz yo atake pwa enkoni yo.

EXECUTIVE SUMMARY

This report summarizes cowpea variety trials conducted in Northwest Haiti between 1993 and 1995 by the Productive Land Use Systems Project. The results of these trials indicate that ***farmers can substantially increase cowpea yields and substantially increase shelf life without use of insecticide by adopting high-yielding varieties with resistance to seed storage pests. Adoption of these varieties can contribute to increased farmer income and increased sustainability of the food production system.*** Varieties with host plant resistance to storage weevils offer a low-cost, safe solution to Haitian farmers who cannot afford the cost of pesticides. The USAID/Haiti mission and other donors can make a significant contribution to sustainable agriculture in cowpea-growing areas of Haiti by supporting the multiplication and distribution of seed of selected cowpea varieties, and by supporting cowpea variety testing and studies to address insect pest problems.

Cowpea (*Vigna unguiculata*), known locally as *pois inconnu*, is an important crop in drier areas of Haiti, with greater tolerance to drought and low soil fertility than crops such as common bean. One of the major problems with cowpea is its susceptibility to insect pests, among them, weevils that destroy the seed during storage. With local Haitian varieties, significant loss of food grain and seed occur in storage due to damage by weevils. The International Institute of Tropical Agriculture (IITA) has a program to breed cowpea for resistance to weevils, as well as to other insect pests and diseases. Cowpea varieties obtained from the International Institute of Tropical Agriculture were divided into two groups of extra early maturity varieties and one group of early maturity varieties and tested in field trials in Northwest Haiti, together with one or two local cowpea varieties. The crops were grown without input of fertilizer or insecticide.

Yields were generally low, due to drought, as well as other problems. Out of 10 trials in which statistically significant differences were recorded, IITA varieties gave yields superior to those of the local varieties in five trials. In one trial, IT87D-885 yielded 900 kg ha^{-1}, nearly 600 kg more than the local variety. In several more trials, higher yields were recorded for introduced varieties than for the local variety, but differences did not test significant. In no case did the local variety yield significantly higher than all introduced varieties.

Grain from two of the trials were stored in paper bags on shelves in Barbe Pagnole to test their resistance to storage pests. In each, the local variety had the greatest seed damage (100 % of seeds damaged) and greatest loss of seed weight after 6 ½ months storage. Among extra early maturity varieties, IT89D-374-57 suffered the least damage, and seed weight loss was reduced to half that of the local variety. Among early maturity varieties, IT89D-792 had the least weight loss and IT87D-670-2 had the least percentage seed damage. Damage to the local variety was 15 fold and 20 fold higher, respectively, than these two varieties.

At Bombardopolis, several farmers were asked to assess the performance of the varieties tested. Four varieties were selected as superior, based upon yield, early maturity and large seed size: IT87D-879-1, IT87D-885, CNCX252-IE and IT86D-444. Not all varieties were available to the farmers for assessment.

Information on the best performing varieties are summarized in the table, below. These include varieties that yielded more than the local variety in the extreme environmental conditions of Northwest Haiti, varieties least damaged by weevils and varieties preferred by Haitian farmers, because of grain quality and agronomic performance. Although our information is incomplete, we can identify varieties that appear promising based upon the criteria reported here. Four varieties in each maturity class were outstanding in at least two of the three criteria.

Superior cowpea varieties, based upon yield, resistance to pests or farmer preference in trials in Northwest Haiti.

Maturity Class	Variety	Superior Yield†	Superior Resistance to Storage Pests†	Farmer Preference‡
Extra Early	IT87D-885	X	X	X
	IT87D-879-1	**X**	NA	X
	IT89KD-374-57	**X**	**X**	
	IT87KD-941-1	X	X	
	IT90K-77	X		NA
	IT86D-719	X		NA
	IT90-284-2	X		NA
Early	IT86D-444	X	X	X
	IT87D-670-2	X	**X**	NA
	IT89KD-245-1	**X**	X	
	IT89KD-793	X	X	NA
	IT89KD-391		X	
	IT89D-792		**X**	
	CNCX252-IE		NA	X

†Must have been statistically superior to local variety in at least one test. Lack of an "X" does not necessarily mean that the variety does not produce good yields
‡Based on interview with farmers in Bombardopolis in 1994.
NA. Information not available on variety.
Note: Highlight indicates most outstanding varieties. Bold "X" indicates best in one or more trials.

Recommendations:

- The most promising cowpea varieties should be multiplied and distributed to farmers in the Northwest, and to the Ministry of Agriculture and non-governmental organizations (NGOs) for on-farm testing in other parts of Haiti.
- Storage tests should be conducted with those varieties whose resistance to storage weevils has not yet been reported, in order to complete gaps in our information on these varieties.
- Additional yield trials should be conducted, especially where poor growing conditions did not allow very conclusive assessments. Trials should also be conducted to compare the best varieties from all three groups, regardless of maturity class, as well as promising varieties from other sources.
- Information should be gathered on Haitian consumer preferences for cowpea and on consumer and farmer assessment of the most promising varieties in order to better target recommendations to client farmers and consumers.
- Insect pest problems affecting yield of cowpea in Haiti should be studied by someone trained in entomology, to identify the most important pests, the level of infestation and damage, and the stages at which they attack cowpea. As production of cowpea intensifies, insect pests in the field will become the major obstacle to higher yields. A strategy to address these problems should be developed, based upon a knowledge of which insect species cause the greatest economic damage and at what stages.

PREFACE

This report compiles information gathered from numerous cowpea variety field trials and two seed storage trials conducted between 1993 and 1995 by CARE International, in collaboration with SECID Agronomist Yves Jean and Dr. Frank E. Brockman, SECID/Auburn University Agronomist and Team Leader. The trials were designed and supervised by SECID, but implemented by CARE. In December 1995, Dr. Brockman's position was terminated, and in March 1996, we were given 6 months to terminate the On-farm Adaptive Research Program. These trials were just one component of many being conducted by Yves Jean, who alone had the responsibility to oversee trials in all of the CARE and PADF regions across Haiti. Many times we had requested permission to hire a second agronomist in order to meet the increasing demands of CARE and PADF for agronomic research, but without success. Six months were insufficient for the SECID Agronomist to summarize and report on all of the research trials under his supervision. Consequently, some of his activities went unreported or under-reported. However, I felt the findings of the cowpea trials were too important to leave undocumented. Bruchid resistance and high yields of IITA varieties are factors that could potentially transform cowpea production in Haiti. I therefore sought to complete the report, using summary tables compiled by Jean and additional information from Semi-annual Reports and an Info-PLUS Report. This publication was delayed in large part by our effort to make the report as complete as possible and because of the difficulty for the two of us to communicate following Jean's departure from SECID. Unfortunately, due to various moves and the passage of time, we were not able to locate all the data that had been collected from seed storage tests and field trials. Had this program not been terminated precipitously, we would have provided a fuller accounting of varietal resistance to damage in storage and also included more information on farmer feedback. Yves Jean is to be commended for his hard work in overseeing these trials and for going the extra mile on data analysis, including use of data transformations, when necessary, to increase precision in the analyses.

Results of other trials conducted by the On-farm Adaptive Research Program include SECID/Auburn PLUS Reports No. 42 (yam), 43 (bean), 44 (sweet potato), 45 (cassava) and 46 (peanut). Additional reports related to crop production are SECID/Auburn PLUS Reports No. 2, 7 - 13, 20, 21, 26, 27, 30 and 48. Access to information on improved varieties and production techniques remains a major constraint facing Haitian farmers.

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INTRODUCTION

Cowpea[1] (*Vigna unguiculata*) is an important crop in the drier areas of Haiti, where it is known as *pois inconnu*. The crop is believed to have originated in West Africa (Ng and Marechal, 1985), where it remains the most important legume crop grown. It is an excellent crop for drought-prone areas because of some drought tolerance. It also fixes atmospheric nitrogen, and has the capacity to utilize soil P at low concentrations, a particularly advantageous characteristic on the phosphorus-fixing, high pH limestone-based soils that dominate Haiti's landscape. In Northwest Haiti, cowpea is grown in pure stands or intercropped with maize, cassava and other crops. Most of the varieties grown in Haiti tend to be semi-erect with small seed.

A major constraint of cowpea production worldwide is insect pests. In West and Central Africa, it is not uncommon to observe up to 100 % losses in the field due to bud and floral abscission following attack of floral thrips (*Megalurothrips sjostedti*) and the larvae of *Maruca testulalis*. Failure of grain to develop in the pods is common under heavy attack from pod borers and pod sucking insects. Once in storage, the grain can be rapidly turned to powder by storage insects.

In Haiti, yields do not appear to be as seriously affected by insect attack in the field, although it is not uncommon to find evidence of bud and floral abscission. The grain is highly susceptible to losses during storage, due to bruchids[2] or seed-boring weevils. Bruchid eggs are laid on seed while in the field. The larvae hatch and feed on seed by boring. Several generations of bruchids may occur during a year of storage, resulting in the grain being reduced to mostly powder. Losses during storage consequently can be very serious.

Bruchid infestations may be controlled in storage by fumigation, treatment with chemicals, or by treatment of the seed with oil to deprive the weevils of oxygen. An alternative to treatment of the grain is host plant resistance. Resistance to bruchids was identified at the International Institute of Tropical Agriculture (IITA) in Nigeria, and introduced into many varieties developed by the Institute.

Very little work has been done to improve the crop in Haiti, although a limited number of trials have been conducted at Damien and on the Plain of Aquin. Gachette (1994) tested 15 erect and spreading varieties from IITA and a local variety from Dondon in an unreplicated trial at Damien in the Cul de Sac. Fertilizer, irrigation and insecticide were applied to the crop. Under these conditions, yields between 575 and 1800 kg ha^{-1} were recorded, with all but one IITA variety

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[1] also known as black-eyed peas or Southern peas in the United States

[2] the most common species is *Callosbruchus maculatus*

yielding higher than that of the local variety (625 kg ha^{-1}). Data on disease incidence on the varieties was also reported. Pierre (1995) tested 6 varieties intercropped with maize and sole cropped in a replicated trial at Damien. A basal dose of compound fertilizer and insecticide was applied to the cowpea. Varieties $IT82K_2245$ and CNCX out-yielded the three local varieties in both sole and intercropped conditions. Maize yield was reduced by 1500 kg ha^{-1} (43 %) in presence of $IT82K_2245$, whereas CNCX only reduced maize yield by 500 kg ha^{-1} (13 %). The variety Genoa had the least effect on the maize, but also the lowest grain yield. No data was available to the senior author regarding the trial conducted at Aquin, but the variety CNCX 252 IE was identified as promising due to its good performance.

The present trials were conducted during approximately the same time period as those previously described, but under much less favorable conditions and without inputs. Varieties of cowpea were obtained from IITA for testing in Northwest Haiti in collaboration with CARE. These varieties have been selected for resistance to insect pests including storage bruchids. The objective was to identify cowpea varieties that yield higher than local varieties and are less subject to losses during storage. This research was a collaborative effort between SECID and CARE, in which SECID designed the trials and CARE implemented them under the supervision of SECID agronomist, Yves Jean. Data from the trials were transmitted to SECID for analysis and reporting.

MATERIALS AND METHODS

Cowpea trials were conducted in three CARE regions in Northwest Haiti (Figure 1; Table 1). All the sites are noted for irregular rainfall and potential for drought stress. The cowpea varieties obtained from IITA were classed into two groups according to maturity (Table 2). Extra-early maturing varieties mature in approximately 60 days. Early maturity varieties mature in about 70 days. The extra-early cowpea varieties were sub-divided into two sets, with one set (Set B) being tested primarily at Barbe Pagnole and the other set (Set A) only at Bombardopolis and Lafond. A local control, consisting of the "best" variety according to local farmers, was included in all trials. At Lafond, a second local variety from Bombardopolis, Ti Bombade, was included in the extra-early trials. Ti Bombade was the local variety used at Bombardopolis. A variety that performed well in trials conducted in the Plaine d'Aquin by the Ministry of Agriculture, CNCX 252 IE, was included in some of the early maturity trials at Bombardopolis and Lafond. Its origin is not known, but it may be from IRAT.

With the possible exception of CNCX 252 IE, there was no correspondence between the varieties reported here and those tested by Gachette (1994) and Pierre (1995). The latter included a CNCX variety but the full name was not recorded.

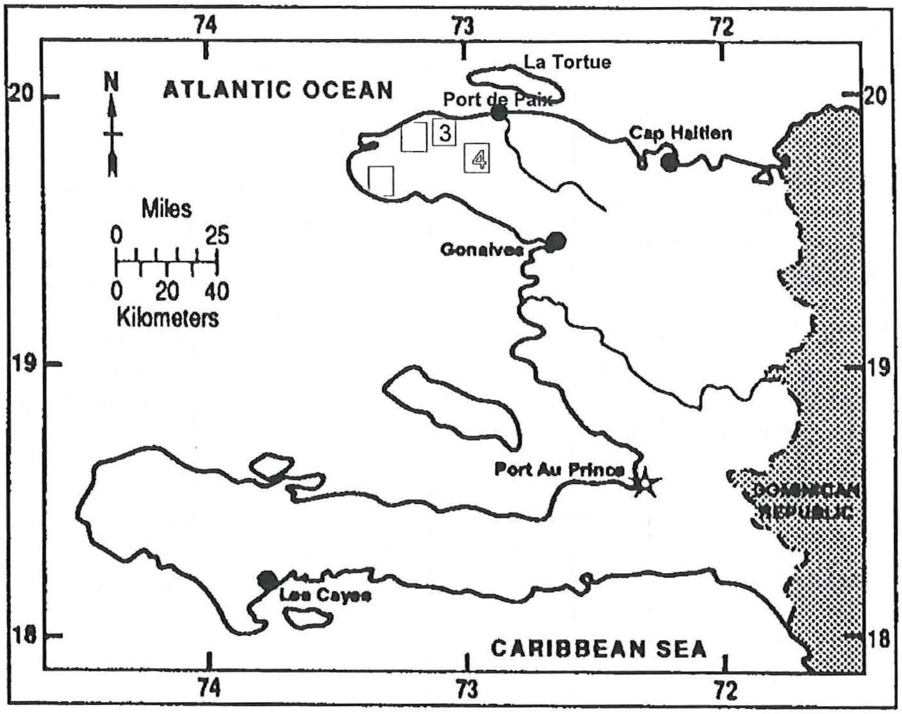

Figure 1: Study sites on the map of Haïti 1: Bombardopolis 2: Barbe Pagnole 3: Passe Catabois 4: Lafond

Field Trials

Trials of extra-early cowpeas were planted on 23 March 1994 and 4 May 1995 at Bombardopolis (designated B_1 and B_4, respectively), on 10 May and 24 September 1994 at Barbe Pagnole (Bp_1 and Bp_3), and on 4 May 1995, 23 August 1994 and on 25 August 1995 at Lafond (L_2, L_3, and L_4). Trials of early maturity varieties were planted on 14 March 1994 and 4 May 1995 at Bombardopolis (B_2 and B_3), 12 May 1994 and 22 September 1994 (Bp_2 and Bp_4) at Barbe Pagnole, and 5 May 1995 and 26 August 1995 (L_1 and L_5) at Lafond. Trial B_5 was planted in the first season of 1995, but the exact date and information relating to the management of the trial are lacking. L_4 and L_5 were planted in the fields of four and two farmers, respectively, with one replicate per farmer. The remainder of the trials were planted at CARE training centers with four replicates.

Table 1. Description of trial sites.					
CARE Regions	**Locations**	**Altitude (m)**	**Annual Rainfall (mm)**	**Temp- erature (°C)**	**Soil**
Bombardopolis	Commune of the Arrondissement of Môle St. Nicolas, North-west Department.	600	898	23	Red clay, generally shallow but deep in areas of accumulation. Calcarious substrate.
Barbe Pagnole	Section Communale of Savanne Pouceli, Commune of Jean Rabel, Arrondissement of Môle St. Nicolas; North-west Department.	250 - 300	855	25	Clay-loam of variable depth over calcareous substrate, highly altered.
Lafond	Section Communale of Haut des Moustiques, Commune of Bassin Bleu, Arrondissement of Port de Paix, North-west Department.	350 - 450	900	24	Clay over calcareous substrate.

In addition to the trials mentioned above, a trial of extra-early varieties was reported in the SECID (1994a) semi-annual report, and the available yield data are included in this report, but without details on the methodology, as we were unable to locate these. Other trials established at Bombardopolis, Lafond and Passe Catabois in 1993 were lost due to drought and failure to protect the trials from damage by goats and guinea fowl. Following a high failure rate in the 1993 trials, SECID requested that technicians be assigned specifically to supervise research trials, rather than leaving the trials to extension agents to supervise. Technicians were hired by CARE to supervise these trials, resulting in improved implementation, but these technicians were subsequently laid off after a year following budget cuts.

A randomized complete block design was used in all trials with four blocks, except for L_5, which had two blocks (Table 3). Rows were spaced 50 cm apart, while hills (*poquets*) within rows were 20 cm apart. One to two plants were planted per hill. Harvest areas were 4 m^2 to 5 m^2.

Plots were harvested when the majority of varieties were fully mature. However, the relatively late maturing varieties, IT89KD-347-57 and IT87D-941-1, were harvested prior to complete maturity and yields may be underestimated for these two varieties. Plants were counted at harvest to determine percent survival.

Table 2. List of cowpea varieties introduced from IITA and CRDA†.		
Extra Early Maturity Varieties		Early Maturity Varieties
Set A	Set B	
IT86D-1010	IT90K-76	IT86D-444
IT87D-611-3	IT90K-77	IT86D-715
IT87D-829-5	IT90K-284-2	IT87D-670-2
IT87D-879-1	IT89KD-374-57	IT89KD-792
IT87D-697-2	IT87KD-941-1	IT89KD-391
IT87D-957	IT86D-719	IT89KD-793
IT87D-885	IT87D-590-5	IT8ID-985
		IT89KD-245
		IT89KD-245-1
		CNCX 252 IE

†Varieties with names beginning "IT" came from IITA.

Table 3. Plot Layout.							
Trials	Rows	Row Length (m)	Plants per Hill	Hills per Row	Harvest Area (m^2)	Spacing (cm)	
						Rows	Hills
B_1, Bp_1, Bp_3, Bp_4, L_3	4	4	2	21	4	50	20
B_2, Bp_2, L_4	4	4	1	21	4	50	20
B_3, B_4, L_1, L_2, L_5	2	5	1	25	5	50	20

Seed Storage Trials

Seed samples harvested at Barbe Pagnole from trials of extra-early Set B varieties and early varieties at the end of 1993 were stored in paper bags on the shelf for 6 ½ months. The bags were weighed periodically to determine weight loss. At the end of the period, the grain was examined to determine the percentage of grain having holes caused by storage weevils.

RESULTS AND DISCUSSION

Days to Flowering

Values for days to flowering are recorded in Tables 4 and 5 for extra-early and early maturity varieties, respectively. Flower buds should be present by 30 days in extra-early varieties and by 35 days for early varieties. Values in excess of 40 for extra-early cowpeas and 50 for early maturity varieties are highly suspect and may reflect inadequate follow-up of the trials. Alternately, flowering may have appeared to be delayed due to high insect pressure causing flower buds and flowers to abort, giving inexperienced eyes the impression that flowering was delayed.

Table 4. Days to Full Bloom of Extra- Early Cowpea Varieties in Northwest Haiti.

	Bombardopolis		Barbe Pagnole		Lafond		
Varieties	**B_1**	**B_4**	**Bp_1**	**Bp_3**	**L_2**	**L_3**	**L_4**
IT86D-1010	63					50	
IT87D-611-3	66					50	
IT87D-829-5	68					48	
IT87D-879-1	68	54				49	
IT87D-697-2	68					47	
IT87D-957	68					48	
IT87D-885	68	56			56	47	55
IT90K-76			40	43			
IT90K-77			36	42			
IT90K-284-2			40	39			
IT89KD-374-57		83	43	43			58
IT87KD-941-1		57	33	37			55
IT86D-719			33	45			
IT87D-590-5			33	40			
Local			33	47	54	53	55
Ti Bombade	61	49			56		56
Mean	66	60	36	42	55	49	56

Table 5. Days to Full Bloom of Early Maturity Cowpea Varieties in Northwest Haiti.

Varieties	Bombardopolis		Barbe Pagnole		Lafond	
	B_2	B_3	Bp_2	Bp_4	L_1	L_5
IT86D-444	77	65	33	54	64	56
IT86D-715	81	71	31	49	63	52
IT87D-670-2	77		36	54		
IT89KD-792	84		39	51		
IT89KD-391	91	83	39	44		54
IT89KD-793	91	60		41	45	
IT8ID-985	91	87	41	45		52
IT89KD-245	92		41	49		
IT89KD-245-1	112		41	47		
CNCX 252 IE		53			51	
Local	75	52	33	47	51	50
Mean	87	67	43	49	57	53

Days to Maturity

Time to maturity for Extra Early cowpea varieties in West Africa is around 60 days, while Early Maturity varieties reach maturity in about 70 - 75 days. Cowpeas have indeterminate flowering (successive formation of flowers, rather than all at the same time), but the early maturity and especially the extra early varieties are selected for more synchronous flowering and maturation compared to varieties with longer maturation periods. Nevertheless, pods will mature over a range of one to two weeks, so that 2 - 3 harvests may be necessary to minimize field loss and damage. Days to 95 % maturity refers to the period when the majority of pods have attained physiological maturity. The average maturity of 110 and 76 days for extra early cowpeas, and 94 days for early maturity at Bombardopolis (Tables 6 and 7) are suspicious. In the trial with extra early varieties, the relatively late varieties, IT89KD-347-57 and IT87D-941-1, were harvested before complete maturation, although the days to maturity at Bombardopolis are very long for extra-early varieties. This may suggest that pod development was delayed because of abscission of initial flowers.

In the early maturity trials, values for maturity as low as 49 at Barbe Pagnole (Table 7) are of doubtful credibility, whereas values greater than 100 at Bombardopolis and Barbe Pagnole are also of concern. Lack of information on the circumstances surrounding these extreme values makes it difficult to pass judgement on the trials.

Table 6. Days to Maturity for Extra-early Cowpea Varieties in Northwest Haiti.

Varieties	Bombardopolis		Barbe Pagnole		Lafond		
	B_1	B_4	Bp_1	Bp_3	L_2	L_3	L_4
IT86D-1010	105					62	
IT87D-611-3	109					na	
IT87D-829-5	112					62	
IT87D-879-1	112	69				62	
IT87D-697-2	112					62	
IT87D-957	112					na	
IT87D-885	112	76			67	62	62
IT90K-76			54	52			
IT90K-77			61	55			
IT90K-284-2			53	52			
IT89KD-374-57		83	84	52			64
IT87KD-941-1		84	67	52			64
IT86D-719			52	56			
IT87D-590-5			51	54			
Local			51	59	64	62	67
Ti Bombade	103	69			64		64
Mean	110	76	59	54	65	62	64

Table 7. Days to Maturity for Early Maturity Cowpea Varieties in Northwest Haiti.

Varieties	Bombardopolis B_2	Bombardopolis B_3	Barbe Pagnole Bp_2	Barbe Pagnole Bp_4	Lafond L_1	Lafond L_5
IT86D-444	91	78	49	66	77	64
IT86D-715	96	86	49	62	81	61
IT87D-670-2	91		59	64		
IT89KD-792	100		62	63		
IT89KD-391	100	NA	114	54		64
IT89KD-793	100		118	58		
IT8ID-985	120	NA	114	57		61
IT89KD-245	120		NA	61		
IT89KD-245-1	120		NA	60		
CNCX 252 IE		77			71	
Local	118	69	49	61	66	61
Mean	94	78	77	61	74	62

Survival

Survival may reflect the growing conditions experienced in the field, or quality of the seed at the time of planting. Many of the trials had survival rates of less than 50 % (Tables 8 and 9). Since we do not have data on emergence, it is not clear whether this was due to poor germination and emergence or to loss of plants during the course of the growing season. Drought appears, from the rainfall summaries in Appendix I, to have occurred around establishment time in trials B_1, B_2, L_4 and L_5, and may explain the low stands in these trials. Under good management, hills without plants should be reseeded within a few days following emergence, but the success of subsequent plantings would also depend upon the rainfall conditions following reseeding. It is not known whether gaps in rows were reseeded. The final time that the early maturity trials were planted at Bombardopolis and Barbe Pagnole, better survival rates were observed, suggesting a possible improvement in management.

In most cases, differences in survival among varieties were not significant (Tables 8 and 9). This is good, because it indicates that differences in yield among the varieties may not be attributed to differences in plant stands. Where differences were significant, the differences were not very great, except in trial L_4, where over 2-fold differences were recorded.

Table 8. Survival (%) of Extra-early Cowpea Varieties in Northwest Haiti.

	Bombardopolis		Barbe Pagnole		Lafond		
Varieties	B_1	B_4	Bp_1	Bp_3	L_2	L_3	L_4
IT86D-1010	46					37	
IT87D-611-3	49					31	
IT87D-829-5	46					34	
IT87D-879-1	47	55				26	
IT87D-697-2	42					31	
IT87D-957	44					25	
IT87D-885	43	56			57	29	20
IT90K-76			36	71			
IT90K-77			30	72			
IT90K-284-2			37	76			
IT89KD-374-57		64	39	72			30
IT87KD-941-1		75	39	73			28
IT86D-719			39	74			
IT87D-590-5			40	76			
Local			36	68	75	23	38
Ti Bombade	47	56			71		48
Mean	46	61	37	73	68	30	33
$LSD_{0.05}$		8	5				18
Significance	**ns**	***	*	**ns**	**ns**	**ns**	*
CV %	9	8	9	6	17	23	31

ns, *, **, *** not significant, significant at the 0.05, 0.01 and 0.005 levels of probability, respectively

Table 9. Survival (%) of Early Maturity Cowpea Varieties in Northwest Haiti.

Varieties	Bombardopolis B_2	Bombardopolis B_3	Barbe Pagnole Bp_2	Barbe Pagnole Bp_4	Lafond L_1	Lafond L_5
IT86D-444	39	56	35	78	34	32
IT86D-715	37	58	36	77	36	22
IT87D-670-2	38		35	79		
IT89KD-792	30		37	78		
IT89KD-391	34	44	35	82		34
IT89KD-793	35		35	80		
IT8ID-985	37	56	36	78		39
IT89KD-245	33		38	80		
IT89KD-245-1	31		35	77		
CNCX 252 IE		49			36	
Local	42	51	35	75	27	29
Mean	36	57	36	78	33	31
$LSD_{0.05}$					6	6
Significance	ns	ns	ns	ns	*	**
CV %	18	18	11	5	11	7

ns, *, **, *** not significant, significant at the 0.05, 0.01 and 0.005 levels of probability, respectively

Yield

Extra-early cowpeas

Yields were quite low in most of the trials (Table 10), with the exception of trial B_1 at Bombardopolis, and trial L_2 at Lafond in 1994, where yields of 500 kg ha^{-1} may be considered fair, especially given that no insecticides were used. In the humid savanna of West and Central Africa, where insect pests are serious problems, yields of 0 to 200 kg ha^{-1} may be expected where the crop is not protected. The yield of 900 kg ha^{-1} for IT87D-885 at Bombardopolis may be considered outstanding under these circumstances.

Bombardopolis

At Bombardopolis, in 1994, rainfall was fairly low throughout the trial period (Appendix 1a), yet higher yields were recorded from this trial (B_1) than from any of the other trials on cowpea in the Northwest. It is possible that the low rainfall provided a less favorable environment for the insect pest population, thus permitting a larger number of pods to set seed. IT-87D-885, IT87D-879-1 and IT87D-697-2 yielded significantly more grain than the local variety (Table 10). The yield of IT87D-885 was three times that of the local variety.

In 1995 (B_4), rainfall was higher than in 1994 (Appendix 1a), which is reflected in higher stands(Table 8). However, yields were considerably lower (Table 10). The mix of varieties also differed in this trial, which contained some varieties from Sets A and B. IT87D-879-1 yielded highest followed by IT87D-885. However, only IT87D-879-1 yielded significantly higher than the local variety at the 5% level of probability.

Barbe Pagnole

At Barbe Pagnole, very low yields in the Fall 1993 trial were attributed to extremely dry conditions during the growing season (SECID, 1994b). Six of the seven introduced varieties yielded significantly higher than the local variety, with the highest yields recorded for IT89KD-374-57, IT87KD-941-1 and IT90K-284-2 (Table 10).

In the May 1994 planting (Bp_1), yields were again low (Table 10) as were survival rates (Table 8). Rainfall during the establishment phase would appear to have been adequate (Appendix 1b), although rainfall during the pod development and filling stages was negligible. None of the introduced varieties yielded significantly more than local variety, despite the fact that IT90-K-77 and IT86D-719 out-yielded the local variety by 67 % and 54 % (Table 10). The lack of significant differences in this test is due to a lack of precision in the test, as indicated by a CV value greater than 30%.

In the September 1994 planting (Bp_3), stands were superior to other trials in the series (Table 8), but yields were again low (Table 10). This may be attributable to low rainfall during much of the growing season (Appendix 1b). Despite very low precision in the trial, all but one of the introduced varieties yielded significantly higher than the local variety (Table 10). IT89KD-374-57 and IT87KD-941-1 both yielded over 6 times that of the local variety, while IT87D-590-5, IT90K-384-2 and IT90K-77 yielded over four fold that of the local variety.

Lafond

At Lafond, the trial planted in May 1995 (L_2) gave reasonable stands and yields (Tables 8 and 10), considering the lack of inputs. The variety IT87D-885 gave a higher yield than did Ti Bombade, but the yield did not differ significantly from the standard local variety. Stands were fair (Table 8).

In the August 1994 and August 1995 plantings, stands were poor and yields were low. In 1994, rains appeared to have been satisfactory during the first month, but poor thereafter (Appendix 1c), but in 1995, the reverse appears to have been true. In 1994, only IT87D-885 yielded significantly higher than did the local variety, while in 1995, there were no differences in yield between varieties. Yields of IT87D-885 and IT87KD-941-1 appear to have been adversely affected by significantly lower stands compared to the local variety (Table 8).

Across Site Analysis

Comparisons across sites and trials are hampered by the fact that not all the varieties are represented across all sites. Nevertheless, several conclusions may be drawn. Variety IT87D-885 was consistently among the highest-yielding varieties in Set A, ranking highest in three trials and second in one (Table 10). Its performance in two trials of Set B varieties was not outstanding, but in one trial yield differences were not significant and the variety had low stands (L_4), while in the other, no information is available on stands (1993). In trial B_4, which included some varieties from both Sets, it ranked second. Variety IT87D-879-1 was also noteworthy, yielding highest in Set A in one trial, second in a second and satisfactorily in a third trial.

Table 10. Grain yield of Extra-early Cowpea Varieties in Northwest Haiti.

	Bombardopolis		Barbe Pagnole			Lafond		
Varieties	B_1	B_4	1993	Bp_1	Bp_3	L_2	L_3	L_4
				kg ha^{-1}				
IT86D-1010	656						296	
IT87D-611-3	562						220	
IT87D-829-5	429						299	
IT87D-879-1	781	338					256	
IT87D-697-2	626						249	
IT87D-957	342						191	
IT87D-885	903	288	107			652	404	95
IT90K-76			84	194	167			
IT90K-77			99	236	199			
IT90K-284-2			142	143	213			
IT89KD-374-57		49	145	26	291			141
IT87KD-941-1		164	143	81	285			83
IT86D-719			119	217	179			
IT87D-590-5				169	214			
Local			32	141	47	509	200	205
Ti Bombade	309	243				361		193
Mean	576	216	109	151	199	507	264	143
$LSD_{0.05}$	371	165	55	106	154	234	134	
Significance	*	**	*	**	**	0.06	0.06	**ns**
CV %	44	46		47	52	27	34	56

ns, *, **, *** not significant, significant at the 0.05, 0.01 and 0.005 levels of probability, respectively

None of the trials involving Set B varieties had trial means above 200 kg ha^{-1}. It is therefore risky to draw conclusions. Varieties IT89KD-374-57 and IT87KD-941-1 ranked highest in two of the trials at Barbe Pagnole, but lowest in at third trial at that location, as well as in a trial at Bombardopolis. However, it was reported that because these two varieties matured later than the remaining varieties, these varieties were not completely harvested. Because cowpea pods do not mature at one time, it is likely that the yields reported are not representative of these varieties in either trial. IT90K-77 ranked highest in one trial, followed by IT86D-719.

Early Maturity Varieties

Bombardopolis

Trials of early maturity varieties were planted only in the first season, in 1994 (B_2) and in 1995 (B_3). In 1994, drought followed establishment and rainfall was low throughout most of the period (Appendix 1a), which may explain the poor stands (Table 9) and low yields (Table 11). Despite a high CV, yield differences tested significant and IT86D-444 yielded more than double the local variety. IT87D-670-2 also yielded significantly higher than the local variety.

In 1995, rains were somewhat better (Appendix 1a) and stands improved, though they were less than satisfactory (Table 9). Mean yields were nevertheless no better than in the previous year (Table 11). Differences between varieties tested significant, but none of the varieties yielded significantly more than the local variety, and only CNCX 252-IE ranked higher than the local variety. Among the four IITA varieties included in the trial, only IT86D-444 gave a yield comparable to that of the local variety. Another trial (B_5) did not test significant, but yields were proportionally similar to B_3.

Table 11. Grain yield of Early Maturity Varieties in Northwest Haiti.

	Bombardopolis			Barbe Pagnole		Lafond	
Varieties	**B_2**	**B_3**	**B_5**	**Bp_2**	**Bp_4**	**L_1**	**L_5**
				kg ha^{-1}			
IT86D-444	350	205	256	273	63	139	110
IT86D-715	88	109		191	143	172	164
IT87D-670-2	307		136	273	116		
IT89KD-792	136			75	247		
IT89KD-391	261	65		0	224		211
IT89KD-793	298			0	249		
IT8ID-985	21	78		22	283		165
IT89KD-245	21			0	290		
IT89KD-245-1	5			0	310		
CNCX 252 IE		243	304			187	
Local	171	219	273	225	81	216	164
Mean	166	153	242	177†	201	179	163
$LSD_{0.05}$	127	121		95			
Significance	***	*	ns	***	ns	ns	ns
CV %	53	53	42	64	73	56	37

ns, *, **, *** not significant, significant at the 0.05, 0.01 and 0.005 levels of probability, respectively.
†or 106 if 0 included in analysis.

Barbe Pagnole

The trials were planted in May (Bp_2) and in September 1994 (Bp_4). The May trial appears to have been established in a period of good rainfall, based on the rainfall summaries (Appendix 1b) but the crop was entirely dependent on residual moisture for pod and seed development. Stands and yields were poor (Tables 9 and 11). The varieties can be divided statistically into three categories, 1.) those with yields over 200 kg ha^{-1} (IT86D-444, IT87D-670-2 and the local variety); 2.) two varieties with yields over 100 kg ha^{-1}; and 3.) four varieties with no grain yield. None of the varieties yielded significantly more than the local variety. In the September planting (Bp_4), rainfall was more evenly distributed (Appendix 1b), stands were better (Table 9), but differences among varieties were not significant, despite a nearly four-fold advantage for IT89KD-345-1 over the local variety. A logarithmic transformation of the data renders the test significant at 8 % (Appendix 5f). With this lower standard of precision, one may assume that the yield of this variety was superior to that of the local variety.

Lafond

The two trials, planted in May (L_1) and August (L_5), both had low survival rates (Table 9) and low yields (Table 11). The rainfall summaries (Appendix 1c) do not provide a clear picture, but in the case of L_1, it is quite likely, with only 32.6 mm recorded for the decade in which the crop was planted, that the rainfall following planting may have been inadequate to give good stands. Thereafter, the rainfall was erratic, with some decades recording low rainfall and others high. With L_5, rainfall in the decade of trial establishment was only 29.4 mm, and there was no rainfall during the following decade. This may well have resulted in poor emergence or seedling mortality. There were no significant differences among varieties in either trial.

Across Site Analysis

It is clear that the potential yield of these varieties was not approached in any of the trials, so any conclusions drawn must be tentative. However, IT86D-444 was among the highest yielding varieties in three of the four trials at Bombardopolis and Barbe Pagnole. IT87D-670-2 was among the highest yielding varieties in two of the three trials in which it was included and the value of the information from the third trial, Bp_4 must be discounted because of the high variability in the trial. CNCX 252 IE ranked highest in the trial in which it was included at Bombardopolis (B_3) and ranked second and third in the trials at Lafond, where the results were not significant. CNCX (no suffix given) was one of the two highest-yielding varieties in the trial reported by Pierre (1995). Another variety that ranked high in a trial at Bombardopolis and one at Barbe Pagnole was IT89KD-793.

Farmer Appraisal

At Bombardopolis, Agronomist Yves Jean met with farmers at Bombardopolis to obtain their opinion of the cowpea varieties tested. Farmers liked the following varieties: IT87D-879-1, IT87D-855, CNCX 252 IE and IT86D-444. These varieties were preferred because of their high yield, earliness and large seed size. Their preferences are consistent with the agronomic data presented above.

Storage Tests

In the Extra Early Set B, at 6½ months after harvest, there were significant differences among varieties for percent damaged seed and in seed weight loss (SECID, 1994b). One hundred percent of the seed of the local and several of the improved varieties showed evidence of weevil damage, i.e. holes in grain. Variety IT89KD-374-57 showed the least damage, followed by IT87D-885 and IT87D-941-1. The remainder of the varieties did not differ significantly from the local variety in terms of percent damaged seed.

Significant differences were also recorded for loss of seed weight due to weevil damage. After 6 ½ months in storage, the local variety lost approximately 90 % of its original weight, whereas IT89KD-374-57 lost less than half that amount. This was also the highest yielding variety in the 1993 trial (Table 10).

Similarly, differences were significant among Early Maturity varieties for percent weight loss and percent damaged seed. The local variety was the most seriously affected with 100% of seed damaged by bruchids. Variety IT87D-670-2 had the least damaged seed, with less than 5 % damaged, followed by IT89KD-391 and IT89KD-793. IT86D-444 and IT89KD-792 had < 40 % damaged seed, while IT86D-716 had greater than > 90 % damaged seed.

IT89KD-792 had the least loss in seed weight (< 5%), followed by IT89KD-793 and IT89KD-245-1. Each of these varieties lost < 20 % of their weight over the period. By comparison, the local variety had lost three quarters of its original weight. Varieties IT87D-670-2 and IT89KD-793 were believed in 1994 (SECID, 1994b) to best combine high yield with a high level of resistance to the storage weevil.

SUMMARY AND CONCLUSIONS

Improved cowpea varieties selected for yield and resistance to storage weevils have the potential to increase crop yields and farmer income, and at the same time increase food security. With local varieties, significant loss of food grain and seed occur in storage due to damage by weevils. Varieties with host plant resistance to weevils offer a low-cost, safe solution to Haitian farmers, who cannot afford the use of pesticides, which may also carry significant health risks. In trials conducted in the extreme environmental conditions of Northwest Haiti, introduced varieties yielded more than local varieties, suffered considerably less damage by weevils during storage than did local varieties and were preferred by Haitian farmers because of grain quality and agronomic performance.

The most promising varieties, based upon the tests reported here, are summarized in Table 12. This list of 14 varieties does not represent all the varieties that were superior to the local variety in either yield or resistance to storage pests, only those that significantly outperformed the local variety <u>and</u> ranked in the top three in at least one trial. The only exception is variety CNCX 252 IE, which ranked superior in yield to, but not significantly different from, the local variety in a trial at Bombardopolis and one at Lafond. It was included among the elite varieties because it was among the four selected by Bombardopolis farmers as superior in yield, earliness and seed size. It may also be the variety which yielded highest in a trial reported by Pierre (1995). Varieties which came out first in a given category and test are indicated with a bold "**X**."

Table 12. Superior cowpea varieties, based upon yield, resistance to pests or farmer preference in trials in Northwest Haiti.				
Maturity Class	**Variety**	**Superior Yield†**	**Superior Resistance to Storage Pests†**	**Farmer Preference‡**
Extra Early	IT87D-885	**X**	X	X
	IT87D-879-1	**X**	NA	X
	IT89KD-374-57	**X**	**X**	
	IT87KD-941-1	**X**	X	
	IT90K-77	X		NA
	IT86D-719	X		NA
	IT90K-284-2	X		NA
Early	IT86D-444	X	X	X
	IT87D-670-2	X	**X**	NA
	IT89KD-245-1	**X**	X	
	IT89KD-793	X	X	NA
	IT89KD-391		X	
	IT89D-792		**X**	
	CNCX252-IE		NA	X

†Must have been statistically superior to local variety in at least one test. Lack of an "X" does not necessarily mean that the variety does not produce good yields
‡Based on interview with farmers in Bombardopolis in 1994.
NA. Information not available on variety.
Note: Highlight indicates most outstanding varieties. Bold **X** indicates best in one or more trials.

The results presented here are not complete. Some of the varieties have not been adequately tested in the field and the results of some field trials were inconclusive. Not all the varieties were included in the seed storage trials and the farmers at Bombardopolis did not have the opportunity to evaluate all the varieties. Nevertheless, the conclusions are clear. ***Farmers have the potential to substantially increase cowpea yields and substantially increase shelf life by simply adopting one of the high yielding varieties listed above with resistance to seed storage pests. Adoption of these varieties can contribute to increased farmer income and to increased sustainability of the food production system.*** The USAID/Haiti mission can make a significant contribution to food security and farmer income in cowpea growing areas of Haiti by supporting the multiplication and distribution of seed of selected cowpea varieties and by supporting cowpea variety testing and studies to address insect pest problems in cowpea.

Recommendations

- Seed of IT87D-885, IT87D-879-1, IT89KD-374-57, IT87KD-941-1, IT87D-670-2, IT89KD-793, CNCX 252 IE, IT89KD-245-1 and IT86D-444 should be made available to farmers in the Northwest for production and testing, and to CRDA and non-governmental agencies working in other cowpea producing areas for on-farm testing.
- Storage trials should be conducted on the Set A extra early varieties and CNCX252-IE, for which data was not available. Varieties from other sources, including local varieties, should also be tested.
- Additional yield trials should be conducted, particularly for Set B of the extra-early varieties, and for the early maturing varieties, especially at Barbe Pagnole and Lafond, where growing conditions did not allow very conclusive assessments. Trials should also be conducted to compare the best varieties from all three groups, as well as promising varieties from other sources.
- Information should be gathered on Haitian consumer preferences for cowpea and on consumer and farmer assessment of the most promising varieties. This will permit better initial selection of varieties to include in trials, in order to better target varieties to meet consumer and farmer preferences.
- Information is needed on the extent of the insect pest problems affecting yield of cowpea in Haiti. Abscission of flowers and buds as a result of insect attack is a major cause of low yields in Africa. Evidence of abscission has been observed in farmers' fields in several places in Haiti, but the extent of the problem in Haiti is not known. It appears not to be as important a problem as in West Africa, but it may nevertheless be an important cause of low yield. A trained entomologist should determine the most important insect pest species in the major cowpea growing areas of Haiti, to determine the levels of infestation and damage, and the stages at which they attack cowpea. Based upon these observations, appropriate cultural measures to reduce insect damage should be recommended.

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Appendix 1: Rainfall (mm) by 10-day periods (decades) for 1994 and 1995 in the project areas.

a) Bombardopolis

Année	Décade	Janv	Fev	Mars	Avril	Mai	Juin	Juil	Août	Sept	Oct	Nov	Dec	Total
1994	1	49.50	0.00	11.50	0.00	81.50	0.00	6.00	81.80	2300.00	40.50	0.00	0.00	
	2	2.50	62.00	0.00	28.50	34.00	83.00	4.00	54.50	40.00	31.50	105.00	18.00	
	3	0.00	0.00	35.00	38.00	28.50	8.00	4.00	9.00	25.50	64.50	0.00	63.00	
	Total	52.00	62.00	46.50	66.50	144.00	91.00	14.00	145.30	88.50	136.50	105.00	81.00	1032.30
1995	1	4.00	7.00	41.80	4.00	59.00	81.00	17.50	130.50	0.00	67.00	0.00	25.00	
	2	7.00	2.00	13.40	2.00	20.00	109.00	0.00	203.00	25.70	34.30	31.50	0.00	
	3	0.00	79.00	0.00	64.80	99.00	0.00	9.00	7.00	37.90	23.50	36.00	28.60	
	Total	11.00	88.00	55.20	70.80	205.50	190.00	26.50	340.50	63.60	124.80	67.50	53.60	1297.00

b) Barbe Pagnole

Année	Décade	Jan	Fev	Mars	Avril	Mai	Juin	Juil	Août	Sept	Oct	Nov	Dec	Total
1994	1	109.10	0.00	49.10	78.60	33.20	3.20	0.00	41.50	12.90	2.20	0.00	0.00	
	2	25.70	50.00	8.00	7.86	127.70	0.60	12.40	5.60	11.30	18.20	65.00	53.60	
	3	61.90	8.50	1.20	57.10	27.60	3.40	0.00	10.40	57.00	10.00	18.20	75.50	
	Total	197.15	58.60	58.30	135.70	183.50	7.20	12.40	57.50	81.20	30.30	83.20	129.10	1034.15
1995	1	0.00	18.50	27.50	0.00	10.90	55.70	12.40	10.00	0.00	67.00	2.80	0.00	
	2	4.00	0.00	8.00	0.00	25.80	51.80	2.30	40.50	38.20	60.48	66.70	0.00	
	3	4.10	46.60	0.00	2.80	44.20	0.00	37.00	21.20	137.50	19.70	82.50	5.00	
	Total	8.10	65.10	35.50	2.80	83.10	107.50	51.70	71.70	175.70	147.18	152.00	5.00	905.38

c) Lafond

Année	Décade	Janv	Fev	Mars	Avril	Mai	Juin	Juil	Août	Sept	Oct	Nov	Dec	Total
1994	1	24.70	0.00	89.00	6.40	83.00	10.00	15.50	92.80	28.40	14.50	0.80	0.00	
	2	81.00	37.40	25.00	28.00	169.40	0.00	5.00	54.50	71.00	40.60	49.00	2.50	
	3	38.30	15.00	0.00	42.50	7.50	7.80	3.60	53.50	8.00	5.30	75.00	62.00	
	Total	144.00	52.40	114.00	76.90	259.90	17.80	24.10	200.80	107.40	60.40	124.80	64.50	1247.00
1995	1	0.00	14.80	10.10	14.60	32.60	144.00	48.00	23.90	0.00	88.40	0.00	0.00	
	2	5.60	0.00	97.00	2.50	59.00	76.50	47.10	54.10	69.00	24.00	33.60	9.50	
	3	6.50	2.00	0.00	0.00	13.10	0.00	26.20	29.40	85.90	2.00	11.30	9.00	
	Total	12.10	16.80	107.10	17.10	104.70	220.50	121.30	107.40	154.90	114.40	44.90	18.50	1039.70

Appendix 2: Survival, yield and yield components of cowpea at Bombardopolis

a) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial B_1

Variety	Survival (%)	Yield (kg / ha)	Pods / m²	Pods / plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT86D-1010	46	656.10	55	3	7	892.10	15.79
IT87D-611-3	49	561.90	78	4	6	968.20	12.13
IT87D-839-5	46	428.60	52	3	5	656.40	14.86
IT87D-879-1	47	781.40	58	3	7	1060.30	18.17
IT87D-697-2	42	626.00	62	4	7	791.30	14.29
IT87D-957	44	342.00	36	2	6	465.60	16.47
IT87D-885	43	903.10	49	3	9	1188.60	20.39
Local	47	309.20	39	2	10	433.10	7.91
Significance	NS (α= 0.31)	S (α= 0.03)	S (α = 0.07)	NS (α= 0.17)	S (α = 0.0001)	S (α= 0.03)	S (α = 0.0001)
$LSD_{0.05}$	6	370.60	26	2	1	478.15	2.13
CV %	9	43.75	33	36	13	40.29	9.67

b) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial B_2

Variety	Survival (%)	Yield (kg / ha)	Pods / m²	Pods / plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT86D-444	39	350.31	26	3	8	463.56	17.60
IT869-715	37	88.13	7	1	9	119.75	15.60
IT87D-670-2	38	307.44	31	4	5	408.25	21.03
IT89KD-792	30	135.75	12	2	5	187.94	26.65
IT89KD-391	34	260.88	19	3	6	346.69	26.70
IT89KD-793	35	298.06	24	3	8	416.81	16.62
IT8ID-985	37	20.63	1	0.24	6	29.56	16.14
LOCALE	42	171.44	18	2	11	239.84	8.78
IT89KD-245	33	20.69	2	0.19	3	25.88	10.81
IT89KD-245-1	31	4.56	0.38	0.075	3	6.31	7.81
Significance	NS (α = 0.23)	S (α = 0.0001)	S (α= 0.0001)	S (α= 0.0001)	S (α= 0.0076)	S (α= 0.0001)	S (α= 0.035)
$LSD_{0.05}$	9	127.33	11	1	4	175.51	12.03
CV %	18	52.94	53	51	42	53.89	50.56

c) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial B_3

Variety	Survival (%)	Yield (kg / ha)	Pods / m^2	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT86D-444	56	204.90	20	1.81	8	353.13	15.67
IT69-715	58	108.50	13	1.07	5	186.90	22.99
IT9KD-391	44	64.50	4	0.58	5	118.60	21.00
IT8ID-985	56	78.00	3	0.31	6	101.55	15.11
LOCALE	51	218.75	24	2.40	11	347.05	7.96
CNCX	49	243.00	20	1.96	11	403.20	11.41
Significance	NS ($\alpha = 0.33$)	S ($\alpha = 0.02$)	S (α =0.01)	S ($\alpha = 0.007$)	NS ($\alpha = 0.11$)	S ($\alpha = 0.006$)	S ($\alpha = 0.006$)
$LSD_{0.05}$	15	121.13	12	1	6	176.1	7.62
CV %	18	52.55	54	48	50	45.69	30.59

d) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial B_4

Variety	Survival (%)	Yield (kg / ha)	Pods / m^2	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT87D-879-1	55	337.50	27	2	7	547.9	17.00
IT87D-885	56	287.50	23	2	7	457.3	17.84
LOCALE	56	243.00	30	3	8	393.6	8.09
IT89KD-374-57	64	49.33	8	0.33	4	118.0	12.50
IT87D-941-1	75	163.50	21	1	4	322.9	18.58
Significance	S ($\alpha = 0.0006$)	S ($\alpha = 0.014$)	NS (α =0.13)	S ($\alpha = 0.05$)	S ($\alpha = 0.02$)	S ($\alpha = 0.019$)	S ($\alpha = 0.0001$)
$LSD_{0.05}$	8	164.80	17	1	2	255.3	2.24
CV %	8	45.59	51	47	26	37.38	8.63

Appendix 3: Survival, yield and yield components of cowpea at Barbe Pagnole

a) Survival, yield, pod number /m², pod number / plant and pod weight in trial Bp_1

Variety	Survival (%)	Yield (kg / ha)	Pods / m^2	Pods /plant	Pod Weight kg / ha
IT9OK-76	36	194.38	28	2	390.6
IT9OK-77	30	235.63	25	2	309.4
IT9OK-284-2	37	142.50	15	1	282.5
IT89KD-374-57	39	25.83	2	0.13	48.5
IT87KD-941-1	39	81.25	6	0.36	100.0
IT86D-719	39	216.88	30	2	635.8
IT987D-590-5	40	168.75	33	2	256.9
LOCALE	36	141.25	31	2	240.0
Significance	S (α = 0.02)	S (α = 0.01)	S (α = 0.0004)	S (α = 0.0007)	S (α = 0.05)
$LSD_{0.05}$	5	106.4	14	1	219.5
CV %	9	46.64	44	46	57.37

b) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial Bp_2

Variety	Survival (%)	Yield (kg / ha)	Pods / m^2	Pods /plant	Pod Weight kg / ha	
IT86D-444	35	273.13	30	4	423.75	
IT86D-715	36	190.50	29	4	285.63	
IT87D-670-2	35	273.13	22	1	326.88	
IT89KD-792	37	75.00	7	0	90.63	
IT89KD-391	35	0.00	0	0	0.0	
IT89KD-793	35	0.00	0	0.2	0.0	
IT8ID-985	36	21.88	2	5	28.13	
LOCALE	35	225.00	36	0	313.13	
IT89KD-245	38	0.00	1	0.07	0.0	
IT89KD-245-1	35	0.00	0	0	0.0	
Test de signification de F	NS (α = 0.95)		S (α = 0.0001)	S (α = 0.0001)	S (α = 0.0001)	S (α = 0.0001)
PPDS (α = 0.05)	6	95.33	11	2	140.82	
Coefficient de variation (%)	11	63.60	61.35	65	66.11	

c) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial Bp_3

Variety	Survival (%)	Yield (kg / ha)	Pods / m²	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT9OK-76	71	167.31	17	0.58	5	223.3	23.25
IT9OK-77	72	198.56	24	0.76	4	240.1	20.67
IT9OK-284-2	76	213.19	24	0.74	3	314.9	18.00
IT89KD-374-57	72	290.69	33	1.09	5	376.6	20.95
IT87D-941-1	73	285.20	26	0.87	5	362.7	21.50
IT86D-719	74	179.00	22	0.67	3	268.3	14.80
IT87D-590-0	76	214.13	19	0.60	4	252.3	28.00
LOCALE	68	47.44	4	0.14	4	60.9	15.00
Significance	NS ($\alpha = 0.31$)	S ($\alpha = 009$)	NS ($\alpha = 0.14$)	NS ($\alpha = 0.10$)	NS ($\alpha = 0.67$)	NS ($\alpha = 0.15$)	NS ($\alpha = 0.5$)
$LSD_{0.05}$	7	153.69	19	0.57	3	219.9	13.23
CV %	6	52.40	60	57.14	44	56.99	42.05

d) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial Bp_4

Variety	Survival (%)	Yield (kg / ha)	Pods / m²	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT86D-444	78	62.6	5	0.14	6	79.0	23.50
IT86D-715	77	142.6	13	0.40	6	182.9	21.00
IT87D-670-2	79	116.1	12	0.35	4	159.3	17.50
IT89KD-792	78	246.9	27	0.79	5	335.8	21.75
IT89KD-391	82	224.4	22	0.64	5	286.2	23.25
IT89KD-793	80	249.3	27	0.78	4	334.7	26.75
IT8ID-985	78	282.7	18	0.56	5	336.9	30.75
LOCALE	75	81.1	7	0.20	5	105.1	11.33
IT89KD-245	80	290.0	26	0.76	5	378.5	24.50
IT89KD-245-1	77	309.6	29	0.88	4	393.2	26.00
Significance	NS ($\alpha = 0.59$)	NS ($\alpha = 0.17$)	NS ($\alpha = 0.19$)	NS ($\alpha = 0.16$)	NS ($\alpha = 0.70$)	NS ($\alpha = 0.19$)	NS ($\alpha = 0.15$)
$LSD_{0.05}$	6	211.6	21	0.60	3	275.7	11.92
CV %	5	72.73	80	75	38	73.32	33.52

Appendix 4: Survival, yield and yield components of cowpea at Lafond

a) Survival, yield, pod number /m^2, pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial L_1

Variety	Survival (%)	Yield (kg / ha)	Pods / m^2	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT86D-444	34	139.0	15	2	7	268.5	13.66
IT69-715	36	172.0	13	2	8	263.0	14.50
Locale	27	215.5	24	4	8	318.5	10.42
CNCX	36	187.0	14	2	9	183.0	12.71
Significance	S (α= 0.02)	NS (α= 0.75)	NS (α = 0.26)	S (α= 0.07)	NS (α = 0.58)	NS (α= 0.56)	S (α = 0.05)
LSD$_{0.05}$	6	159.4	13	2	3	211.02	2.83
CV %	11	55.9	47	46	23	51.08	13.04

b) Survival, yield, pod number /m^2, pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial L_2

Variety	Survival (%)	Yield (kg / ha)	Pods / m^2	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT87D-885	57	652.50	38	3	10	1177.00	17.60
TIBOMBADE	71	361.00	49	3	8	857.00	9.58
LOCALE	75	508.50	70	5	7	1318.00	10.08
Significance	NS (α = 0.14)	S (α = 0.06)	S (α= 0.0001)	S (α = 0.02)	NS (α= 0.1)	S (α= 0.0001)	S (α= 0.0001)
LSD$_{0.05}$ 20	233.69	7	1	3	415.23	0.57	
CV % 17	26.62	8	14	21	21.48	2.64	

c) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial L_3

Variety	Survival (%)	Yield (kg / ha)	Pods / m²	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT86D-1010	37	296.25	34	2	6	440.0	13.90
IT87D-611-3	31	220.00	40	3	4	426.3	13.75
IT87D-829-5	34	299.38	42	3	5	508.8	14.75
IT87D-879-1	26	255.63	27	3	5	413.3	16.10
IT87D-697-2	31	248.75	31	3	6	355.0	14.18
IT87D-957	25	190.63	26	3	6	281.9	13.53
IT87D-885	29	404.38	32	3	7	514.4	18.35
LOCALE	23	200.00	28	3	8	310.0	9.85
Significance	NS ($\alpha = 0.17$)	S ($\alpha = 0.06$)	NS ($\alpha = 0.21$)	NS ($\alpha = 0.30$)	S ($\alpha = 0.003$)	NS ($\alpha = 0.27$)	S ($\alpha = 0.0001$)
$LSD_{0.05}$ 10	134.05	15	1	2	229.4	2.10	
CV %	23	34.48	30	19	17	36.53	10.01

d) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial L_4

Variety	Survival (%)	Yield (kg / ha)	Pods / m²	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT89KD-374-57	30	141.33	14	2	8	216.67	12.61
IT87D-941-1	28	83.00	10	2	8	87.00	10.88
IT87D-885	20	94.67	9	2	8	126.00	16.39
TI Bombade	48	192.50	23	2	9	274.50	8.79
LOCALE	38	204.50	25	3	8	252.00	9.71
Significance	S ($\alpha = 0.05$)	NS ($\alpha = 0.27$)	NS ($\alpha = 0.20$)	NS ($\alpha = 0.5$)	NS ($\alpha = 0.9$)	NS ($\alpha = 0.21$)	S ($\alpha = 0.0001$)
LSD 0.005)	18	136.0	15	2	4	196.20	1.47
CV %	31	55.52	54	39	30	60.48	7.71

e) Survival, yield, pod number /m², pod number / plant, Seeds per pod, pod weight and 100 seed weight in trial L_5

Variety	Survival (%)	Yield (kg / ha)	Pods / m^2	Pods /plant	Seeds / pod	Pod Weight (Kg /ha)	100 Seed Weight
IT86D-444	32	110.0	10	2	10	170.00	11.00
IT86D-715	22	164.0	14	4	8	152.00	15.50
IT9KD-391	34	211.0	27	4	6	296.00	13.83
LOCALE	29	164.0	13	2	12	241.00	10.50
IT8ID-985	39	165.0	21	3	9	239.00	9.00
Significance	S ($\alpha = 0.008$)	NS ($\alpha = 0.6$)	NS ($\alpha = 0.16$)	NS ($\alpha = 0.23$)	S ($\alpha = 0.008$)	NS ($\alpha = 0.61$)	S ($\alpha = 0.008$)
$LSD_{0.005}$	6	168.1	16	2	2	267.30	2.47
CV %	7	37.19	34	30	9	43.84	7.43

Appendix 5: Survival, yield and yield components using logarithmic transformation of yield data for selected trials (B_2 and B_3 at Bombardopolis, Bp_1, Bp_2, Bp_3 and Bp_4 at Barbe Pagnole and L_1 and L_4 at Lafond).

a) Survie, rendement, nombre de gousses /m2, nombre de gousse / pied, nombre de grains / gousse, poids gousses et poids 100 grains dans l'essai B_2

Variété	Survie (%)	Rendement (kg / ha) ; Valeur transformée Log 10 (x+1)	Gousses / m2	Gousses / pied	Grains / gousse	poids gousses (Kg /ha)	poids 100 grains
IT86D-444	39	2.48	26	3	8	463.56	17.60
IT86D-715	37	1.94	7	1	9	119.75	15.60
IT87D-670-2	38	2.47	31	4	5	408.25	21.03
IT89KD-792	30	2.11	12	2	5	187.94	26.65
IT89KD-391	34	2.40	19	3	6	346.69	26.70
IT89KD-793	35	2.47	24	3	8	416.81	16.62
IT8ID-985	37	1.02	1	0.24	6	29.56	16.14
LOCALE	42	2.21	18	2	11	239.84	8.78
IT89KD-245	33	0.80	2	0.19	3	25.88	10.81
IT89KD-245-1	31	0.42	0.38	0.075	3	6.31	7.81
Test de signification de F	NS (α = 0.23)	S (α = 0.0001)	S (α= 0.0001)	S (α= 0.0001)	S (α= 0.076)	S (α= 0.0001)	S (α= 0.035)
PPDS (α = 0,05)	9	0.67	11	1	4	175.51	12.03
Coefficient de variation %	18	25.39	53	51	42	53.89	50.56

b) Survie, rendement, nombre de gousses / m2, nombre de gousse / pied, nombre de grains / gousse, poids gousses et poids 100 grains dans l'essai B_3

Variété	Survie (%)	Rendement (kg / ha) ;	Gousses / m2 Valeur transformée log 10 (x+1)	Gousses / pied	Grains / gousse	poids gousses (Kg /ha)	poids 100 grains
IT86D-444	56	2.30	20	1.81	8	353.13	15.67
IT86D-715	58	1.98	13	1.07	5	186.90	22.99
IT9KD-391	44	1.73	4	0.58	5	118.60	21.00
IT8ID-985	56	1.40	3	0.31	6	101.55	15.11
LOCALE	51	2.31	24	2.40	11	347.05	7.96
CNCX	49	2.35	20	1.96	11	403.20	11.41
Test de signification de F	NS (α = 0.33)	S (α = 0.08)	S (α =0.01)	S (α = 0.007)	NS (α = 0.11)	S (α = 0.006)	S (α = 0.006)
PPDS (α = 0.005)	15	0.74	12	1	6	176.1	7.62
Coefficient de variation (%)	18	24.55	54	48		50 45.69	30.59

c) Survie, rendement, nombre de gousses /m2, nombre de gousse / pied et poids gousses dans l'essai Bp_1

Variété	Survie (%)	Rendement (kg / ha); valeur transformée log10=(x+1)	Gousses / m2	Gousses / pied	poidsgousses (Kg /ha)
IT90K-76	36	2.27	28	2	390.6
IT90K-77	30	2.32	25	2	309.4
IT90K-284-2	37	2.09	15	1	48.3
IT89KD-374-57	39	1.04	2	0.13	100.0
IT87D-941-1	39	1.88	6	0.36	353.8
IT86D-719	39	2.33	30	2	256.9
IT87D-590-5	40	2.19	33	2	240.0
LOCALE	36	2.12	31		
Test de signification de F	S (α = 0.02)	S (α = 0.0009)	S (α = 0.0004)	S (α = 0.0007)	S (α = 0.05)
PPDS (α = 0.05)	5	0.48	14	1	219.5
Coefficient de variation (%)	9	15.52	44	46	57.37

d) Survie, rendement, nombre de gousses /m2, nombre de gousse / pied, nombre de grains / gousse, poids gousses et poids 100 grains dans l'essai Bp_2

Variety	Survival (%)	Yield (kg / ha) leur transformée log10 (x+1)	Pods / m^2	Pods /plant	Seeds / pod
IT86D-444	35	2.36	30	4	423.75
IT86D-715	36	2.28	29	4	285.63
IT87D-670-2	35	2.33	22	1	326.88
IT89KD-792	37	1.47	7	0	90.63
IT89KD-391	35	0.00	0	0	0.0
IT89KD-793	35	0.00	0	0.2	0.0
IT8ID-985	36	1.09	2	5	28.13
LOCALE	35	2.35	36	0	313.13
IT89KD-245	38	0.00	1	0.07	0.0
IT89KD-245-1	35	0.00	0	0	0.0
Test de signification de F	NS (α = 0.95)	S (α = 0.0001)	S (α = 0.0001)	S (α = 0.0001)	S (α = 0.0001)
PPDS (α = 0.05)	6	0.58	11	2	140.82
Coefficient de variation (%)	11	33.62	61.35	65	66.11

e) Survie, rendement, nombre de gousses /m2, nombre de gousse / pied, nombre de grains / gousse, poids gousses et poids 100 grains dans l'essai Bp_3

Variété	Survie (%)	Rendement (kg / ha) leur transformée log10 (x+1)	gousses / m2	gousses / pied	grains / gousse	poids gousses (Kg /ha)	poids de 100 grains
IT90K-76	71	2.15	17	0.58	5	223.3	23.25
IT90K-77	72	2.06	24	0.76	4	240.1	20.67
IT90K-284-2	76	1.81	24	0.75	3	314.9	18.00
IT89KD-374-57	72	2.42	33	1.09	5	376.6	20.95
IT87D-941-1	73	2.41	26	0.87	5	362.7	21.50
IT86D-719	74	1.73	22	0.67	3	268.3	14.80
IT87D-590-5	76	2.24	19	0.60	4	252.3	28.00
LOCALE	68	1.28	4	0.14	4	60.9	15.00
Test de signification de F	NS (α = 0.31)	NS (α = 0.37)	NS (α = 0.14)	NS (α = 0.10)	NS (α = 0.67)	NS (α = 0.15)	NS (α = 0.49)
PPDS (α = 0.05)	7	1.07	19	0.57	3	219.9	13.23
Coefficient de variation (%)	6	36.30	60	57.14	44	56.99	42.05

f) Survie, rendement, nombre de gousses /m2, nombre de gousse / pied, nombre de grains / gousse, poids gousses et poids 100 grains dans l'essai Bp_4

Variété	Survie (%)	Rendement (kg / ha); va leur transformée Log10 (x+1)	gousses / m2	gousses / pied	grains / gousse	poids gousses (Kg /ha)	poids 100 grains	
IT86D-444	78	1.68	5	0.14	6	79.0	23.50	
IT86D-715	77	2.15	13	0.40	6	182.9	21.00	
IT87D-670-2	79	1.62	12	0.35	4	159.3	17.50	
IT89KD-792	78	2.31	27	0.79	5	335.8	21.75	
IT89KD-391	82	2.31	22	0.64	5	286.2	23.25	
IT89KD-793	80	2.25	27	0.78	4	334.7	26.75	
IT8ID-985	78	2.43	18	0.56	5	336.9	30.75	
LOCALE	75	1.42	7	0.20	5	105.1	11.33	
IT89KD-245	80	2.37	26	0.76	5	378.5	24.50	
IT89KD-245-1	77	2.46	29	0.88	4	393.2	26.00	
Test de signification de F	NS (α = 0.59)	S (α = 0.08)	NS (α = 0.19)		NS (α = 0.16)	NS (α = 0.7 0)	NS (α = 0.19)	NS (α = 0.15)
PPDS (α = 0.05)	6	0.78	21	0.60	3	275.67	11.92	
Coefficient de variation (%)	5	25.49	80	75	38	73.32	33.52	

g) Survie, rendement, nombre de gousses /m2, nombre de gousse / pied, nombre de grains / gousse, poids gousses et poids 100 grains dans l'essai L_1

Variété	Survie (%)	Rendement kg / ha); va leur transformée Log10 (x+1)	Gousses / m2	Gousses / pied	Grains / gousse	Poidsgousses (Kg /ha)	Poids 100 grains
IT86D-444	34	1.90	15	2	7	268.5	13.66
IT86D-715	36	1.99	13	2	8	263.0	14.50
Locale	27	2.20	24	4	8	318.5	10.42
CNCX	36	2.09	14	2	9	183.0	12.71
Test de signification de F	S (α= 0.02)	NS (α= 0.53)	NS (α = 0.26)	S (α= 0.07)	NS (α = 0.58)	NS (α= 0.56)	S (α = 0.05)
PPDS (α = 0.05)	6	0.47	13	2	3	211.0	2.83
Coefficient de variation %	11	14.36	47	46	23	51.08	13.04

h) Survie, rendement, nombre de gousses /m2, nombre de gousse / pied, nombre de grains / gousse, poids gousses et poids 100 grains dans l'essai L_4

Variété	Survie (%)	Rendement (kg / ha); va leur transformée log10 (x +1)	Gousses / m2	Gousses / pied	Grains / gousse	Poids gousses (Kg /ha)	Poids 100 grains
IT89KD-374-57	30	2.06	14	2	8	216.67	12.61
IT87D-941-1	28	1.90	10	2	8	87.00	10.88
IT87D-885	20	1.95	9	2	8	126.00	16.39
TI Bombade	48	2.17	23	2	9	274.50	8.79
LOCALE	38	2.18	25	3	8	252.00	9.71
Test de signification de F	S (α = 0.05)	NS (α = 0.46)	NS (α =0.20)	NS (α = 0.49)	NS (α = 0.9)	NS (α = 0.21)	S (α = 0.0001)
PPDS (α = 0.005)	18	0.40	15	2	4	196.20	1.47
Coefficient de variation (%)	31	11.65	54	39	30	60.48	7.71