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Maize-Cowpea Intercropping Report

Submitted to

Women in Development

and

The Gambian Mixed Farming Project

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Summary

I was selected as a Women in Development fellow to work in the Gambia on a maize-cowpea intercropping study with the Gambia Mixed Farming Project(MFP). Shortly after my arrival in the Gambia, I was offered a position as a staff member on MFP. I remained in the Gambia for five months(June-October, 1985).

The Women's Societies from twenty-eight villages located throughout the country were selected to participate in the intercropping program. These societies supplied their own maize seed for the project and paid MFP D100 for cowpea seed and fertilizer. The objectives of this project were to introduce an agronomic practice which might be beneficial to soils low in fertility, to introduce a crop high in protein to the Gambian diet, and to provide the women with information on growing a high value cash crop for their own benefit(for consumption or sale). Sixteen societies harvested maize and eleven harvested cowpeas. Of these societies, eight harvested both crops. Eight society fields failed, mainly due to insect problems, livestock grazing, or poor location of the field. Using unknown cowpea cultivars may have caused cowpea failures in some fields.

Cowpea cultivar trials and cowpea-maize intercropping trials were also conducted on the experimental station at Yundum.

Literature Review

Intercropping legumes and grains may be one method of using nitrogen more efficiently. Research involving intercropping has resulted in a mixture of information regarding its benefits.

Historically, intercropping has been practiced in eastern Gambia(Weil, 1980). In recent years, however, farmland has been used increasingly for cash crop production(groundnuts) rather than subsistence. The female labor force, once traditionally reserved for food production, has become increasingly involved in groundnut production. Consequently, less food is produced for consumption and more must be imported.

Cowpeas are a valuable cash crop and would provide a source of income for the women farmers as well as improve the nutritional balance of local food production. Intercropping maize with cowpeas would provide one crop high in carbohydrates complemented by one high in protein. Cowpeas could be particularly important to female growers since males in some regions of the Gambia are traditionally given higher quality foods(Weil, 1980). In Tanzania, Jeffers and Triplett(1979)considered the nutritional benefits of intercropping cereals and legumes to be one of the most important measures of the success of intercropping. Total yield is usually the parameter for evaluating successful intercropping. Although yield is an important parameter, it does not reflect nutritional value or land use which are also important benefits of an intercropping system(Francis, 1978).

Intercropping cowpeas(*Vigna unguiculata*)with maize was introduced to the Gambia. Cowpeas is a summer crop which grows best with 750-1000mm of rainfall. However, it is drought tolerant and has been reported to do well in the Sudan with only 400mm of rainfall(Skerman,1977). To enhance nitrogen fixation, inoculation with a specific strain of cowpea Rhizobia is

beneficial. Inoculation is not essential; cowpeas are nonspecific and will nodulate freely with native Rhizobia(Skerman, 1977). This characteristic is critical in an agricultural system such as the Gambia's where inoculum is unavailable and/or unaffordable. Cowpeas compete well with low growing weeds. They are quick growing and high in protein thus valuable for human nutrition and animal forage. The thick stems of cowpeas require time to dry, consequently hay-making is more difficult. Hay should be mixed with sorghum or maize stover to provide sugar for fermentation, add bulk, and prevent protein losses (Skerman, 1977).

Insect pests are considered the major constraint to cowpea production (Raman et. al, 1978). Cowpeas, one of the major pulse crops in West Africa, are attacked by various insects at all stages of growth.

In Eastern Gambia, Weil (1980) has described the soil as low in clay, sandy, free draining, and low in fertility. Decline in soil nitrogen content naturally accompanies agricultural development(Greenland, 1980). In the Gambia, groundnuts are rotated with millet but maize is monocropped on the same field each year. Average fertilizer application is 2 bags per hectare(Eckert and Fulcher, 1984). Intercropping legumes and grains may prove to be a viable alternative to nitrogen appliction in agricultural systems such as the Gambia's where nitrogen is unavailable or unaffordable. Legumes are commonly included in an intercropping situation since potentially they may fix some of their own nitrogen and consequently conserve soil nitrogen for the benefit of other crops(Nambian et al., 1983).

Gajendra and Rajat De(1979)characterized multiple cropping systems as having plant species diversity, closed cycling of soil nutrients, reduced pest incidence, erosion control, and low, but stable yields. Traditional farm systems with intercropping have low use of technology, and require much labor;

often the availability of family labor is important(Francis, 1978).

Intercropping is a very intensive agricultural method which may result in increased productivity. Compatibility of the crops to be interplanted must be considered to avoid competition(Allen and Obura, 1983; Andrews, 1972; and Reddi et al., 1980). Intercropping is often regarded as a subsistence farmer's technique to reduce risk. Selecting the appropriate species reduces the risk(Faris et al., 1983). In the semi-arid areas of northeastern Brazil, cowpeas or common beans were intercropped with maize or sorghum. Sorghum affected the legume growth less than maize, possibly because the sorghum was shorter and more light could be intercepted by the legumes(Faris et al., 1983). Osiru and Willey(1972) suggested that some crops do better when mixed because they suffer more from intra-specific than inter-specific competition. They found the advantages of intercropping to be more evident at higher population densities.

Intercropping experiments of maize and beans in Brazil(Santa Cecilia and Vieira, 1978), Columbia(Francis et al., 1982), Sri Lanka(Gunasenu et al., 1979), and Uganda(Osiru & Willey, 1972)all indicated that beans did not affect the maize yield. The reverse was not true since bean yields were much reduced. Francis et al.(1982)estimates that the amount of competition from the maize is two to four times per plant more than that from the beans. The amount of competition depends on height, hybrid maize, and bean density.

One of the greatest advantages of crop mixtures is greater utilization of resources. Francis(1978)noted better root anchorage and consequently less lodging when maize roots were interspersed with the roots of intercropped beans.

Osiru and Willey(1972)intercropped dwarf sorghum and beans in Uganda and obtained considerably higher yields than from sole crops. Height differences were not great, therefore they did not consider height competition a

significant factor. They attributed the higher yield to the difference in rooting depths of the two crops which enabled better exploitation of soil resources.

Fisher(1977a)intercropped maize and beans in Kenya highlands and had better results for the sole-cropped than the intercropped plants in three of the four years that the study was conducted. Very short rainy seasons affected the success of the intercroppings. Mixed cropping may be a disadvantage in seasons when severe competition for water occurs.

Eaglesham et al.(1981)intercropped maize and cowpea in Nigeria under three different fertilizer regimes(0, 25kg/ha, 100kg/ha). At 0 and 25 kg/ha application levels, the nitrogen content of the maize was higher than the sole-cropped maize. Through use of N^{15} it was determined that cowpeas absorbed the same amount of fertilizer nitrogen as intercropped maize disproving the hypothesis that cowpeas "spared" fertilizer nitrogen for maize. At the 25 kg/ha fertilizer rate, the use of diluted N^{15} in intercropped vs. sole-cropped maize indicated a transfer of fixed nitrogen from cowpeas to maize. They concluded that nitrogen excretion by legumes benefited other crops only when soil nitrogen fertility was low.

Nnadi(1980)states that the contribution of nitrogen to succeeding crops in the Savanna region of Nigeria is most likely through the decomposition of roots and nuts left in the soil. Density of the roots and length of time between harvest and the next planting determine whether root nitrogen has mineralized and is available(Nnadi & Balasubramanian, 1978).

Searle et al.(1981)intercropped maize and legumes in a subhumid environment in Australia and determined there was no contribution of fixed nitrogen from the legumes to the maize. They stated this would have been possible only if the legumes senesced well before the maize matured.

Application of nitrogen inhibited nitrogen fixation in the intercropped legumes. Searle et al. attributed this decrease directly to the increase in soil nitrogen and indirectly to increased maize growth which resulted in shading of the legume.

Most intercropping research in Africa shows mixed cropping to be more productive than sole-cropping(Fisher, 1977b). Mixed cropping is the dominant system of farming for tropical subsistence farmers in Nigeria. Sorghum and millet are often intercropped with groundnuts. The cereal is planted very early at wide spacings. Later in the growing season more cereal is planted if rainfall is low, or a cash crop such as groundnuts is planted if rainfall is plentiful(Baker, 1978). Intercropping consistently resulted in greater cash returns than sole cropping of groundnuts. In Sri Lanka, Gunasena et al(1979) intercropped maize and soybeans and yielded higher economic returns regardless of the nitrogen level. However, total yield of the intercropped system depended considerably on the amount of nitrogen applied.

In Kass's (1978) review of polycropping systems, he indicates that in general, polyculture has definite advantages over monoculture. However, choice of crops and environmental conditions determine whether this technique is beneficial in specific situations. He states that the advantages of polyculture are evident with regard to nutrient uptake from the soil, economic return, and improvement of soil nitrogen status if one crop is a legume.

Blumberg(1981) stresses the idea of development with equity when introducing new projects to a country. This type of development is concerned with who is benefitting from development and encourages designing programs which aid more than a limited group.

Hill(1981) emphasizes the importance of providing women farmers as well as men with educational opportunities in agriculture. Efforts to include women as project co-operators should be intensified.

Problems specific to women farmers need to be identified for these women to benefit from new agricultural programs(Ashby, 1981). Existing extension services for rural women have focused on their domestic role and cousequently women do not receive training in improved agricultural methods.

Kidd(1984) evaluated the GMFP's efforts to integrate women into farming systems research. With regard to maize production she emphasized that women as well as men need to have access to new technologies and farm implements. She also recommended including individual women farmers as demonstrators in on-farm trials. Crop extension services are infrequently consulted by women farmers. Kidd recommends using the informal "farming groups" to which many of the women belong for providing information to the women and receiving feedback from them.

Maize-Cowpea Intercropping with the Women's Society

Margaret Norem
Marie Sambou

Introduction

The Gambia is an independent republic within the Commonwealth. It is one of the smallest countries in Africa, 250 miles long and 15-30 miles wide. Senegal surrounds the Gambia on three sides, the fourth is bordered by the Atlantic Ocean. The Gambia is on the west coast of Africa between 13°3′ and 13°49′N latitude and between 16°48′ and 13°47′W longitude. The total land area is 10,367 sq.km. The Gambia lies within the valley of the Gambian river. The highest point above sea level in the country is 90m (Dunsmore et al,1976).

The air temperature varies considerably throughout the country. Temperature and diurnal variation are moderated in the west by the Atlantic Ocean. Inland diurnal and seasonal variations are more extreme(Dunsmore et al,1976).

With regard to precipitation, the Gambia has a 7 month dry season and 5 month rainy season (June-October). The heaviest rainfall months are July and August. Average annual rainfall is 900-1100mm. Average annual rainfall declines south to north(2.5-5.0mm/km) and declines from the coast inland. The rainy season is characterized by storms of 1 1/2 to 3 km diameter, thus adjacent land areas have different rainfall over short periods. The daytime high temperature during the rainfall months is 30-34°C(Dunsmore et al, 1976).

Socio-economic

Present occupation of land has been established by historical factors. The original members of a patrilineage moved to unoccupied land and had exclusive rights to the land. Each village has an identifiable area of land

that falls under the village Alkalo. Any compound has the right to clear unclaimed land outside village jurisdiction and claim this land for the village. Land is transferred from generation to generation along male lines. Women obtain rice land primarily from their husbands but also from their parents (Dunsmore et al., 1976).

Five main ethnic groups in the Gambia account for 95% of the population(Alers-Montalvo et al., 1983):

Ethnic Group	%
Mandika	42.3
Fula	18.2
Wolof	15.7
Jola	9.5
Serahuli	8.7

Marketing outlets are local markets, village traders, Gambian Produce and Marketing Board, and "other" sources.

Credit is available primarily from cooperatives, but also from Rural Development Projects and banks.

Cropping System

Certain crops are farmed in the Gambia according to sex. Groundnuts are traditionally a male crop although women are beginning to grow more groundnuts. Millet and sorghum are also men's crops but women help with harvesting. Alluvial rice is a women's crop. Maize is grown by both sexes. Vegetables are grown by women. Strange farmers are seasonal migrants from other parts of the Gambia or other countries. In return for working in the compound head's fields two or three days per week, they are given land to farm or cash crop on. Strange farmers return to their own village at the end of the cropping season(Dunsmore et al, 1976).

Much of the farming is done by manual labor. Land preparation is usually done by animal traction although clearing by hand is still quite common.

Farm equipment and draft animals are desirable purchases if cash is available. Pesticides, improved seed, and fertilizer are other inputs farmers desire to purchase if money is available to do so.

Background for Maize Program and Mixed Farming Project

In 1979 the Department of Agriculture in the Gambia introduced a cereal package deal to encourage an increase in the production of millet, maize, sorghum and upland rice. This cereal package demonstrated the advantage of using good seed, fertilizer, timely operations, insecticides and improved farming implements (Kidman,1985). Maize was introduced through this program as a crop with export potential.

The Mixed Farming Project (MFP) began in the Gambia in 1981. The objective of this project was "to improve the well-being of the rural people through intensified integration of crop and livestock production within existing Gambian farming systems." One component of this project was the maize production program. Maize was selected for emphasis because it is an easy crop to grow and a good cash crop, particularly since the government offered a guaranteed price. Another advantage of maize is that it is an early food crop, requiring only 60-70 days to mature. Maize can be safely stored in the dry season. NCB, a Nigerian maize cultivar, was chosen for the MFP trials. The choice was based on results of maize cultivar trials conducted from 1975-1982.

The MFP maize program emphasized improved farm management practices to increase yields. Seminars were conducted for training extension personnel. The selection of farmers to participate in the program was based on their established credit. Some women were also selected to participate in the MFP maize program. This involvement eventually led to the development of the women's component of MFP.

The women's component of MFP concentrated on teaching rural women how to prepare maize as well as how to achieve better yields. Hand mills were introduced to villages and cooking demonstrations conducted. Results of this have been reported in previous MFP women's component reports. A maize-cowpea intercropping package was introduced to the Women's Societies in 1985. The results of this project will be discussed in this report.

Women's Societies

In numerous Gambian villages the women have organized women's societies. The extension service of the Department of Agriculture encourages the formation of these societies because they provide a means of bringing women together to be taught improved agricultural methods. The women's societies use cropping projects as a means of obtaining funds for social and charitable purposes. Income is generated from the sale of crops harvested from the society field. Each society has a savings account. Money is saved to purchase inputs for the next growing season and to contract the field preparation. Seed is reserved from the harvest to plant in the following year.

Women's societies can be hired to work on another field to receive additional income for the society. MFP hired women's societies to transplant grasses upcountry and to weed fields at the experimental station at Yundum. Women's societies may also be called on for nonprofit community service. For example, if the village is building a school, the society members may be asked to help with construction or cook for those doing the work.

Women's society members typically range in age from 15-40. These societies are an ideal network for channeling education to village women.

1985 Maize-Cowpea Intercropping Program

The MFP Women's Program designed a project to introduce maize-cowpea

intercropping to the women's societies during the 1985 growing season. the objectives of the intercropping project were to improve the human diet, improve stover quality for livestock, increase the rural family income, and introduce a valuable agronomic practice.

Cowpeas and maize were intercropped on one hectare. Women's societies provided their own maize and MFP provided them with local cowpea cultivars. Planting began in early July after the rains began. Harvesting of maize was in October. Cowpea harvests varied with the cultivar. For maize and cowpeas, five rows were selected at random and 10m of each row was harvested.

The technical package for the women's societies intercropping program (Marlett and Sambou, 1985) was designed considering results of intercropping studies conducted by the MFP maize agronomist on the experimental station in 1984. The technical package was distributed to extension workers in each division who were responsible for explaining the package to the societies and assisting the women in its implementation. Society selection for participation was based on the society's financial status and village location. Twenty-eight of the seventy-eight societies that had grown maize in 1984 were able to pay back their loan to the FAO fertilizer revolving fund credit scheme. These societies were selected to participate in the intercropping program. All five agricultural divisions in the Gambia were represented.

Fields were cleared by hand or animal traction. The society paid for the clearing from its savings. Once the heavy rains began, 15-15-15 compound fertilizer was broadcast over the field at a rate of 200 kg/ha with 90 cm between rows and 25 cm between plants. Two weeks after planting maize, fields were weeded and cowpeas were planted between the maize rows. Several local varieties of cowpeas were distributed to the women's societies.

Results

In some villages the agricultural extension personnel were more effective than in others and spent more time assisting the Women's Societies. The extension workers changed the intercropping design in some villages. In others, the technical package was abandoned completely and cowpeas and maize were grown separately. Too many societies were involved for MFP to assume complete responsibility for monitoring of the society fields. Consequently, it was essential that MFP personnel instruct agricultural extension personnel thoroughly with regard to the technical package.

The women's society fields are frequently the last fields assigned by the village Alkalo and are often in poor condition. Women plant society fields after their own planting is concluded so typically planting is late. Time available for field maintenance is very limited. Women usually work in their society field on Wednesday, their day of rest. Almost all of the labor is hand labor. Women work together as a group, singing while they work.

In the 1985 growing season, abundant rainfall resulted in high weed infestations in many of the fields. Presence of cowpeas in between maize rows suppressed weed growth in some fields, however in others the weeds were not deterred by the cowpeas. The women were aware of the need to weed their fields more frequently but simply had no time for the additional task.

One disadvantage of growing cowpeas is that they are plagued with insect pests. Agricultural demonstrators and society members were advised to monitor fields for insect pests and contact Crop Protection Service (CPS) when pests were observed. CPS was provided with a list of participating villages and was to provide chemicals for spraying as needed. Fuel shortages often made pesticide distribution difficult. Thrips (*Megalurothrips sjostedti*) is a major insect pest in cowpeas during the flowering stage. They infest cowpea blossoms, causing them to abort. If untreated, the cowpea plants continue

developing vegetatively but lose all their blossoms before pod development can occur. Thrips are very small and can go unnoticed to the untrained eye.

Society fields were visited by MFP personnel(Norem, Sambou)throughout the growing season. Progress was monitored and problems discussed during these visits. The importance of monitoring for thrips was emphasized during these visits.

Each society was required to provide its own maize seed and to pay MFP D100 ($28.57) to participate in the program. This is a significant sum of money and its payment should have indicated society interest in the program. Of the 28 women's societies participating, eight did not harvest either maize or cowpeas from their fields(Table 1). It is important to examine whether these failures were due to lack of interest, time constraints, or pest damage.

Several societies planted maize and then had no time to maintain the fields. Fields became densely overgrown with weeds and cowpeas were never planted. One society explained that the severe rice shortage had forced the women to spend much of their time searching for rice and consequently they did not have time for the society field. A common problem for several villages was that they were assigned fields 2 km or further from their village. As they became busier in their own fields they did not have time to travel the distance to maintain the society fields. When fields were so distant, it was difficult to have a society member or child guard the field and watch for insects or monkeys. One society reported that its distant field was destroyed by monkeys.

Sixteen of the societies did harvest maize(Table 1). Yields varied from very high to quite low. The women had experience with maize from previous growing seasons and were aware of the investments needed for a good crop.

Results of cowpeas were unsuccessful with only eleven villages reporting

harvests(Table 1). As previously mentioned, in several fields cowpeas were not even planted due to dense weeds. Weeds were a major problem in fields in which cow eas were planted as well. In many fields the thrips infestations went unobserved or had developed too far before CPS was contacted. Sometimes CPS could not respond to calls due to fuel shortages.

Another problem was that the cowpea seed that was distributed was local cultivars from throughout the Gambia and the Cassamance region of Senegal. The seed had been purchased at the local markets and growth characteristics, including day length requirements were not known. Possibly several of these cultivars were not planted at the right time of year to produce pods.

Using cultivars of known characteristics would have enhanced the chances of obtaining a cowpea harvest. However, the use of a known cultivar is no guarantee due to the severe insect problems which accompany cowpea cultivation. (On the experimental station at Yundum, many known cultivars produced only vegetative growth due to thrips infestations.)

Discussion

This method of intercropping was new to the Gambian women, however, growing cowpeas was not new. Cowpeas are a desirable food crop and are frequently grown in backyard gardens. Undoubtedly local cultivars are used and pesticides are not available. In a backyard garden the cowpeas are close to the compound and easier to monitor for insects. Pests are also easier to control since fewer plants are grown.

While visiting some women's societies, they were asked about local customs for controlling insect pests. Practices for controlling the cowpea weevil *Callosobruchus maculatus*, a severe problem in harvested seed, included steaming seeds or storing them in oil, ash, or chillies to repel the weevils.

A survey conducted by CPS(Sagnia, 1984)revealed several local methods

which may be effective in controlling insect pests on cowpeas as well as other crops. Broadcasting wood ashes on plants, particularly vegetables, to protect them from insects is widely practiced in the Gambia. Insects can be attracted to a site away from the field using bran, fresh cow dung, or green baobab fruit. They are then killed by burning or burying. Burning blister beetles is reported to produce an odor which discourages other blister beetles from the area. Another practice of dubious value is cutting the ovipositors off of ten female blister beetles and using these insects to frighten away others. Neem tree berries(*Azadirachta indica*)are dried, pounded, and used as seed dressing or to ward off field pests.

These local methods of pest control are important to identify and evaluate. Instructing village women to use particular customs such as these may be more valuable than teaching them to rely on pesticides which are frequently unavailable and often too late in arriving to be effective.

Conclusion

In retrospect, it is apparent that local Gambian customs for cowpea production should have been better understood prior to implementing this program. The technical package should have included more information on insect pests and extension agents should have received training regarding these pests. Ideally, a pesticide spraying program should have been set up in advance rather than relying on contacting CPS once pests were observed. Finally, a known cowpea cultivar with proper day length requirements should have been distributed. Unfortunately, this is the final season for MFP so an important follow-up program is not possible. Hopefully these suggestions will be useful to other projects carrying on future intercropping work in the Gambia.

Despite the failure of the cowpea crop the work with the women's societies should be regarded positively. The village women were recognized as farmers and singled out for instruction. The women seemed eager to learn and always receptive to MFP personnel. The women's societies in the Gambia are an ideal network that is already established and could easily be used by developmental projects for the WID efforts. In 1986 the DOA of the Gambia established a permanent Women's Program. Marie Sambou, a MFP staff member and my counterpart was assigned to this group.

Table 1

Participating Villages

Village	Division	Maize Harvest(kg)	Cowpea Harvest(kg)	Comments
Giroba-Kunda	URD	150	-	
Mansa-Jang	URD	976	270	
Kisi-Kisi	URD	900	380	
Tinkinjo	URD	1100	400	
Tuba	URD	1800	130	
Taibatu	URD	-	290	
Bajon Koto	URD	-	230	
Madina Koto	URD	-	496	
Jendeh	URD	100	340	
Koli Bantang	URD	-	-	
Limbambulu	URD	2300	240	
Bati	MID	400	8	
Njoben	MID	2400	-	Planted both crops in same row at same time.
Boiram	MID	2500	-	Planted both crops in same row at same time.
Saruja	MID	830	-	180 cm between maize rows.
Cha-Kunda	MID	1000	35	
Kanni Kunda	LRD	-	-	Livestock grazed field.
Madina Sancha	LRD	600	-	
Jassong	LRD	-	-	Extension Agent resigned.

Table 1 (continued)

Village	Division	Maize Harvest(kg)	Cowpea Harvest(kg)	Comments
Kerewan	WD	-	-	Did not Intercrop.
Busumbala	WD	-	-	Cowpeas not planted.
Beeta	WD	285	-	Very late planting.
Kassange	WD			Results not known.
Jorem Bunda	WD	50	-	
Kanuma	NBD	-	-	Cowpeas not planted due to weeds.
N'Jawara	NBD	158	-	
Sallikere	NBD	-	-	Field 2 km from village.
Kerewan	NBD	-	-	Field too far from village.

MFP 85-4
Maize-Cowpea Intercropping
Margaret Norem MFP
Sankung Sagnia CPS

MATERIALS AND METHODS

Cowpeas *Vigna unguiculata* and maize *Zea mays* were grown simultaneously in alternate rows under two intercropping arrangements at the experimental station at Yundum. A planting pattern alternating single rows of maize(Jekka variety) and cowpeas(variety TN88-63) was compared with a pattern alternating double rows of maize and cowpeas. There were 50 cm between rows. The experimental design was a randomized complete block with eight replications of two treatments. Maize was planted on July 9, 1985. Cowpeas were planted at first weeding on July 23, 1985. Compound fertilizer 15-15-15 and urea were each applied to the maize twice. Cowpeas did not receive fertilizer applications.

Plant stand counts of maize were made one month after planting and at harvest. Number of ears, fresh weight, dry weight, and grain weight were measured on two rows from each plot. Percent moisture was measured using a crop moisture detector(Delmhorst Instrument Co., Model G-6C). Yield in kg/ha was calculated for maize using this measurement. Plant stand counts of cowpeas were made one month after planting. Prior to harvest, the number of pods per 5m section for two rows per plot was counted. Two rows from each plot were harvested and fresh weight, dry weight and seed weight were measured. Yield in kg/ha was calculated.

Insect monitoring and pesticide applications were conducted by the Crop Protection Services.(Table 5) Activities of foliage beetles(*Ootheca mutabilis*), thrips(*Megalurothrips sjostedti*), legume pod borer(*Maruca testulalis*) and pod sucking bugs(*Anaplocnemis curvipes*, *Riptortus dentipes*,

Aspavia armigera, *Nezara viridula*)were monitored throughout the growing season. Insect damage was assessed at harvest.

RESULTS AND DISCUSSION

For all of the parameters measured for cowpeas, and all except one of the parameters measured for maize, there were no significant differences between treatments(Tables 1 and 2). Single rows of maize produced significantly more ears than double rows of maize. This difference was not reflected in the weight measurements. Monitoring for insect activity on cowpeas revealed no significant differences due to crop arrangements with one exception(Table 3). At 38-40 DAP there was a significantly higher number of thrips present on single rows of cowpeas than on double rows of cowpeas. Percent pod damage was not affected by cropping arrangement(Table 4). Double row arrangement produced 66% healthy pods and single row arrangment produced 62% healthy pods.

Several cowpea plants from each plot were uprooted and examined for the presence of nodules. Very small nodules were detected on some of these roots. This indicates that a minimal amount of native Rhizobia was present or its activity was suppressed due to adverse soil conditions. Absence of nodules on most cowpea roots indicates that almost no nitrogen fixation was occuring.

The field used for this research had been planted with sorghum in 1984 and groundnuts in 1983. Soil samples were taken, however, results are not yet available. The field was not level and drainage after heavy rainfall resulted in fertilizer losses and lodging of maize. Maize stands were very poor and maize appeared nitrogen deficient. A good maize yield is 1500-2000 kg/ha; yields from this field were extremely low(Table 1). Monocrops of maize at the same site also did poorly indicating that intercropping did not inhibit the maize and that poor maize was a result of poor soil.

The cowpeas grew very well covering many of the smaller maize plants. Cowpeas apparently were more tolerant to adverse field conditions. Cowpea yields of 158 and 177 kg/ha for single and double row cropping respectively, were fair yields. Time did not permit including data from a second harvest which would have resulted in higher yields. A yield of 300-600 kg/ha is considered good in West Africa.

No conclusions can be drawn with regard to the effects of these two cropping arrangements on crop performance or insect pest populations. Cowpeas were not shaded by maize in either arrangement and growth was not suppressed. A good maize stand may have affected cowpea performance due to shading. The presence of cowpeas did not enhance maize growth. Since no nitrogen fixation occured, maize did not benefit from the intercropping arrangement. Inoculation with Rhizobia to encourage nodulation and consequently nitrogen fixation may enhance maize performance. In this particular field the benefits could still be minimal.

TABLE 1. Maize plant stands and harvest weights

CROP-PING ARR. MENT	STAND AT ONE MONTH	STAND AT HARVEST	NO. EARS PER 2 ROWS	FRESH WEIGHT 2 ROWS(g)	DRY WEIGHT 2 ROWS(g)	GRAIN WEIGHT 2 ROWS(g)	YIELD (KG/ HA)
Double Row	62a	48a	23b	4630a	1069a	703a	296.6a
Single Rows	61a	54a	48a	5370a	1233a	821a	348.6a

Means in the same column followed by the same letter are not significantly different at the 5% level of probability (Student's t test).

TABLE 2. Cowpea plant stand and harvest weights

CROPPING ARRANGE-MENT	STAND AT 1 MONTH	NO. PODS PER 5M SECTION 2 rows	FRESH WEIGHT (g)	DRY WEIGHT (g)	SEED WEIGHT (g)	YIELD (KG / HA)
Double Rows	59a	440a	1153a	550a	353a	176.6a
Single Rows	62a	499a	923a	465a	317a	158.4a

Means in the same column followed by the same letter are not significantly different at the 5% level of probability (Student's t test)

TABLE 3. Mean number of thrips and *Maruca* larvae for five growing periods

CROPPING ARRANGE-MENT	NO. THRIPS / 20 RACEMES / PLOT			NO. THRIPS / 20 FLOWERS/ PLOT		NO MARUCA LARVAE 20 FLOWERS/ PLOT	
PERIOD	30-35 DAP*	38-40 DAP	42-45 DAP	45-58 DAP	52-55 DAP	45-48 DAP	52-55 DAP
Double Rows	0.00a	0.375a	0.00a	19.13a	4.13a	10.13a	1.0a
Single Row	0.125a	0 .750b	0.00a	15.38a	3.75a	6.25a	1.5a

Means in the same column followed by the same letter are not significantly different at the 5% level of probability (Student's t test).

*DAP = Days after planting.

TABLE 4. Percent pod damaged by *Maruca* and pod-sucking bugs as compared to healthy pods in the two cropping arrangements

CROPPING ARRANGEMENT	% HEALTHY PODS	% POD DAMAGE BY MARUCA	% POD DAMAGE BY PSB+
Double Rows	66.88a	18.13a	13.13a
Single Rows	61.88a	16.25a	20.63a

Figures in the same column followed by the same letter are not significantly different at the 5% level of probability (student's t test).

+ PSB = pod sucking buds

Table 5
Insecticide Application Schedule

Insect Pest	Crop	Insecticide and Rate	Date of Application
Millipedes	Maize	BHC + millet bran 1:20 by volume	July 17
Millipedes	Cowpeas	BHC + millet bran 1:20 by volume	July 29
Amsacta	Maize Cowpeas	Malathion @ 1.5 l formulation/ha	July 27
Thrips	Cowpeas	Decis + Dimethoate @ 0.5 l and 1.25 l formulation/ha respectively	August 16
Aphis craccivora	Cowpeas	Dimethoate @ 1.25 l formulation/ha.	Sept. 2
Thrips and Maruca	Cowpeas	Decis and Dimethoate @ 0.5 l and 1.25 l formulation/ha respectively	

Cowpea Cultivar Evaluation

Margaret Norem

A cowpea cultivar trial was planted at Yundum using sixteen cowpea cultivars provided by Dr. A. Hall of the University of California at Riverside. Cowpeas were intercropped with Jekka maize using an alternate row design (Figure 1). Two weeks following the maize planting, at first weeding, cowpeas were planted.

MAIZE

Compound fertilizer 15-15-15 and urea were applied on the maize. Extremely heavy rainfall affected the amount of fertilizer actually taken up by the maize. Maize stands were very poor. The field used for this trial had been planted with groundnuts in 1984 and maize in 1983. Results from soil samples were not available for this report. It is apparent that the field was nitrogen deficient. No maize harvest data was collected.

COWPEAS

Drought resistant cowpea varieties from Senegal and California were planted in the cultivar trial. These varieties required 60-75 days to mature. Vegetable type cowpeas from India were also planted. This type is harvested while the pods are still green and the pods are eaten. The growing period for the vegetable type is 50 to 60 days. At the time of cowpea germination, the fields were infested with hairy caterpillar, *Amsacta, sp.*, and millipedes which destroyed many cowpea seedlings. The easternmost plots had particularly poor stands as a result of this infestation. There was no extra seed available for replanting.

Cowpea cultivar data is reported in Table I. California Blackeye-5 (CB-5), short cycle varieties E-16 and A-31 and drought resistant cultivar 8006 had the highest yields. Other cultivars had very good vegetative growth but poor pod production due to insect damage.

Roots of three plants from each cultivar were examined for nodules. An occasional very small root nodule was detected. Lack of nitrogen fixation may be attributed to the absence of native soil Rhizobia or the suppression of Rhizobium activity caused by adverse soil conditions. Inoculation with a selected cowpea strain of Rhizobia may have enhanced growth of cowpeas.

CONCLUSIONS

Initial results indicate that with good insect control, several of these cowpea cultivars could be grown in The Gambia. Short growing seasons and large seed are characteristics which make these cultivars attractive for cultivation in The Gambia. No conclusions can be drawn with regard to the performance of these cultivars in an intercropping situation due to poor maize stands.

Harvested seed has been given to S. Owens, Maize Agronomist, for future research.

M.F.P. 85 - 5
Cowpea Cultivar Evaluation
Table 1

Planting Date: Maize - July 9, 1985 Cowpeas - July 23, 1985
Harvest Date: Vegetable Type Cowpeas - Sept. 23, 1985
Drought Tolerant Cowpeas - Oct. 4, 1985

Cultivar	Stand Count 22 DAP		Stand Count at Harvest		No. Pods Per Plant		Fresh Weight (g)		Dry Weight (g)		Nodule Prod. (+, -)	
Plot	1	2	1	2	1	2	1	2	1	2	1	2
CB 5	16	14	13	12	3	2	60	NA	18	NA	-	+
UCR-193	6	11	5	11	10	5	125	155	56	42	-	-
UCR-194	6	7	6	7	7	10	95	115	40	56	-	+
UCR-204	6	7	5	3	9	6	100	25	49	NA	+	-
UCR-206A	4	4	4	3	9	10	135	90	27	17	-	-
PRIMA	2	7	1	7	2	5	10	125	1	6	-	-
1-12-3	0	8	0	6	0	5	0	135	NA	44	-	-
CB-3	4	12	4	10	2	4	35	210	9	46	-	-
CB-5	4	18	3	9	3	5	10	260	3	79	-	-
8006	9	18	7	17	3	5	90	255	69	82	+	-
8055	18	20	4	18	4	2	90	80	73	42	+	+
1-2-1	18	18	6	20	2	1	55	85	44	55	+	+
1-12-3	14	25	2	21	4	2	45	100	38	59	+	-
C-17	12	25	14	27	2	3	60	50	34	33	-	+
3-14-13	3	20	13	27	3	2	5	40	5	33	-	+
CHINO M-1	6	22	16	18	3	2	10	20	9	18	-	-
E-16	4	21	17	18	4	3	20	100	17	75	-	+
A-31	7	18	9	18	7	5	25	105	17	74	-	+

MFP 85-5
Cultivar Trial
Figure 1

Maize	Maize
8006 Resistant Drought, Fusarium Wilt	CB-5 Standard California Cultivar
Maize	Maize
8055 Resistant Fusarium Wilt	UCR-193 Vegetable, Edible Pod, 50 Days
Maize	Maize
1-2-1 Drought Tolerant, 60-75 Days	UCR-194 Vegetable, Edible Pod, 54-55 Days
Maize	Maize
1-12-3 Drought Tolerant, 60-75 Days	UCR-204 Vegetable, Edible Pod, 57 Days
Maize	Maize
C-17 Short-cycle (Chino ELX 1-12-3)	UCR 206-A Vegetable, Edible Pod, 57 Days
Maize	Maize
3-14-13 Drought Tolerant, 60-75 Days	Prima Vegetable
Maize	Maize
Chino M-1 Vigorous, High Yielding	1-12-3 Drought Tolerant, 60-75 Days
Maize	Maize
E-16 Short-cycle (Chino E1 x 3-14-13)	CB-3 Vegetable
Maize	Maize
A-31 Short-cycle	CB-5 Standard California Cultivar
Maize	Maize
Maize	Maize
Plot 1	Plot 1

Plot 2 is a replicate of Plot 1

RECOMMENDATIONS

With regard to future cowpea-maize intercropping projects it is recommended that a known cultivar with a short growing season be planted. The technical package for such a project should include information on cowpea insect pests and methods of control. Pest control should emphasize local traditional methods (which have been researched and found to be effective) of pest control which do not depend on pesticides since obtaining pesticides is a major constraint. Field maintenance must also be emphasized.

The technical package must be clearly written and explained fully to the extension agents who will be communicating this information to the women farmers. Extension agents need to recognize the importance of communicating with rural farmers as well as with the project supervisors.

Women's Societies are good networks for channelling education which is already well-established. Some critics feel that by relying too much on this network to educate the women, the women may be overlooked for the main project activities and objectives. In attempting to aid rural women farmers, it is important to meet with the women and discuss their interests and educational needs and determine whether these are considered in the project objectives. In addition to assessing their interest in particular project activities, it is important to discover whether they are comfortable being trained alongside men. Due to cultural traditions, it may be necessary to single women out in such groups as the Women's Societies for training, rather than integrating them completely into the main project. To summarize, it is important to fit the project to their needs and customs, rather than fitting the women into the project.

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Yundum, Western Division,
The Gambia

9th March, 1984.

PEST CONTROL METHODS USED BY GAMBIAN FARMERS.

Reported in survey by C.P.S. staff, July, 1981.

(Survey organized by S.B. Sagnia, Scientific Officer). Village (s) and division listed are those in which the method was reported.

1. Bird scaring, using ropes tied to poles at the corners of early millet fields. Sometimes "bells" made with empty milk tins and small stones are attached to the ropes.
   Boiram, Njoben, Mamutfana, M.I.D. Sandi Kunda, URD.

2. Bush pig and bush fowl scaring with white plastic bags tied to sticks in sorghum fields. Jahali, MID. The same method is used for village weaver birds in rice nurseries, Fulabantang, M.I.D. (Similar scaring devices can be seen in groundnut fields in the M.I.D.)

3. Killing millipedes with a hoe in millet, sorghum and groundnuts. Tallen Fula, N.B.D.

4. Placing heaps of grass in the field to attract millipedes in maize, millet, and groundnuts. These heaps are then set on fire to kill the millipedes. Sama Musu and Kerr Katim, N.B.D.

5. Handpicking and burning of millipedes and hairy caterpillars on early millet and groundnuts. Ntoro Cham, NBD.

6. Burning rope and making scarecrows that look like people to drive away bushpigs attacking groundnuts. Tambasansang, U.R.D.

7. Placing baobab fruits (Adansonia digitata) on the ground to attract cotton stainers (Dysderus spp) on various crops. Mankamang Kunda, U.R.D.

8. Burying, locusts in trenches dug around the field, burning them in the field and driving away the flying locusts with tree branches. Barro Kunda, L.R.D.

9. Repelling blister beetles (Meloidae) by burning some of them or by hanging leaves of the "Keno" tree (Pterocarpus erinaceus ?) in the maize or millet field. Jappeni, LRD.

10. Cooking blister beetles at the corners and the center of the millet field to make a repellant smell. To prevent an attack, the farmer destroys or removes any dry grass from the field of millet seedlings, since the grass is a good habitat for the beetles. Ballanghar Jallata, M.I.D.

11. Handpicking of blister beetles or burning sorghum or millet bran in the millet field to repel them. Follolo, L.R.D.

12. Burning blister beetles or "netto" fruit (Parkia biglobosa) to repel the beetles in millet fields. Sittahoma, L.R.D.

13. Distracting blister beetles by placing split green baobab fruit, which the beetle prefers, at various points in the millet field. Manduar, L.R.D.

14. Handpicking and smoking (to repel?) blister beetles in millet. Manduar L.R.D.

15. Handpicking, drying and burying millipedes on groundnuts. Jassong, L.R.D.

16. Burning grasses to "kill" blister beetles with the smoke in maize, millet and findo (Digitaria exilis). Sareh Manso, U.R.D.

17. Using goat dung or pepper (Capsioum) on harvested groundnuts to protect them from the groundnut beetle (Carydon serratus). Fatoto, U.R.D.

18. Mixing goat dung with stored rice and groundnuts to control insects. Tabanding Wuli, U.R.D.

19. Smoking out the store and mixing "dofee" (bran) with rice or groundnuts to protect them against insects. Foday Kunda, U.R.D.

20. Broadcasting wood ashes on vegetables to protect them from pests. (This is a widely followed practice in The Gambia) Chamoi, U.R.D.

21. Use of woodashes on late millet seedlings to "kill" army worms. Sotuma, U.R.D.

22. Fencing fields and lighting fires around the field at night to scare bushpigs attacking groundnuts. They are also hunted with guns. Sandi Kunda, U.R.D.

Reported in 1981-82 Farmer Training Program. From the Lower River Division, By M. L. Touray.

23. Use of manure as a fertilizer to control Striga hermonthica.

24. Use of a cow manure slurry to control cassave mealybug.

25. Adding a slurry of Neem (Azadirachta indica) leaves? or berries? to the soil in vegetable gardens to control insects.

REPORTED IN 1983 FARMER TRAINING PROGRAM

Except where noted, methods are from the North Bank Division as reported by Seedy F.D. Njie, Pest Control Superintendent.

26. Broadcasting bran to attract/distract millipedes and grasshoppers and burying them by plowing.

27 Placing fresh cow dung in the field as a repellant for millipedes.

28. Clearing weeds around the field to reduce blister beetle attack.

29 Collecting and burning blister beetles so that smoke acts as a repellant.

30. Baiting blister beetles with split green baobab fruit so farmer can kill them.

31. Cutting the ovipositors off of ten blister beetles to frighten others.

32. Burning creosote or old tires so smoke is a repellant for blister beetles and bush pigs.

33. Driving locusts into trenches and burying them.

34. Clearing the area around the groundnut stack to prevent attack by sucking bugs.

35. Early threshing of groundnuts to reduce sucking bug attack.

36. Placing wood of "Jalo" tree (Khaya senegalensis) on the groundnut stack to repell sucking bugs.

37. Neem tree (Azadirachta indica) berries? dried and pounded used as a seed dressing or for field pests.

38. Leaves of the "waiye" tree (?) placed at the corners and center of the field to prevent diseases.

39. Flowers of the "sunn" tree (Lannea acida) used as a seed dressing to prevent all pest attacks.

40. Fresh cow dung used as an attractant for insects, which are then killed

41. Use of ashes against termites (?)

42. Removal of "dead hearts" on cereals to control stemborers.

43. Uprooting young plants and using compound fertilizers to control Striga hermonthica.

44. Simultaneous planting of large areas of cereal crops to reduce weaver bird attack.

45. Early harvesting to reduce losses caused by weaver birds.

47. Burning pieces of cloth tied to trees at night to repel pigs and monkeys.

48. Keeping fires burning around field at night to repel pigs and monkeys.

49 Burning bran at the suspected entry points of bush pigs at night.

50. Using trained dogs (in field or hunting?)

51. Hunting pigs and monkeys with guns.

52. Hanging a dead monkey on a stick in the field to scare others.

53. Baiting millipedes with the fruit of "bush mango" (Cordyla pinnata). East Kiang, L.R.D.

54. Using salt water to control termites in stores. L.R.D.

55. Bending the stalk of a smutted sorghum plant to bury the head so that the new head is smut-free. Western Division.

56. Use of "wollo" tree (Terminalia sp.) leaves to repel blister beetles and sucking bugs. Fonis, Western Division.

REPORTED BY FRAMERS IN MAMUTFANA, M.I.D., 1984.

(according to S. Bruce-Oliver, Field Coordinator)

57. Scattering bran in the groundnut field to distract millipedes from seedlings.

58. Burning a fire at night to attract blister beetles so they can be placed in the fire - the smell drives other beetles away.

59. Placing a stick of wood in the ground to attract termites away from groundnut plants.

COMPILED BY
DAVID CHALKLEY
TRAINING OFFICER
MARCH 7, 1984.

Birds - 1, 2, 44, 49, 48.

Blister beetles - 9, 10, 11, 12, 13, 14, 16, 28, 29, 30, 31, 32, 56, 58.

Bush pigs - 2, 6, 22, 32, 47, 48, 49, 50, 51.

Caterpillars - 5, 21.

Cotton stainers - 7.

Diseases - 38, 55.

Grasshoppers - 26.

Groundnut beetle - 17.

Insects (general) - 18, 19, 20, 25, 37, 39, 40.

Locusts - 8, 33.

Mealybug - 24.

Millipedes - 3, 4, 5, 15, 26, 27, 53, 57.

Monkeys - 47, 49, 50, 51, 52.

Stemborers - 42.

Striga - 23, 43.

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Smoke/smell - 6, 10, 11, 12, 14, 16, 19, 29, 32, 48, 58.