Transfer of Sorghum, Millet Production, Processing and Marketing Technologies in Mali

Bi-Quarterly Report
October 1, 2009 – March 31, 2010

USAID/EGAT/AG/ATGO/Mali
Cooperative Agreement # 688-A-00-007-00043-00

Submitted to the USAID Mission, Mali

by

Management Entity
Sorghum, Millet and Other Grains Collaborative Research Support Program (INTSORMIL CRSP)

Leader with Associates Award: EPP-A-00-06-00016-00

INTSORMIL
University of Nebraska
113 Biochemistry Hall
P.O. Box 830748
Lincoln, NE 68583-0748 USA
SRMLCRSP@UNL.EDU

Table of Contents

	Page
Introduction	3
Management Entity	4
Production-Marketing Activities	4
Food Processing Technology Activities	24
Décrue Sorghum Activities	28
Training Activities	55

Production-Marketing

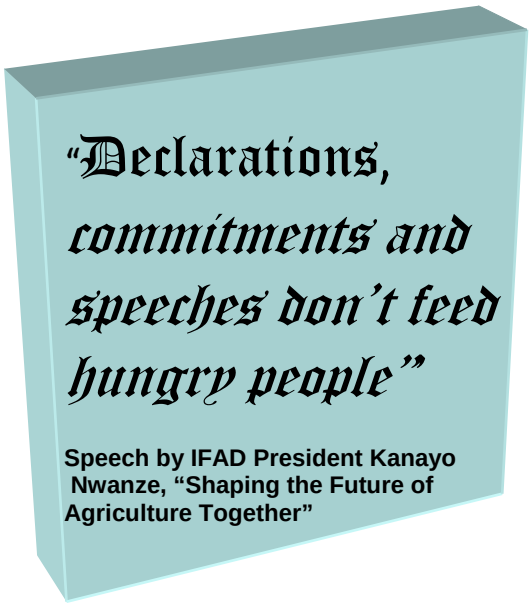
Décrue

Processing

Training

Introduction

Thomas Melito, Director, International Affairs and Trade, Government Accountability Office (GAO) in *GAO's March 2010 report, Global Food Security: U.S. Agencies Progressing on Governmentwide Strategy, but Approach Faces Several Vulnerabilities (GAO-10-352)* stated that "Global hunger continues to worsen and more than 1 billion people are estimated to be undernourished worldwide. The international community has set ambitious goals toward halving global hunger by 2015, and major donors, including the United States, have made a commitment to increase aid for agriculture and food security by $22 billion in the next 3 years. However, according to IFAD President and former WARDA DG Kanayo Nwanze in a speech on the future of agriculture to the G8 leaders and participants at the Global Conference on Agricultural Research for Development, "Declarations, commitments and speeches don't feed hungry people." In response, Roger Thurow in "Outrage and Inspire" <http://globalfoodforthought.typepad.com/> stated that it was time to put their (G8 leaders) declarations, commitments and speeches about attacking hunger through agriculture development into action. This report presents progress in putting commitments into action via the USAID/Mali Mission supported Cooperative Agreement with INTSORMIL "***Transfer of Sorghum, Millet Production, Processing and Marketing Technologies in Mali.*** This action is being done by meeting the following objectives***.***



Objectives

- Facilitate adoption of production and marketing technologies to improve the incomes of sorghum and millet producers
- Facilitate the development of markets for food use for millet and sorghum and as a poultry feed for sorghum
- Develop stronger farmers' groups and enhance their marketing power
- Extend mechanized food processing technologies to entrepreneurs and processor groups
- Introduce improved agronomic practices into décrue farming systems in northern Mali.

This report details the activities and progress achieved during the period January 1 – March 31, 2010 (including the Dec. 2009 Partner's Meeting in Bamako) under the Cooperative Agreement # 688-A-00-007-00043-00. The report covers progress in the **Production-Marketing**, **Food Processing, Décrue Sorghum** and **Training** components.

Project Components

Management Entity

USAID Mali Mission Partner's Meeting December 2009

INTSORMIL was represented at the Partner's meeting by the Management Entity (E. Heinrichs), IER Coordinator (M. Diourte)), Production-Marketing (J. Sanders, B. Ouendeba and N. Yaro Diarisso), Processing (B. Hamaker and Yara Koreissi), Décrue Sorghum (V. Prasad. A. Wahab Toure) and Training (J. Lowenberg De-Boer). A Power Point presentationat the meeting covering all components of the project has been posted on the INTSORMIL website < http://intsormil.org/> under "ME Presentations" entitled <**2009 USAID Mali Mission Associate Award Partner's Meeting**>. All project components found the meeting extremely profitable as new collaboration was established which will significantly increase the impact of the project. These new collaborative relationships are described in the component reports that follow.

Production – Marketing Activities

John Sanders, Purdue University

Update on the Production-Marketing Project for the 2010 Crop Year

April 2010

John H. Sanders
Botorou Ouendeba
Niaba Teme

From March 11-25 Botorou Ouendeba, Niaba Teme and John Sanders traveled to the various sites in which either IICEM or the Production-Marketing project are supporting the extension of new technologies in the summer of 2010.

The Production-Marketing project is collaborating with IICEM to put approximately 3,000 ha in new sorghum and millet technologies with the aid of bank financing during the crop year, 2010. This includes 2,500 ha in sorghum (see Table 1).

IER-AMEDD-Production/Marketing project demonstrated the potential of the Caudatum-Guinea cross, Grinkan, in 2008 and 2009 in the greater Koutiala region including a field day supported by the project in the fall of 2009 (See Photos 1 and 2 of Grinkan) . IICEM will be providing a guarantee fund in the absence of collateral for the input credits to pay for the fertilizer and seed. Lending is expected at a 14% annual rate for a ten month period. AMEDD will be providing the extension and marketing support . Production-Marketing and IER will be providing the technical inputs for the agronomy, marketing, and institutional development of the farmers' coops.

Present priorities are to get the loans operational, purchase the fertilizer[1] and distribute it to farmers by mid-May. We spent time with AMEDD technicians and in the field with the farmers' groups in four different villages in the Koutiala region. In Garasso farmers had 200 tons of Grinkan to sell from the 2009 harvest. They are anxious to sell before the rains start as it is very difficult to get a truck to the village once the rains start. AMEDD is helping them market and the PAM program is apparently willing to pay them 125 CF/kg presently. The harvest price was below 100 CFA/kg in 2009 so this will be a good gain from the marketing as well as very high yields of Grinkan. Farm level averages are expected to be 1.5 t/ha with best farmers 2 to 3.5 tons/ha. *It will be necessary to keep pushing with the bank, AMEDD, the fertilizer company and transporters to make sure that the fertilizer is in the villages by mid May.* [2]

We are also collaborating with IICEM in expanding the area in the millet cultivar, Toroniou. This cultivar and the associated agronomic and marketing practices of the Production-Marketing project have been adopted in Tingoni (near Segou). Average farmer yields of 1.2 tons have been achieved with best farmers getting 1.5 to 2 t/ha. Again the technical question is whether the combination of Sasakawa 2000 and the DRA can organize with the bank for the farm loans, purchase and deliver the fertilizer into the farmers' villages by mid May. IICEM is again providing the loan guarantees and bank conditions are expected to be similar to those in Tingoni. Sasakawa is further behind than AMEDD in the bank contacts and negotiations with fertilizer dealers.

In Tingoni the "bache" are not working according to farmers as they are breaking too often as the farmers thresh with tractors running over the grain. The World Food Program used two sieves for cleaning and gave the farmers a quality premium. We need to reexamine our program for cleaning the grain and evaluate moving to sieves or to mechanical threshers. So far the experience with mechanical threshers has been one of frequent breakdowns during critical

[1] Most of the seed (9.2 tons) has already been set aside in storage by AMEDD.

[2] The fertilizer needs to be available early before the farmers have made all their planning decisions on priority crops and the land areas for their different activities

periods. We probably need to discuss with IICEM purchase of several threshers and following the repair issue. Is this a failure of brining in clean grain and therefore repeatedly breaking the threshers down. We also need to convince farmers after cutting the heads to avoid putting them on the ground. The 20 to 25 CFA/kg price premium for quality is an important project component so our improved strategy needs to be identified and pursued in the 2010 season.

Our priority in 2010 is to facilitate this IICEM expansion by providing technical orientation and field reviews but we are expanding our own pilot project operations into Mopti (300 ha), Segou (100 ha), Kolokani (60) and the Kayes (195) region in 2010 (see Table 1).Our own pilot project work in 2010 is now shifting to lower rainfall and more difficult regions further from the major markets, specifically Mopti and Kayes. Here we will be more concerned with fertilization and with risk. We also need an improved millet cultivar to succeed Toroniou and a cross between Guinea and Caudatum to avoid the headbug-mold complex that plagues us with Seguifa.[3]

In the Mopti region the regional DRA director has been replaced and the new regional director has expressed strong interest in the project. We visited all the prospective sites and there is substantial farmer interest. We are also coordinating with IICEM on building storage facilities in the six sites selected once the farmers commit to doing the construction. Then IICEM can finance the cement, doors, windows and roof. As in Tingoni this is also the millet cultivar Toroniou. We need to improve on the seed supply as the farmers were unhappy with the poor seed quality. We also need to work with the millet breeders of IER on an improved millet cultivar adapted to this region and to the greater Segou region as Toroniou is an old cultivar. Farmers have been very happy in the Mopti region with the fertilizer response and with the potential to build storage facilities. Farmers are very familiar with the seasonal price variation of their basic staple so the interest in the storage facilities and better marketing practices is substantial. IICEM technical people will be investigating this storage investment planning in the spring of 2010.

Faso Jigi is a large farmers' cooperative with headquarters in Segou. We have begun working with them in 2010 and will put 100 ha in new technology of Seguifa, moderate fertilizer, improved agronomy, water retention and improved marketing practices in 2010. Farmers are happy with the improved yields of the technology package and the higher food quality of Seguifa in the other regions where it has been grown.[4] This will be in two villages (Katiena and Sakoubougou) of 50 ha each of which 10 ha in each village will be reserved for women. Substantial interest was demonstrated by the farmers in our organizational meetings in March.

We are in our third year of activity in Kolokani and will add another 60 ha to the 110 ha already there. Most farmers are very happy with Seguifa but it needs to be planted later and this often results in it not getting the better soil areas of the farmers. Also there are complaints of poor

[3] Farmers have been happy with the higher yields of this improved cultivar, Seguifa, but they need to plant late to avoid the late season rains and this raises the risk of the early termination of rains. IER has produced excellent crosses of Caudatum and Guineas, which we are using in our field program including Grinkan and Nachtichama. They just need to produce some more intermediate height, intermediate season length Caudatum-Guine crosses and to accelerate the regional adaptation trials. We continue to push for this.

[4] 300 ha of Seguifa were grown in the region in 2009 but the fertilizer recommendations were not followed and yields were poor. Only one sack of DAP was used and yields ranged from 400 to 800 kg/ha. Nevertheless, farmers in Faso Jigi liked the potential yields of the cultivar and appreciated the food quality. Continuing problem with "moisissure" (mold).

germination, which may be related to the mold problem. There is substantial interest in the construction of storage facilities in the three villages associated with the program. We are confident that IICEM will be looking into this in 2010. We need a program for 2010 to develop a substitute for Seguifa. Neither the INTSORMIL breeder nor Acar of IER are happy with Seguifa. But farmers happy with the good prices, 150 CFA/kg during 2009 and animals appreciate the Seguifa stalks. In this region the support of DRA is excellent.

We started our activities in the greater Kayes region in Diakounte Camara with 75 ha in Seguifa in 2009. Farmers were happy there with the yields of Seguifa. Niaba Teme of IER will be identifying another three sites for a further expansion of 195 ha in this region. As with the Mopti region this region has also been identified as a priority region for working with the small farmers and this is a big shift from the cotton zone and even the Segou zone. Again we will be focusing on raising soil fertility and the utilization of the water retention practices. We will also be developing our methods for moving more quickly to the construction of the cereal storage facilities.

So in 2010 our focus will be on providing technical support to the IICEM initiatives in the Koutiala and Segou regions. This will also give us more experience in bringing the banks in once the pilot projects have identified successes. Our second major focus in 2010 is on adapting the project to the lower resource base regions further from the major markets, specifically the Mopti and Kayes regions. Thirdly we will be developing a system with IICEM to organize the construction of storage facilities as we develop the new farmer cooperatives. In 2010 we will again put more efforts into the ties between food and feed processors and our emerging cooperatives. This is especially important as the large scale bank financed expansion takes place. As we move into these more difficult regions risk insurance becomes more important. Some coops have already been requesting members to contribute to emergency funds but only on a very small scale. We focus here on poor rainfall years rather than the major drought disasters as the latter require public intervention. Note that the marketing emphasis of the project is an important part of the risk strategy as in poor rainfall years the price can double over the season so there are very high returns then to storage and to inventory credit. We also need a descriptive bulletin on the fertilizer market but will probably put that off until 2011. For our major expansion regions in 2010, Koutiala and Segou-Tingoni we need to be implementing a seed production strategy once the loans are forthcoming and the fertilizers are put in the villages. Note also the importance of an improved cleaning strategy and potentially pilot project investments in some threshers and 2010 would be a good year to do this following closely the repair issue.

Table 1. Old and New Area in Production-Marketing Project and in Associated Projects with IICEM

	New (ha)	Old (ha)[5]	Total (ha)
Koutiala			
IICEM-AMEDD	2500		2500
P-M Project		270	270
Tingoni			
IICEM-Sas.2000	500		500
P-M Project		110	110
Faso-Jigi-Segou			
P-M Project	100		100
Mopti			
P-M Project	300	120	420
DRA			
Kolokani			
P-M Project	60	110	170
DRA			
Kayes			
P-M Project	195	75	270
DRA			
Total	**3655**	**685**	**4340**

[5] Note that a fundamental component of the Production-Marketing project is to provide input credits that have to be repaid to the farmers' cooperative in kind at harvest. The farmers' coop holds on to the cereals until the post harvest price recovery. Then they are sold and these funds become a rotating fund to provide these credits in subsequent years. So we expect the old areas to continue the program so they are included here.

Garasso/Koutiala: New sorghum cultivar, Grinkan. October, 2008

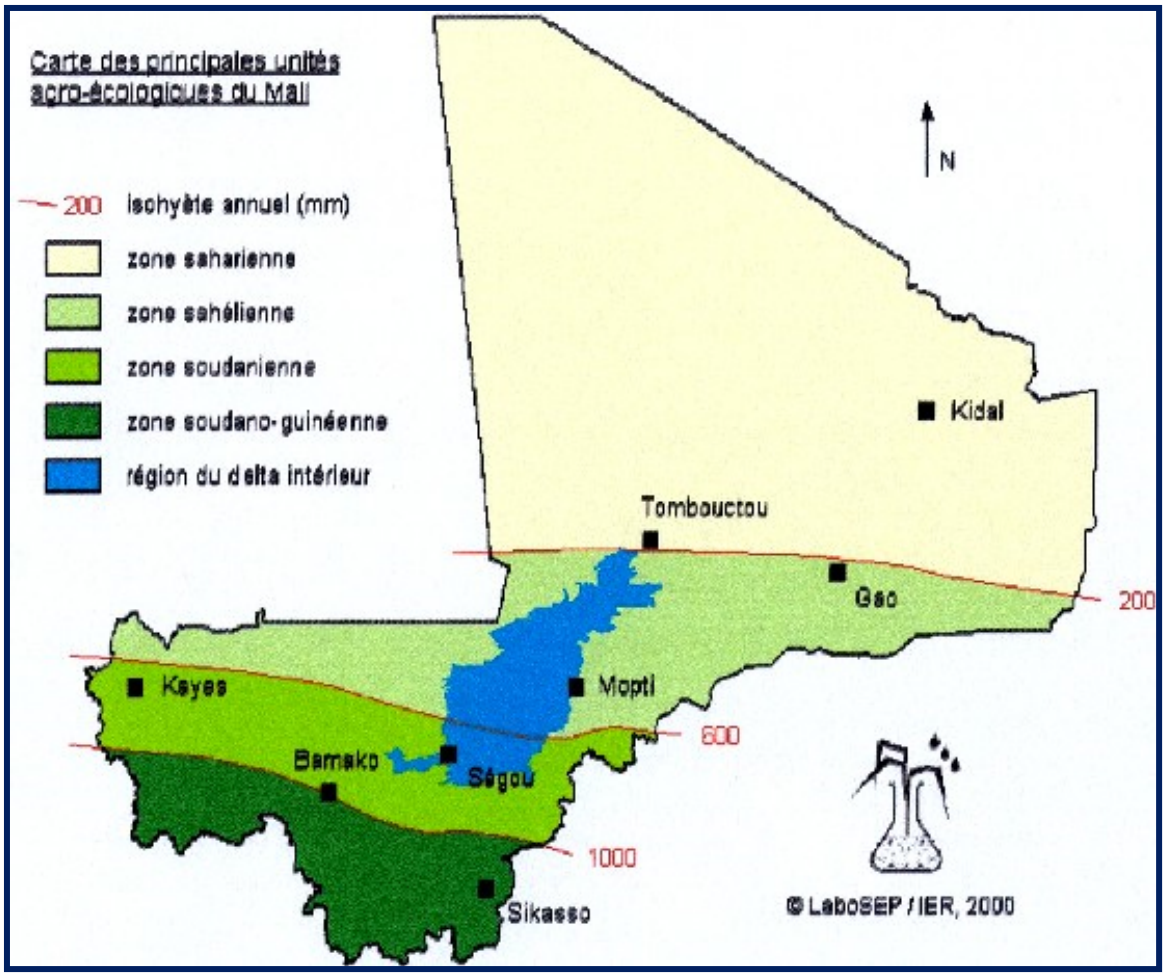
Mr. Bougouna, the Director of AMEDD, and a local farmer showing Grinkan production in Garasso in 2009 grown for seed for the 2010 crop year in the IICEM expanded program.

Report on Women's Participation in the IER-INTSORMIL/ USAID-Mali Mission Production-Marketing Project in 2009

Jeanne Coulibaly
Agecon/Purdue University

In 2009, women have been integrated into the production-marketing component of the IER-INTSORMIL project in Mali. The goal is to help women to benefit from the adoption of new technologies which are likely to impact positively their welfare as well as the whole household's well-being. Thus, this report gives an evaluation of women's participation and gains in the program for the 2009 agricultural campaign. The extent of their involvement in the project sites, difficulties encountered, as well as their traditional role in the agricultural production system will be detailed. Women's situation in the southern cotton zone presents many similarities across villages in this region but differs in some extent from the northern soudano-sahelian sites of the project. So, the analysis of women in the different villages of the cotton zone will be combined and contrasted from that of the sudano-sahelian zone.

The sites in the southern Sudano-guinean agro-ecological zone are represented by some villages in the districts of Koutiala, Dioila, Kolokani and Baraouili (Tingoni). The northern Sudano-sahelian site concerns the village of Oualo in Mopti region. In all those sites, 10% of the areas planted in 2009, have been allocated to women.



In the southern villages, women involved in the program are generally the first spouses of men already members of the project. Following the instructions of the project, every woman participating in the project has been allotted 1 ha of land by their husband or the household head to be under their own control. However, the interviews made with some women reveal a lack of effective management of the inputs and control of their harvests. Most of the time, women don't have any knowledge of the quantity of fertilizer and seeds borrowed from the cooperative and used on their plots. In fact, the management of these inputs is realized by their husbands. These latter ones control the output of women's plots as well. Women are just used as labor on the plot supposed belonging to them but don't manage the inputs neither the outputs. The hectare allocated to women works more likely as an extension of men's area under the program. As a proof, during the survey when men were asked about the areas cultivated under the project, they include women's area on their total area cultivated very often. Hence, by registering the land under their wives' name, men gain greater access to land than the project allowed.

Women in those villages are strongly influenced by the traditional farming system where the household head is the main decision maker regarding participation of adult household members including women in farming activities. In the traditional farming system, the household head is the decision maker regarding family members' labor allocation on the communal plot and the private plots. Social and religious customs prevailing in a given household dictate the extent of women involvement on the communal land. This varies from no work on the communal land or part employment only during the peak labor demand season that are planting and harvesting to a full employment throughout the agricultural campaign. Indeed, even though some families exempt

women from participating in the communal work, many other households require women to be engaged in all agricultural activities. Thus, they perform the same tasks as men except for the heaviest works (land preparation or carrying heavy wood). Older women are not required to be involved in the communal work; they are also prevented from the domestic house work.

During the time of cotton prosperity, women used to be remunerated after their work on the communal plot. They were compensated in nature with some cloths “complet de pagnes”, shoes, baskets of cereals or cash income. However, these days, with the cotton crisis, some of them don’t perceive any payment while others are only compensated in-kind with some grains. Despite this reduction in their wages, women still allocate the same amount of time on the family field. Under a strong influence of social customs, they don’t claim any compensation, or increase in their payments after their work on the communal land. They believe that they still have to participate on the communal field to help the household producing the subsistence food necessary for the family’s consumption.

Women are granted an average of two days off from the communal field during the week. They are allowed to work on their private plots after performing their tasks on the communal field or during the days off from the family land. The allocation of private plot depends on the land availability and the age of the spouse. Generally younger spouse are less likely to have access to a private plot. Women with private plots usually grow rice, cowpeas, groundnuts, and some vegetables (tomato, okra). The areas of these private plots are very small, no greater than 0.25 ha on average. These are marginal lands of poor quality compared to the family land. Any attempt to increase women’s private plot might not be successful because of the land constraint particularly in Koutiala. In some villages of this community such as Kaniko, there is a land constraint due to population growth and agricultural mechanization which have led to a decreasing land-people ratio. Women are self-employed on their private plots or use their children’s labor (usually children under the age of 15) as help for their activities. The output from this plot is under women’s control and is used either to complement the family food, to provide for the children’s clothing or for women’s own financial needs. Besides working on the family’s land and private plots, during the peak labor harvesting period, women organize themselves into some gender work teams and contract their labor with some farmers for the communal field activities. The group gets in return some wage payments in cash or in nature with some baskets of grains.

The assets commonly held by women in the household are represented by small ruminants (goats and sheep). These investments are built on the savings made from the sales of the private plots output, small trades of shea butter or other off-farm activities. Very few off-farm opportunities exist for women, especially for those located in the villages far from the main town. Also, the burden of the domestic work represents a time constraint for their participation in the off-farm labor market. Hence, it is common to see that apart from the weekly sales of vegetables at the village market, women are not involved in any off-farm employment activity. The actions identified by women to increase their income are the access to some farm equipments particularly for plowing and the development of small businesses.

In the sudano-sahelian site of the program represented by the village of Oualo, 40 women are involved in the project in a total of 10 ha. Majority of women involved in the project has been allocated 0.25 ha of land; very few were given 1 ha of plot. This allotment of smaller size of land to women is not justified by a land constraint in the area but rather by a time constraint facing women. Men argued that their wives might not have the time and labor required

to cultivate individually 1 ha of land. They face a time constraint due to the domestic work load and their participation on communal and private field activities.

Jeanne Coulibaly, Purdue PhD student (L) and Niaba Teme, IER sorghum breeder (R) in a discussion with farmers of Douentza Village, Mopti Region

In this village, women have a greater control of the inputs used on their areas under the project. They have good knowledge of the quantity of fertilizer, seeds applied on their fields. They were able to follow the agronomic cultural practices necessary to get high yields. However, the main problem encountered, which is a general problem across male and female participants, was the poor rate of germination of the improved Toroniou seed. After many unsuccessful planting, women decided to abandon the improved seed and planted instead their own traditional millet. The program's chemical fertilizer was applied on the local variety. Even though they were not able to give any estimates for the 2009 yields, they seem on average very happy with their harvest. They acknowledged that they will be in control of their output which will not be mixed with their husband's crop harvest. But most of them are not very well informed about the conditions and objectives of the project. For example a significant number of them did not know about the right amount of grains to be reimbursed, neither about the fact that the reimbursement will be used as a revolving fund every year to purchase the inputs.

Jeanne Coulibaly, Purdue PhD student (in red) discussing her study with Bahiru Duguma, INTSORMIL AOTR (L); her mentor, John Sander; Mamourou Diourte, Host Country Coordinator, IER; and Niaba Teme, IER sorghum breeder (R) in Douentza Village, Mopti Region

Regarding the household decision making, there is still a leadership of men on the main production and investment decisions but the pressure is less pronounced compared to the southern sites of the project. In those southern villages, the dominant ethnic groups are Bambara and Minianka, but in Oualo and generally in the Mopti region, the Dogon tribe is in larger number followed by the Fulani, Sonrai and Bambara. A general impression about the women interviewed in Oualo is that they showed some level of freedom, are less fearful and can talk openly about their needs. They believe that having access to some productive resources such as animals for traction, microcredit, or reducing the burden of the household chores by introducing some labor saving technologies grain mills will have potential to increase their agricultural production and welfare.

Women in this village of Oualo are generally exempt from the hardest activities on the communal plot. They bring everyday at noon the meal for men working on the communal plot and are only employed during the harvest time. Their work during the harvest consists on assembling the heads of cereals, putting the bundled heads in baskets to be carried on head load to the village. According to some men, the exemption of women from agricultural work on the communal

plot is a change from the past. In the past, women used to be involved in all agricultural activities. This change came mainly from the influence of the Islamic religion. Men who follow closely the Islamic principles, tried to impose less burden on women. Their work on the communal plot is remunerated after the harvest by 2 to 5 small bundles or “fagots” of millet. This remuneration depends on women’s age. Older women in the household are in general remunerated after their work on the communal plot which is not always the case for the younger one. It is also worth to say that older women have a privilege position compared to younger wives in the household. They are free from many domestic tasks particularly when their daughters in law live in the extended family, they own a larger number of assets (small ruminants) and have fewer restrictions on the use of the crop output.

If it happens that women who work on the communal land are not satisfied with the amount received for their labor work (especially during a good crop season), they initiate a bargain with their husband to increase their compensation, but this usually fails. With social customs limiting their ability to conflict openly, some of them sometimes resist implicitly by practicing some small thefts of the cereals for the family consumption. They take furtively small portions of grains to sell at the local market. Also, when they are in charge of selling the harvest at the local market, they don’t bring back all the revenue from the sales to the husband, they keep small parts of it.

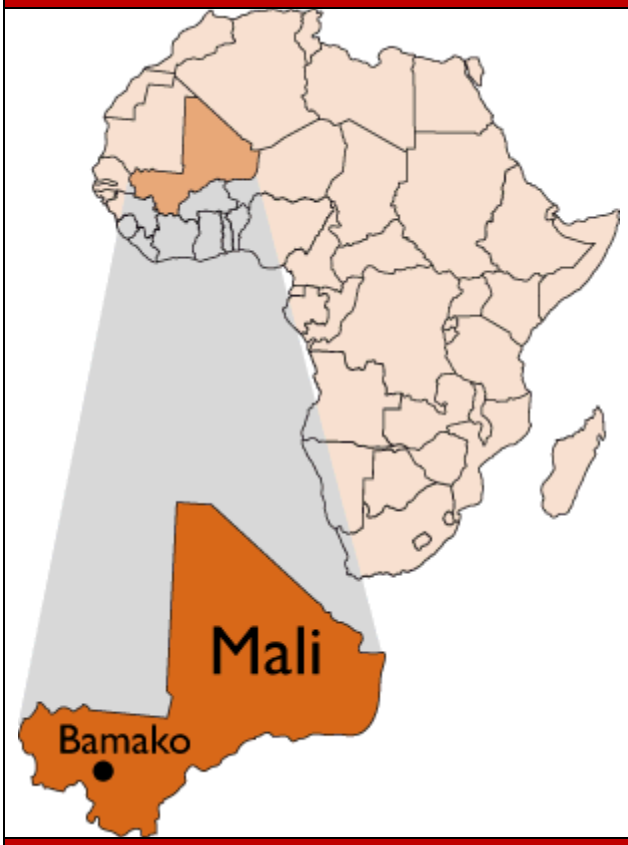
Most women surveyed have access to a private plot where they grow groundnuts, millet, rice or some vegetables. They use the income from the private plots for their personal needs, the children clothing, and everything related to the kitchen (condiments, utensils, soaps…). During the dry season, some women work off farm by making and selling clay pots. One of the interviewees affirmed going to the exile in Bamako to be house maid.

In conclusion, women’s labor participation was effective in 2009 under all sites of the program. However, this incorporation of women into the program is not sufficient to impact women’s well-being. In the cotton zone, women are not benefiting from the introduction of new sorghum technology because men make the main decisions concerning the management of women’s plot and the sales of the output. The decision making process is characterized by a strong patriarchal dominance in which women have little power. Thus, the program needs to find some strategies to empower women and assist them in getting more control over their plots. A starting point can rely on the organization of women in small associations or workgroups in the areas allotted under the project. By being in association, women can use their collective bargaining to address the issue of access to land of good quality and enhance their leadership over the management of their plots. Males ’control over women’s field is less pronounced in the northern site of the project. In Oualo, women appeared to be the main manager of their plots. Nevertheless, they need to be assisted in handling their output for the reimbursement of the credit and the management of the surplus of production. They need also to be encouraged to sell the harvest surplus during the soudure period to take advantage of the increase in the millet prices. The resulting income can be kept as savings in a micro-finance institution and be used to finance their needs and other micro-projects. This strategy will surely impact women and the whole household’s welfare.

Production-Marketing Project

A Day in Douentza Village, Mali

December 2009



Approximately 80 percent of Malians engage in agriculture as a source of income, producing cotton, millet, sorghum, and rice. Nearly two-thirds of the country lives below the poverty line, and 74 percent lives on less than $2 a day. The best productive land is located near the Niger river. Droughts and locust swarms regularly challenge agricultural and pastoral ways of life.

The INTSORMIL Program collaboraties with the Malian National Program, IER in the promotion of sorghum and pearl millet production and marketing . INTSORMIL host country coordinator Mamourou Diourte (white cap) is shown at a field day promoting the production of an improved sorghum variety Seguifa. The banner says "Adopt the sorghum variety Seguifa in all production areas to increase production. Assure food security and participate in the economic growth of Mali."

Dr. Bahiru Duguma, INTSORMIL Agreement Officer's Technical Representative (AOTR), USAID Washington DC observing the small heads of a local millet and sorghum variety in a field that has been harvested near Mopti, Mali. Note the large weeds. Farmers in the Kayes Region in Northwest Mali near Mauritania have almost quit the planting of pearl millet because of the severe damage caused by blister beetles feeding on the heads.

With a watermelon in one hand and balancing a basket of pearl millet head s on their heads women carry the recently harvested crop to their home village, Douentza, Mopti Region, Mali. Pearl millet is a basic food crop in Northen Mali and when harvests are poor, famine and hunger are common. The abundant harvest this year is one of the reasons for the broad smiles you see. The millet will be placed on the roofs of their homes in the village for drying.

Back in the Douentza village the bundles of recently harvested pearl millet heads are returned to the village where they are placed on the roof of mud houses. The hot sun helps manage insects and diseases. Later the millet heads are placed in storage structures or threshed.

.

After drying in the sun the pearl millet heads are placed in storage structures. This is a storage structure in the Douentza village composed of mud walls and a roof of pearl millet stems. This photo was taken in December 2009 in the midst of the 6 month dry season.

Farmers comparing the heads of two pearl millet varieties being stored in a storage building in Douentza village. The INTSORMIL Program is introducing improved millet varieties , production practices and marketing strategies to increase millet production and support the USAID Mission's Global Food Security Initiative.

INTSORMIL and IER/Mali scientists meet with the farmers of Douentza village to discuss the 2009 millet yields and prices received in the Production -Marketing Project conducted in this village in N. Mali. Most villages have a special tree under which all meetings are held. INTSORMIL economist, John Sanders, Purdue University, is leader of the Production-Marketing Project in West Africa .

A highlight of the meeting under the Douentza village tree was a poster describing methods to manage sorghum and millet pests in storage. The poster produced by INTSORMIL scientists Niamoye Yaro Diarisso IER/ Bamako and Bonnie Pendleton, West Texas A&M University was of great interest to the farmers. With the shortage of food in the village losses in storage are devastating.

Botourou Ouendeba, INTSORMIL scientist (white baseball cap) discussing plans for the 2010 seasson for the Production-Marketing project in Douentza village. Locally grown groundnuts (peanuts) (foreground) are provided to the visiting scientists to snack on during the meeting.

	Four women, simultaneously , in unison, threshing millet in a mortar and pestle in Dounteza village. The precision at which they operate the pestles reminds one of the pistons of a 4-cylinder engine Note the woman with a baby on her back.
	Closeup of the mortar with millet grain and the pestle.

Village women, baby and young girl, all benefactors of increased pearlmillet production in Dounteza village. Attractive jewelry and colorful clothing are common among Malian women.

Family meal in the village. Millet and sorghum are important foods in the diet of of rural Malians. The goats in the background will serve as future meals for the villagers.

Food Processing Technology Activities

Bruce Hamaker, Purdue University

The overall goal of the cereal **processing technology and training** component of the project is to establish a successful model of entrepreneurial sorghum/millet processing to competitive marketed food products. Year 2 activities focus on organization of the project, strengthening the IER Food Technology unit, establishing entrepreneurial incubator units and training of processors in the incubator units. The processing team consisted of Bruce Hamaker, Project Leader (Purdue University), Yara Koréissi, Host Country Coordinator (IER, Sotuba) and Mamadou Diouf, Consultant (ITA, retired).

Activities 2008-2009

The processing project team (Y. Koreissi, M. Diouf, B. Hamaker) attended the USAID/Mali workshop in Bamako in December 2009, and presented project aims, activities and progress made-to-date. A number of contacts were made with potentially complementary groups funded through USAID/Mali that could be partnered with towards our objective of moving high quality processed sorghum and millet products into the marketplace, and to bring new processing technologies to Bamako-area (and other) processors.

Processing activities for the quarter included: 1) work to optimize product processing and yields at the incubation unit at IER/Sotuba where the same equipment has been placed as in the entrepreneur units in Mopti, Bandiagara, and Gao; 2) trip by IER food technologists to Mopti/Gao region to transfer optimization results and further train entrepreneurs, 3) trip by M. Diouf and Y. Koreissi to Mopti/Gao region to assess further work on the units that needed to be done to ready entrepreneurs for the March workshop, and 4) workshop on enterprise management and marketing in Mopti, March 4-6.

Entrepreneur units in Mopti, Bandiagara, and Gao are now fully mechanized for processing of decorticated and milled products. A seventh entrepreneur, Mme. Diallo Traore, who had participated in the 2009 processing workship in Mopti has been added to the group. As with any food processing activity, further work was needed to optimize processing conditions to obtain quality high yielding products, and this work was done at IER/Sotuba by S. Mallé, Y. Koreissi, and group. IER technologists traveled to Mopti/Gao and trained personnel at each entrepreneur unit . In February, M. Diouf and Y. Koreissi visited entrepreneur partners for further assessment of needs and requirements, and to prepare for the March processing and marketing workshop.

Project processing consultant, M. Diouf, and entrepreneur partner, Mme. Gariko, in front of her processing unit in Severé, the sister city to Mopti.

A Processing project entrepreneur processing millet at her processing unit in Severé near Mopti.

The March three-day entrepreneur management and marketing training workshop held in Severé was conducted with assistance of an outside specialist, M. Sidibe and his two assistants. Training consisted of entrepreneur unit operation, management considerations, engaging the market, and financial matters. Each entrepreneur partner and 2 assistants participated along with invited participants from IICEM (N. Maiga, expertise in value-chains and markets), head of the Malian food processors association from Bamako (FENATRA), cereal technologist and project director of PCDA (World Bank-financed) project in Mopti/Severe (D. Drame), and IER cereal technologists from Sotuba. The training workshop was organized and attended by the processing project team (Y. Koreissi, M. Diouf, B. Hamaker). Potential collaborators, who have projects through USAID/Mali, were also visited in Bamako to discuss possible future interactions - J.F. Guay, director of IICEM, and head of Catholic Relief Service of Mali.

March 2010 training workshop participants in Severé, Northern Mali

Décrue Sorghum Activities

Scott Staggenborg and Vara Prasad, Kansas State *University*

Introduction

The ***décrue sorghum*** activities are conducted in collaboration with the sorghum program scientists from IER, Sotuba and are conducted in the Bintagoungou and Goundam area. The goal is to identify agronomic practices that lead to increased yields and increased quality of post water recession grown sorghum. The project is being coordinated by Abdoul Wahab Toure, IER Agronomist. Wahab is being assisted by two Institut Rural de Katibougou students who are located at the décrue sites and are conducting their theses based on the project results. Activities conducted by IER scientists will include and testing to identify most suitable cultivars for the region, testing of various cultural practices (cultivars, planting techniques, fertilizer regimes, pest management strategies and transfer of suitable technologies identified to farmers.

Global Objective

To generate improved agronomic techniques along with appropriate décrue sorghum cultivars to sustain food production and foster economic improvement of northern Mali

Specific Objectives

1. To determine farmers' perceptions and knowledge about current management practices and farmers' needs and preferences and at the same time to collect the sorghum cultivars grown in the area.
2. To conduct experiments on integrated soil, water, nutrient and décrue sorghum management strategies for improved productivity.
3. To diffuse the generated improved techniques.

Activities and Results

2009 Research Results- Abdoul Wahab Toure

SEEKING OPTIMAL DATE FOR SORGHUM IN THE DECRUE SYSTEM

OBJECTIVES:

Global:

To determine optimal planting date for sorghum in the décrue system.

Spécific:

- To determine for each of the seven varieties, optimal date in the décrue system.
- To determine sensitivity of the seven varieties to a change of planting date.

MATERIALS AND METHODS:

From the 33 varieties and cultivars tested in Bintagoungou in 2008, seven were selected by farmers. In 2009, the seven varieties and cultivars were tested at four planting dates : (D1 , D2 , D3 e D4) equally spaced by 17 days.
Strip-plot experiment was used with planting date as horizontal factor and varieties as vertical factor. Two farmers were used as replications.
Horizontal plots (planting dates) were composed of 21 rows, seven varieties, three rows per variety. Each variety was 5 m in length and 2.25 m wide.
Vertical plots (varieties) were composed of four planting dates. Each planting date was 2.25 m wide (three rows) and 5 m length.
Plants in three rows, 5 m in length and 0.75 m wide, were thinned to 0.5 m between plants, which was equivalent to 53 333 plants per ha.
Several components were measured : number of germinated hills, of plants after thinning, and the percentage of germination during crop establishment. Number of hills, stems and panicles as well stems, panicles biomass and grain yields were measured.

RESULTS AND DISCUSSION:

The number of germinated hills observed in average (17 508 per ha) was about 75 % of the expected one. From Planting date 1 (PD1 =April 22nd) to Planting date 4 (June 12th) a decrease of the number of germinated hills was observed with the number of days after April 22nd , particularly between May the 9th and June 12th (Table 1).

Table 1. Number of germinated hills per ha in Bougoumeïra. 2009 season.

	ROWS				
	Planting date 1 4/22/2009	Planting date 2 5/9/2009	Planting date 3 5/26/2009	Planting date 4 6/12/2009	Mean
COLUMNS (varieties)					
Saba Tienda (22)	13778	26223	19112	17334	19111
Saba Sôtô (23)	12889	25334	23111	8889	17556
Vrac de BTG (27)	12000	24889	20000	11111	17000
Saba Tienda (28)	12000	24889	21334	11111	17333
04-SB-F5DT-42 (5)	15556	22223	22222	7112	16778
00-CZ-F5P-135 (9)	12445	25334	20000	8000	16445
Niatichama (14)	11556	24445	14667	11112	15445
Moyenne	14540	24762	20064	10667	17508
Effect of date *variety	ns				
CV date*variety					
Planting dates effect	**				
CV dates (%)	123				
Varieties effect	ns				
CV varieties	15.38				

The highest number of germinated hills was observed at 9th of May planting date.

Table 2. Number of plants per ha after thinning in Bougoumeïra. 2009 season.

	ROWS				
	Planting date 1 4/22/2009	Planting date 2 5/9/2009	Planting date 3 5/26/2009	Planting date 4 6/12/2009	Mean
COLUMNS (varieties)					
Saba Tienda (22)	27111	52000	34667	34223	37000
Saba Sôtô (23)	24889	50222	41334	16889	33333
Vrac de BTG (27)	24000	50667	36445	20000	32778
Saba Tienda (28)	23556	46667	40000	22222	33111
04-SB-F5DT-42 (5)	31111	43556	39111	13333	31778
00-CZ-F5P-135 (9)	23556	49778	38667	14223	31556
Niatichama (14)	42667	48889	24444	19556	33889
Moyenne	28127	48825	36381	20063	33349
Effect of date *variety			ns		
CV date*variety			15.87		
Planting dates effect			**		
CV dates (%)			130.8		
Varieties effect			ns		
CV varieties			14.68		

Plant population observed after thinning was in average 33 349 plants per ha, which corresponded to 53 % of the expected plant population (53,333 plants per ha). The tendency of plant population to decrease with respect to the number of days after planting (DAP) was observed from PD2 to PD4. PD1 cannot be ranged in this tendency. Plant population was ranged from 31556 plants per ha (V6) to 37 000 (V1). The highest plant population was observed at 9th of May planting date.

Table 3. Percentage of germination per planting date and per variety. Bougoumeïra. 2009 season

	ROWS				
	Planting date 1 4/22/2009	Planting date 2 5/9/2009	Planting date 3 5/26/2009	Planting date 4 6/12/2009	Mean
COLUMNS (varieties)					
Saba Tienda (22)	52	99	72	65	72
Saba Sôtô (23)	49	95	87	34	66
Vrac de BTG (27)	45	95	75	42	64
Saba Tienda (28)	45	94	80	42	65
04-SB-F5DT-42 (5)	59	84	84	27	63
00-CZ-F5P-135 (9)	47	95	75	30	62
Niatichama (14)	87	92	55	42	69
Moyenne	55	93	75	40	66
Effect of date *variety CV date*variety Planting dates effect CV dates (%) Varieties effect CV varieties					

Averaged over varieties, planting dates showed a tendency of germination percentage to decrease from the 9th of May to 12th of June (PD1 is not taken into account in this tendency) The average germination percentage was 66 %. Germination percentage per varieties was ranged from 62 (V6) to 72 % (V1). The highest % of germination was observed at 9th of May planting date.

Table 4. Grain yield as affected by planting date, varieties and their interaction in Bougoumeïra. 2009 season.

		ROWS Planting dates (PD)				
		Planting date 1 4/22/2009 PD1	Planting date 2 5/9/2009 PD2	Planting date 3 5/26/2009 PD3	Planting date 4 6/12/2009 PD4	Mean
	COLUMNS :varieties (V)					
V1	Saba Tienda (22)	667	2334	600	1467	1267
V2	Saba Sôtô (23)	2134	3200	3334	1800	2617
V3	Vrac de BTG (27)	667	3134	2134	1400	2000
V4	Saba Tienda (28)	1600	1467	934	427	1036
V5	04-SB-F5DT-42 (5)	680	107	506	.	431
V6	00-CZ-F5P-135 (9)	600	187	333	400	377
V7	Niatichama (14)	174	27	93	.	98
	Moyenne	932	1493	1133	1099	1118
	Effect of date *variety	ns				
	CV date*variety	53.42				
	Planting dates effect	*				
	CV dates (%)	118				
	Varieties effect	**				
	CV varieties	46.24				

Average grain yield recorded from the all experiment was 1118 kg/ha; 1730 kg/ha of grain were recorded with local cultivars and 302 kg/ha with new varieties tested in the decrue system.

Planting date * varieties interaction was not significant for grain yield, suggesting: a) the response of varieties to planting date followed the same trend no matter was the varieties; b) differences between varieties did not change from one planting date to another;

Delaying planting date from May to June leaded to a significant loss of 11.60 kg of sorghum grain per day . Low production of April the 24th might be due to the existing soil residual moisture after water retreated and to the beneficial hydric conditions from rainfall during sorghum reproductive phase II (from 50%flowering to physiological maturity.

As planting date, 9th of May appeared to be the optimal one for local cultivars (V1,V2,V3 and V4) in this 2009 experiment. Its performance might be related to : 1)the number of days from water retreat to sowing; 2) the distance between the sorghum plot and the heart of the lake.
More investigations are required for V5, V6 and V7.

Besides, results showed three classes in term of grain yeld performance:

a) Well adapted local cultivars V2 and V3, with average grain yield higher than 2000 kg/ha;

b) Adapted local cultivars, V1 and V4, with average grain yield higher than 1000 kg/ha and lower than 2000 kg/ha;

c) Less adapted varieties V5, V6 and V7, with average grain yield lower than 500 kg/ha:

Dry matter showed yield potential in new varieties V5,V6 and V7, although lower in average, compared to new varieties (Table 5).

Table 5. Dry matter yield as affected by planting date, varieties and their interaction in Bougoumeïra. 2009 season.

		ROWS				
		Planting date 1 4/22/2009	Planting date 2 5/9/2009	Planting date 3 5/26/2009	Planting date 4 6/12/2009	Mean
	COLUMNS (varieties)					
V1	Saba Tienda (22)	8467	27960	12267	12600	15323
V2	Saba Sôtô (23)	15267	21267	16133	14534	16800
V3	Vrac de BTG (27)	14400	26267	22347	8560	17734
V4	Saba Tienda (28)	20533	24400	18867	7494	17436
V5	04-SB-F5DT-42 (5)	9600	14467	15800	.	13289
V6	00-CZ-F5P-135 (9)	11534	11600	11600	5867	10150
V7	Niatichama (14)	4134	12440	9800	.	10549
	Moyenne	11991	19772	15259	9811	14469
	Effect of date *variety			ns		
	CV date*variety			42.97		
	Planting dates effect			**		
	CV dates (%)			35.32		
	Varieties effect			*		
	CV varieties			42.79		

Table 6. Days to flowering as affected by planting dates and varieties

		ROWS				
		Planting date 1 4/22/09	Planting date 2 5/9/09	Planting date 3 5/26/09	Planting date 4 6/12/09	Mean
	COLUMNS (varieties)					
V1	Saba Tienda (22)	153	136	137	108	134
V2	Saba Sôtô (23)	153	136	121	102	128
V3	Vrac de BTG (27)	153	136	121	105	129
V4	Saba Tienda (28)	153	136	119	108	129
V5	04-SB-F5DT-42 (5)	156	145	129	.	143
V6	00-CZ-F5P-135 (9)	153	139	125	.	139
V7	Niatichama (14)	162	145	108	.	138
	Moyenne	155	139	123	106	134
	Effect of date *variety	ns				
	CV date*variety	104.86				
	Planting dates effect	ns				
	CV dates (%)	136.3				
	Varieties effect	ns				
	CV varieties	96.97				

Planting dates, varieties as well as their interaction were not significant for days to flowering. Even though not significantly, days to flowering tended to decrease with respect to planting dates in all varieties. Local varieties appeared in average to be less late than new varieties for days to flowering (130 vs. 140 in average), although the differences were not significant.

Insufficient rainfall did not help new varieties (V5, V6 and V7) to complete their reproductive phase (flowering to maturity). Otherwise they have potential regarding to their dry matter production.(Table 6).

Local varieties, for the tendency of their grain yield (Fig 1) and days to flowering (fig2) to decrease with respect to delaying planting dates, can be recorded as adapted to variable environment of the décrue system. Their sensitivity to the change of planting date help them in adaptation to cropping season duration.

In summary of seeking an optimal planting date for sorghum in the décrue system, it can be recorded:

1) 9th of May among tested planting dates, offered the best conditions for performance of the décrue sorghum, after the water retreat.
2) The first planting date 24th of April and others offered worse conditions for either insufficient soil residual moisture or higher soil water capacity during crop establishment and for insufficient hydric conditions in relation to rainfall during crop development, particularly reproductive phase.
3) The success or failure of a cultivar or variety will depend on its capacity to adjust its number of days from planting to flowering.
4) Favorable hydric conditions of the crop in the décrue system might have a relationship with the number of days after water retreat (for crop establishment) and the number of the days from flowering to physiological maturity.

Investigations on introduced varieties such as Niatichama are required to understand sorghum capacity for adjustment in the décrue system.

TESTING PLANT POPULATION ON SORGHUM IN THE DECRUE SYSTEM

I OBJECTIVES:

1.1 Global objective

To assess on décrue sorghum, research findings (recommended cultural practices) on rainfed sorghum.

1.2 Specific objectives:

-To assess the contribution of thinning, and plant population on sorghum grain yield in the décrue system.

II MATERIALS AND METHODS:

2.1 Experimental design:

The trial was conducted in Bintagoungou (Hameye farm) in a completely randomized design with 5 treatments, in 4 replications:

DP1 = 1m x 1m, 1 plant per hill;
DP2 = 1m x 1m, 2 plants per hill;
DP3 = 1m x 1m, 3 plants per hill;
DP4 = 1m x 1m, no thinning;
DP5 = 0.75 m x 0.50 m, 2 plants per hill (53 333 plants per ha).

2.2 Data collection:

Spatial occupation by the crops was appreciated on the basis of actual number of germinated hills per ha. Germination was appreciated by the ratio of actual to planned number of hills (expressed in %). Number of hills, of stems, of panicles as well as panicle and grain weight will be recorded at harvest.

2.3 Data analysis:

Data were analyzed using Statistical Analysis System. Analysis of variance was used to test treatments effect. Ppds was used for pre-planned comparison, involving farmer's cultural practices, (DP1, DP2, DP3 and DP4) practice and one of the cultural research cultural practice.

III RESULTS AND DISCUSSION:

Table 7. Parameters related to plant population establishment in the décrue sorghum trial. Bintagoungou, 2009 cropping season.

		Germinated hills per ha	Germination percentage	Spatial Occupation % DP4
DP1	1 m x 1 m (1 plant per hill)	4750	48	90
DP2	1 m x 1 m (2 plants per hill)	4750	48	90
DP3	1 m x 1 m (3 plants per hill)	4500	43	86
DP4	1 m x 1 m (No thinning)	5250	53	100
DP5	0.75 m x 0.50 m (2 plants per hill)	13333	50	254
Mean		6517	48	124
Signification		**	ns	
CV (%)		40	33	

NB: DP4 stands for famer's practice while DP5 stands for research practice.

Germination percentage was generally low (48 % in average). Sorghum spatial occupation as well as germinated hills per ha were improved with research treatment (DP5), compared to farmer's practice (DP4). The increase was about 154% for the former and 3 % for the latter (Table 7).

Table 8. Grain and biomass yields, harvest index as influenced by plant population in Bintagoungou. Experiment 2, 2009 crop season.

		Grain Yield kg/ha	Biomass yield kg/ha	Harvest index
DP1	1 m x 1 m (1 plant per hill)	2225	26538	9
DP2	1 m x 1 m (2 plants per hill)	1975	20088	11
DP3	1 m x 1 m (3 plants per hill)	2337	17950	14
DP4	1 m x 1 m (No thinning)	2300	24100	10
DP5	0.75 m x 0.50 m (2 plants per hill)	2675	33633	8
Mean		2302	24462	10
Signification		ns	**	ns
CV (%)		30.08	22.49	46.70

DP4 stands for the farmer's practice and DP5 the research practice

Plant geometry (1 m x 1m) for DP1,DP2…DP4 and (0.80 m x 0.60 m) for DP5 was applied, but not thinning plants to 1,2,3 plants per hill. So only the Dp5 was assessed versus Others, particularly DP4.

Grain yield with research practice, DP5 (2675 kg/ha) was increased about 16 % compared to farmer's cultural practice DP4 (2300 kg/ha), even though not significantly. For the biomass, the increase of DP5, compared to DP4 was significant and about 40 %.

Rainfall conditions of 2009 might have play a role in the lack of significance of plant population effect. Last year results showed that any increase of plant population about 1000 would contribute for an additional 22 kg/ha of grain. So, from table 9, instead of 60 000 stems per ha , one should focus on 100 000 to 150 000 stems per ha to affect significantly grain yield. n increase of plant population about 50000 plants will lead to an additional 1 100 kg ha of grain.

Table 9. Number of hills, stems and panicle as affected by plant geometry.

		Harvested hills per ha	Number of harvested stems per ha	Number of panicles per ha
DP1	1 m x 1 m (1 plant per hill)	5750	35500	101500
DP2	1 m x 1 m (2 plants per hill)	8000	47500	74250
DP3	1 m x 1 m (3 plants per hill)	6500	28250	59750
DP4	1 m x 1 m (No thinning)	7250	38250	87250
DP5	0.75 m x 0.50 m (2 plants per hill)	12000	62667	111333
Mean		7900	42433	86817
Significance		**	**	P0.07
CV (%)		22.875	26.51	28.39

TESTING MICRO-FERTILIZER ON SORGHUM IN THE DCRUE SYSTEM

I. OBJECTIVES:

1.1 Global objective

To assess on décrue sorghum, research findings (recommended cultural practices) on rainfed sorghum.

1.2 Specific objectives:

-To assess the response of sorghum to fertilizer, using micro-dose in the décrue system.

II. MATERIALS AND METHODS:

2.1 Experimental design

A randomized complete block design with 5 treatments and 4 replications was used.:

F0 = Sans engrais
F1 = 0.5 g par poquet de DAP (5 kg/ha)
F2 = 1.0 g par poquet de DAP (10 kg/ha)
F3 = 1.5 g par poquet de DAP (15 kg/ha)
F4 = 2.0 g par poquet de DAP (20 kg/ha)

Fertilizer was applied using tea spoon (one spoon = 3 grams of DAP). Application of DAP occurred three weeks after planting.

The trial was conducted in Bintagoungou (Hameye farm) and Bougamaïra (Alhousseyni farm). Direct planting was used in Bintagounou (BTG) and transplantation in Bougoumaïra. Traditional planting geometry was used (1m x1m) in both sites.

2.2 Data collection:

Spatial occupation by the crops was appreciated on the basis of actual number of germinated hills per ha. Germination was appreciated by the ratio of actual to planned number of hills (expressed in %). Number of hills, of stems, of panicles as well as panicle and grain weight will be recorded at harvest.

2.3 Data analysis:
Data were analyzed using Statistical Analysis System. Analysis of variance was used to test fertilizer effect. Procedure of General linear model was used to test the crop response to fertilizer.

III. RESULTS AND DISCUSSION

Table 10. Number of harvested stems per ha in a fertilizer experiment conducted in Bintagoungou and Bougoumaïra. 2009 cropping season

		Bintagoungou	Bougoumaïra
F0	Sans engrais	80000	36875
F1	0.5 g par poquet de DAP (5 kg/ha)	84375	38750
F2	1.0 g par poquet de DAP (10 kg/ha)	75625	30000
F3	1.5 g par poquet de DAP (15 kg/ha)	74375	34375
F4	2.0 g par poquet de DAP (20 kg/ha)	74375	36875
Moyenne		77750	35375
Signification		Ns	Ns
CV (%)		**26.29**	**32.01**

Plant population was homogenous within both sites even though higher in Bintagoungou , compared to Bougoumaïra, wth 77750 and 35375 stems respectively (Table 10). No significant effect of fertilizer was observed in none of the two sites.

Table 11. Grain yield as affected by micro-fertilizer application in Bintagoungou and Bougoumaïra.

		Bintagoungou Kg/ha	Bougoumaïra Kg/ha
F0	Sans engrais	3438	969
F1	0.5 g par poquet de DAP (5 kg/ha)	3469	1375
F2	1.0 g par poquet de DAP (10 kg/ha)	3094	750
F3	1.5 g par poquet de DAP (15 kg/ha)	3406	750
F4	2.0 g par poquet de DAP (20 kg/ha)	3219	1188
Moyenne		3325	1006
Signification		Ns	Ns
CV (%)		**34.91**	**49.99**

No response was found to fertilizer application in Bintagoungou as well as in Bougoumaïra. Average grain yield was 3335 kg/ha in Bintagoungou with 3438 k/ha for the check treatment. In Bougoumaïra, average grain yield was 1006 kg/ha while the check treatment (no fertilizer) recorded 969 kg/ha in. Saba Tienda was used in both sites.

Absence of fertilizer effect in both sites suggest that the crop requirement in nutrients was provided by soil nutrient contents, at the plant population used in this experiment. When and where plant population will be around 150,000 stems, the sorghum crop will need more nutrients than available nutrients in the soil. With the development of hybrids we are near to that situation.

TESTING CULTURAL PRACTICES ON SORGHUM IN THE DECRUE SYSTEM

I. OBJECTIVES:

1.1 Global objective:

To assess on décrue sorghum, research findings (recommended cultural practices) on rainfed sorghum.

1.2 Specific objectives:

-To assess integrated plant, pest and soil management technology on décrue sorghum.
-To assess sorghum response to fertilizer in the décrue system

II. MATERIALS AND METHODS:

2.1 Experimental design

In 2009, a randomized complete block design experiment was conducted in Bintagoungou (4 replications) and Goundam (2 replications), with 5 integrated cultural practices (PC) as treatments:

PC1: 1m x 1 m, no thinning.

PC2: 0.80 m x 0.60 m 3 plants per hill
[In 2008, PC2 was standing for: (PC1 + the use of Furadan for soil treatment and Apron Starr for seed treatment)].

PC3: 0.80 m x 0.60 m 3 plants per hill +
the use of Furadan for soil treatment and 'Apron Star' for seed treatment.

PC4: PC3 + 1.5 g of Diammonium phosphate (DAP) per hill.
PC5 PC3 + 2.0 g of Diammonium phosphate (DAP) per hill.

NOTA BEMA:
1: In 2008, CP2 was conducted similarly to CP3 (0.80 m x 0.60 m 3 plants per hill + the use of Furadan for soil treatment and 'Apron Star' for seed treatment) on Experiment 1.

2: In 2009, DAP was applied on may the 16th, 4 weeks later from planting date (19th of April); in 2008, DAP was applied when planting sorghum at rates of 4 and 8 g per hill on respectively CP4 and CP5.

3: In 2009, Furadan applied at a rate of 1.5 g per hill, was used for soil treatment.

2.2 Data collection:

Soil was sampled in both Bintagoungou and Goundam sites at 0-20 cm and 20-40 cm layers, on the basis of one sample per replication. Twelve samples were available for soil analysis: texture, organic matter, pH, total and available P, sum of exchangeable cations (Na, Ca, K and Mg) were the soil parameters of interest.

Spatial occupation by the crops was appreciated in each treatment on: a) the basis of actual number of germinated hills per ha; b) the ratio of actual to planned number of hills on % basis. Number of hills, stems, panicles as well as panicles and grain weight were recorded at harvest.

2.3 Data analysis:

Data were analyzed using Statistical Analysis System. Analysis of variance was used to test treatments effect. Ppds was used for pre-planned comparison, involving farmer's practice and one of the cultural practices suggested by research.

III. RESULTS AND DISCUSSION

Table 12. Number of germinated hills as affected by cultural practices. Bintagoungou. Experiment on integrated cultural practices. 2009 season

		Germinated hills per ha	Difference from PC1
PC1	Farmer's practice	10694	
PC2	0.80 m x 0.60 m 3 plants per hill	19167	8473**
PC3	PC2 + seed and soil treatment	17500	6806**
PC4	PC3 + 1.5 g of DAP per hill (32 kg/ha)	16945	6251**
PC5	PC3 + 3.0 g of DAP per hill (64 kg/ha)	16667	5973**
Mean		16195	6876
Signification		*	
CV		17	

Significant differences were observed between cultural practices for germinated hills (Table12). All tested research cultural practices (PC2, PC3, PC4, and PC5) with 17570 germinated hills in average, showed a better crop establishment capacity, compared to farmer's practice (10694 hills per ha). This suggests a better germination percentage and a better spatial occupation of the crop with research practices compared to farmer's practice (Table 13).

Table 13. Germination percentage and spatial occupation of the décrue sorghum as affected by cultural practices.

		Germination Percent	Spatial Occupation % PC1
PC1	Farmer's practice	60	100
PC2	0.80 m x 0.60 m 3 plants per hill	86	179
PC3	PC2 + seed and soil treatment	79	164
PC4	PC3 + 1.5 g of DAP per hill (32 kg/ha)	76	158
PC5	PC3 + 3.0 g of DAP per hill (64 kg/ha)	75	156
Mean		75	151

Germination percentage with an average of 75 % was low. Although, spatial occupation with research cultural practices was improved about more than 60% in average, compared to farmer's practice. This improvement of spatial occupation can be explained by applied plant geometry in PC2, PC3, PC4 and PC5 (0.80 m x 0.60 m).

Table 14. Plant population and number of plants per hill posterior to thinning. Bintagoungou. 2009 cropping season.

		Plant population posterior to thinning	Number of plants per hill	Difference From PC1
PC1	Farmer's practice	45070	4.25	
PC2	0.80 m x 0.60 m 3 plants per hill	45278	2.50	1.75**
PC3	PC2 + seed and soil treatment	43611	2.25	2.00**
PC4	PC3 + 1.5 g of DAP per hill (32 kg/ha)	47222	3.00	1.25**
PC5	PC3 + 3.0 g of DAP per hill (64 kg/ha)	39167	2.50	1.75***
Mean		44069	2.90	
Significance		ns	*	
CV		30	28	

No significant differences were observed between cultural practices for plant population posterior to thinning, although the better spatial occupation of PC2, PC3, PC4 and PC5 was observed in Table 14. This may be explained by the number of plants left per hill posterior to thinning. This last parameter may have compensated in the favor of PC1 (farmer's practice), its low germination % as well as its low spatial occupation.

Expected plant population (60,000 plants per ha) with 0.80 m x 0.60 m as planting geometry, and 3 plants per hill posterior to thinning, was not reached due to the influence of both germinated hills and the number of plants left per hill on the final plant population in the field. The former was insufficient at 25% and the latter at 44%.

Final effect of this plant population could not be measured on grain yield due to incomplete development of sorghum crop. Drought occurred before 50% flowering, and compromised grain production in this experiment. Then data collection on dry matter was also compromised by animal invasion at the end of October.

In Goundam, no significant effect of neither seed and soil treatment, nor fertlizer was observed for grain yield as well as biomass. (Table 15). Once again, plant population was at a very low level for crop to require more than soil available nutrients.

Table 15. Yield and yield components of sorghum grain as affected by cultural practices in Goundam.

		Germinated hills per ha	Harvested hills per ha	Harvested stems per ha	Harvested panicles per ha	Stem yield kg/ha	Panicles yield kg/ha	Grain yield kg/ha	Biomass yield kg/ha	Harvest index %
PC1	Farmer's practice	13542	10938	42969	50782	5469	1680	704	7149	14
PC2	0.80 m x 0.60 m 3 plants per hill	16146	9375	29688	26563	6485	1368	703	7852	10
PC3	PC2 + seed and soil treatment	17708	14844	38282	47657	7500	2071	821	9570	11
PC4	PC3 + 1.5 g of DAP per hill	16667	14063	39063	54688	6875	1602	743	9570	11
PC5	PC3 + 3.0 g of DAP per hill	18750	18750	47657	49219	9063	2032	1172	11094	14
Mean		16563	13594	39532	45782	7078	1750	828	8828	12
Signification		ns	ns	ns	ns	ns	ns	ns	ns	ns
CV (%)		24	17	28	27	23	37	56	25	44

Conclusions:

- Sorghum plant population is very often poor in farmers' fields in the décrue system with less than 50 000 plants per ha.
- Poor plant population provides sorghum crop the capacity to meet its nutrients requirement from soil available nutrients in the décrue system.
- For sorghum crop to respond to fertilizer application in the décrue system, higher plant population such as 125,000 to 150,000 plants per ha will be needed.
- Higher plant population requires improvement of any factor capable to influence crop establishment e.g. seed quality, soil moisture management, technique of planting and nutrient management.
- Seed quality can be improved through purification and the use of a well adapted cultivar with a high yielding capacity such as Saba Sôtô and Vrac de Bintagoungou .
- Investigation on the number of days from water retreat to planting dates, on the number of days from planting date to the end of cropping season.
- Saba Sôtô and Vrac de Bintagoungou appeared to be well adapted cultivars in the décrue system due to their capacity of adjusting their number of days to flowering and their high yield potential of 2000 kg/ha..
- As such, seed purification of the two cultivars Saba Sôtô and Vrac de Bintagoungou is needed for diffusion of these cultivars to farmers.

Report of trip to Mali, 29 January to 5 February, 2010- Scott Staggenborg

Departed Kansas City on Friday 29 January and arrived in Bamako on 30 January, 2010. After a day of preparations, we departed for Mopti on 1 February, 2010 and arrived in the evening. A meeting with a group of NGOs, IER staff from Gao-Dire Station, IER Sotuba Station, and IER Extension from Mopti (see photo).

The meeting began on 2 February at 10 am. After introductions, Abdoul Wahab Toure presented the results from his décrue work in 2008 and 2009. After Wahab's presentation, a discussion of his results, how they fit different areas in the north and other issues the group felt was important. Specific questions and suggestions included:

- The concern that no cultivars from the Gao area were included in the 2009 study
- The desire to have the location/origination of each cultivar (Goundam, IER, etc)
- Input from Abukar Toure, sorghum breeder with IER, regarding potential new cultivars
- Some concerns about why a specific cultivar (CSM-60E) is a short season cultivar normally, but was longer seasoned in the décrue work. Illustrates the need to study cultivars.
- Concerns about nutritional value of each cultivar since yield is not the only deciding factor

- They were surveyed by Wahab regarding areas they are currently working and interests.
- The need to put together training materials regarding conducting demonstration plots became obvious based on questions and concerns. Clear deliverables need to be included in agreement.
- Need a written agreement to get NGOs to conduct demonstration plots.

We concluded the first day

The second day of the meeting began with us writing up objectives for demonstration plots. It was decided by the group that cultivar evaluation was the area of most interest because some of the research results were not providing clear recommendations and the more research was needed to clarify such things as fertilizer use and plant density treatments. It was decided that the top three cultivars from the 2008 and 2009 field trials (Saba Soto, Vrac Bingtagoungou, and Soba Tienda) would be common to all demonstration plots with each participant encouraged to add one to three local varieties. This approach would expand our knowledge on the performance of these three, illustrate their relative performance compared with current local varieties, potentially identify new high performing cultivars, and continue the documentation of varieties used in the region.

The later part of the day was spent discussing and advising Wahab on his research trials. They did not feel that new research needed to be added, but that the current projects be continued another year to clarify some of the results. We then returned to the discussion regarding the demonstration plots. The group indicated that they needed logistics support, financial support, communication support, and training on sorghum production and demonstration plot work. They wanted a clearly defined package of information that they could deliver to the farmers. It also became more obvious that we needed to develop a set of deliverables and written agreement for them to decide if they would participate. No one would suggest an amount and I suggested approximately $1000 per demonstration plot and developed a set of deliverables. They had concerns about talking to the farmers before putting the plots out and I indicated that this was implied and that they needed to interact with farmers to find locations and find seed to plant. We concluded the meeting and adjourned.

We traveled back to Bamako on 4 February and met with Gaussou Traore at USAID regarding our meeting. We discussed potential positives and negatives of working with NGOs and IER Extension. A meeting with Mamourou Diourte and Wahab resulted in the 2010 research work plan and the decision that working with the IER Extension group at Mopti was an excellent way to engage them and expand our work into the Mopti area. It was decided to conduct one study on two farmers fields in the décrue sorghum areas near Mopti.

NGOs, IER staff from Gao-Dire Station, IER Sotuba Station, and IER Extension from Mopti meeting in Severé, 2 February 2010 to develop the décrue sorghum workplan.

Décrue Research and Technology Transfer (Demonstrations) Workplan 2010

The 2010 Work plan will consist of two parts, one associated with the proposed research and the other associated with the demonstration efforts.

Research

The research projects will consist of two components. The first will be work conducted in the décrue areas of Lake Faguibine and the Mopti area. The work in the Mopti area will also be connected to some of the demonstration activities.

1. Plant Geometry Study
   The objectives of these studies are to continue to refine our understanding of the effects of plan density on sorghum yields. Results from 2008 and 2009 suggest that higher plant densities result in higher yields. The 2009 results were not-significant across the treatments established, but definite trends exist.
   The treatments for 2010 are:
   1. 1m x 1m hill spacing with no thinning – current farmer practice

2. 0.5m x 0.75m hill spacing with 2 plants per hill
3. 0.5m x 0.75m hill spacing with 3 plants per hill
4. 0.5m x 0.25m hill spacing with 2 plants per hill

Three to four replications and repeated on 2 to 3 farmer fields in Lake Faguibine

2. Seed Protection Study

This study will also be a continuance of previous research. The objective of this study is to determine if seed treatments or planting time fertilizer will influence yields compared with current farmer practices.

The treatments for 2010 are:

1. PC1: 1m x 1m hill spacing without seed treatment or fertilizer – current farmer practice
2. PC2: 0.5m x 0.75m hill spacing with 2 plants per hill
3. PC3: PC2 + seed treatment for insects
4. PC4: PC3 + 5 kg DAP per ha
5. PC5: PC3 + 10 kg DAP per ha

Three to four replications and repeated on 2 to 3 farmer fields in Lake Faguibine

3. Soil Fertility Study

The objectives of this study are to determine the effects of individual plant nutrients. This will be accomplished by comparing a complete fertilizer treatment to those with nutrients removed.

The treatments for 2010 are:

1. No fertilizer control
2. N-P-K-S fertilizer mixture
3. N-P-K fertilizer mixture
4. N-P-S fertilizer mixture
5. N-K-S fertilizer mixture
6. P-K-S fertilizer mixture

Three to four replications and repeated on 2 to 3 farmer fields in Lake Faguibine
This study will also be placed on 1 to 2 farmer fields in the Mopti region.

Cultivar Screening Study

One of the issues that we have become aware of is that some cultivars that are quite productive in Sotuba Station are not well adapted to northern latitudes. In fact, one of the breeders indicated during the 2009 field trip that they have had cultivars that were introduced into the north that did not even flower due to photoperiod sensitivity. Cultivar selection is something that is always mentioned by farmers and others in the region, therefore a method to screen a wide range of cultivars in a lower risk (from drought, livestock feeding, etc) scenario in the north is needed. We propose to plant two replications of 30 to 40 cultivars at the Gao and Dire IER stations. These would be planted in March similar to the same dates used in the décrue field studies. Early season irrigation (March) and irrigation(s) during the dry period in the spring prior to the rains will emulated the décrue environment somewhat. The plots will be rainfed once the rainy season begins. Measurements taken by the resident IER staff will be: anthesis date, maturity date and grain yields. This project will be overseen by Mr. Diallo and Aly Soumare's staff at Gao and Dire stations. The projected cost of this activity is 2,500,000 cfa or $6,000

Demonstrations

A recent meeting in Mopti (Feb 2010) was organized to engage IER extension personnel and NGO personnel regarding potential demonstration plots in the north of Mali. The objective of these activities will be two fold. One is to collect additional data regarding the decrue systems in the Gao, Kidal, Tombouktu, and Mopti areas. These data will focus on cultivar performance in décrue systems. Three common cultivars will be included in each plot with

the participant encouraged to include one to three local cultivars for both comparison and screening purposes. Deliverables will include maturity ratings (anthesis and physiological maturity) and farmer contacts throughout the growing season. All participating NGOs will be offered 450,000 cfa per plot or about $1,000 per plot.

Budget

Item	Amount ($)	Description
IER – Abdoul Wahab Toure		Décrue Sorghum Research
Personnel Costs	9,000	Field technician support and salary for students stationed in Goundam for growing season
Local Travel	5,100	Travel costs associated with field visits to conduct research
Consultant Travel	4,000	Travel for an INTSORMIL agronomist (Prasad) to provide agronomic input (cultivar collections, make cultural practice recommendations and technology transfer activities) in collaboration with IER scientists.
Supplies	1,000	Office and field supplies
Indirect Costs	900	
Total IER Toure	20,000	
IER – Aly Soumare		
Contract Research	6,000	Conduct cultivar screening at Gao and Dire Research Stations
Indirect Costs	282	
Total IER Soumare	6,282	
Technology Transfer		
Technology Transfer	6,000	Outreach activities via DRA Extension and NGOs. Demonstration Plot payments
Total Technology Transfer	6,000	
Grand Total	32,282	

2010 Proposed Décrue Sorghum Demonstration/Research Activities Between INTSORMIL/USAID and NGOs

Objective: To obtain high quality and reliable data on the performance of cultivars in the North of Mali.

Proposed Sites: Farmer's fields up to their discretion.

Proposed Treatments: Three common cultivars as selected by Abdoul Wahab Toure based on results from 2008 and 2009 Décrue research and three or more additional local varieties.

Proposed Conditions: Plots would be planted on farmer's fields up to the NGO's discretion. The plots must be replicated at least three times if adequate seed is available.

Proposed Measurements/Deliverables:

- Stand ratings two weeks after planting.
- Bloom notes – relative maturity of cultivars. Requires one to two visits near flowering period.
- Harvest data – heads per plot/area harvested
- Harvest data – Harvest panicles and take fresh weights and allowed to dry in the sun for several days and take dry weight.
- Seed saved for future use as planting seed (optional).
  Number of farmers contacted through field visits and demonstration trainings/field days.
- Farmer perceptions of cultivars (if possible)

Data will be reported to Abdoul Wahab Toure, who will function as project coordinator in Mali.

Proposed Amount: 450,000 cfa per location
Funds will be dispersed directly from INTSORMIL to the respective organization on behalf of the individual.

Décrue Sorghum Plot Harvest 2009

Abdoul Wahab Toure and his student assistants preparing for the harvest of experimental décrue sorghum plots.

Abdoul Wahab Toure and his student assistants recording data prior to the harvest of experimental décrue sorghum plots.

	**Women farmers helping with the harvesting of experimental décrue sorghum plots.**
	**Farmer helping with the harvesting of experimental décrue sorghum plots.**
	**Décrue sorghum panicles bunched according to replications in experimental plots.**

Women threshing panicles of décrue sorghum to obtain yield of the various treatments.

Woman farmer and daughter helping with the threshing of the décrue sorghum experimental plots.

Student assistant with pile of décrue sorghum panicles from the experimental plots.

Panicles of four décrue sorghum cultivars tested for agronomic performance and grain quality (L to R):

Saba Soto

Saba Tienda

Sorgho Sucré

Saba Bery

Abdoul Wahab Toure and his student assistants discussing the performance of various décrue sorghum cultivars during the harvesting of experimental plots.

Training Activities

Jess Lowenberg-DeBoer, Purdue University

Faculty involved in the Mali Training Program, Jess Lowenberg-DeBoer, Bruce Hamaker, John Sanders (Purdue) and Vara Prasad (Kansas State), attended the INTSORMIL Mali Mission Partners meeting in Bamako, Mali December 8-10, 2009. Lowenberg-DeBoer provided a brief update on the Training Program.

In January 2010, the four Mali students pursuing academic training (**Aly AHAMADOU**, **Fatimata CISSE, Mamadou DEMBELE** and **Bandiougou DIAWARA**) completed the 6 month Intensive English Language training and moved on to their respective universities. Cisse met all the Graduate School admission requirements and began her graduate assistantship at Purdue University in Food Science. Diawara enrolled in the English Language Program at Kansas State since he had not obtained the required TOEFL score for Graduate School admission. He will begin his assistantship and Master's coursework June 2010. Cisse and Diawara's major professors, Bruce Hamaker and Vara Prasad/Scott Staggenborg respectively, report they are working hard and doing well in their classes. Both will be enrolled for research this summer. Research project options have been discussed and are close to finalization, with initiation to begin this summer.

Ahamadou and Dembele were admitted to Purdue's Agricultural Economics Department as post-baccalaureate students because their TOEFL scores were not sufficient for full acceptance into the Graduate Program. During the Spring 2010 semester they are taking academic courses and working independently on their English skills. They will retake the TOEFL in May for planned admittance into the Graduate Program for the summer term.

Sory DIALLO, the last academic candidate, also arrived January 2010 and began his English language training at Kansas State, through their English Language Program (ELP). He is expected to be admitted to the Graduate School/Agronomy Department to begin his Master's coursework in August 2010.

Discussions have started on the short-term training component of the project. Three IER researchers are proposed to complete two-month training programs at Purdue or Kansas State in the areas of breeding, agricultural economics and agronomy. Candidates have been identified and potential training dates are under consideration, taking into account the research and travel schedules of the IER trainees and faculty mentors, as well as training component needs.

Malian Students at Purdue

Fatimata Cisse working with Bruce Hamaker, Purdue University

Mamadou Dembele in his Ag Economics office at Purdue University

Aly Ahamadou in his Ag Economics office at Purdue University

Malian Students at Kansas State Univerfsity

Vara, Sory, Scott, Bandiougou, Alassane

Bandiougou and Sory filling pots with soil

Sory and Bandiougou helping other students in greenhouse

Sory and Bandiougou in greenhouse with sorghum plants

Bandiougou and Sory in a meeting room with Rachel and Vara

Sory and Bandiougou examining soybean plants with Rachel and Alassane

Sory and Bandiougou examining sorghum plants with Rachel and Alassane

Sory and Bandiougou examining soybean plants

Report submitted by:

E. A. "Short" Heinrichs
Assistant Director
INTSORMIL
eheinric@vt.edu
402-472-6011
12 April 2010

File: My Docs1/Buy In USAID Mali/Mali Annual Report 2009