

*A Review*

**The Nicaraguan Maize Seed Production Project-  
After 10 Years**

Self Help International/Nicaragua

2004-2009

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# The Nicaraguan Maize Seed Production Project – After 10 Years

In 1999, Self Help International (SHI) identified the need for the availability of high quality maize seed as a major development objective for small land holders in Nicaragua. Subsistence farmers with small holdings located in isolated regions of Nicaragua had little or no access to quality seed or enhanced production technologies which could enable them to improve the quality of life for themselves, their families and the community. These technologies included chemical weed and insect control, open-air grain drying platforms, or enhanced post-harvest grain storage techniques. It was a courageous step to envision a seed growing cooperative (known locally as a “Seed Bank”) made up of farmers with exceedingly small land holdings, no seed production experience and little or no experience with improved production technologies as a means to achieve the goal envisioned by SHI.

The SHI seed production project was started in 1999 in the community of Melchorita in the state of Rio San Juan, in south eastern Nicaragua. A summary of the first five years activities was prepared in April, 2004<sup>1</sup>. The concluding section of the five year review was entitled “A View to the Future”. It is helpful to reread this section as an overview to the progress that has taken place at the Melchorita Seed Bank since 2003.

**“A View to the Future:** The seed production and seed distribution aspects of The Project are now, after five years, just beginning to be appreciated and to make an impact on maize production locally. The Project has wisely not limited itself only to varieties and technologies unique to SHI/Nicaragua but rather has melded its activities with other governmental and private organizations. The Project enjoys the flexibility of working with entrepreneurs to establish new seed businesses or seed banks in areas of opportunity. It can facilitate the demonstration of improved technologies among other organizations, especially NGO’s, and it has the potential of providing a training based on the experience gained through in-the-field program development.

## APPROXIMATE AREA AND YIELD EQUIVALENT MEASURES

- Manzana (mz), a common land area measurement in Nicaragua.
- One manzana equals about 1.7 acres or 6879 square meters.
- One manzana equals .73 hectare.
- Hectare (ha), also used to measure land areas in Central and South America.
- One hectare equals 10,000 square meters or 2.47 acres.
- Quintal is a unit of weight. In Nicaragua one quintal equals 100 pounds (cwt.). Note: This weight equivalent is not used uniformly throughout Central or South America.
- 10 QQ (quintals) of maize per manzana in Nicaragua equals about 10.5 bushels per acre.
- One metric ton of maize per hectare equals about 16 bushels per acre.
- One quintal “Q” or hundredweight equals 1.78 bushels of maize.

<sup>1</sup>A Review of Five Years Activity by the Self Help International Project, 1999-2003.

The concept of using maize to develop value added initiatives for animal feeding is not yet commonly visualized among small maize producers. The Project is well positioned to promote these activities. The availability of QPM varieties and the technology to produce and store surplus quantities of grain form the basic ingredients necessary for successful value added activities.

In the near future it will be necessary for The Project to develop a more structured business plan to identify its most appropriate courses of action and/or investment. It can be anticipated that new and more productive varieties or hybrids may be in demand. New opportunities for producers to increase production efficiency and/or profitability will be needed. The concept of the Seed Bank is one that has the potential of being replicated in other regions of Nicaragua. The Project should seek ways to indirectly support local initiatives that could provide service and economic benefits to a community. The surest signal of project success will be the movement of maize from being viewed strictly as a human food source to one that is a cash generating crop with multiple marketing opportunities.

Finally, in the future The Project must increase its evaluation and data collecting functions during the principle maize growing season (June through September). Currently most of the information available on the successes of products and programs are subjective in nature. Technical, unbiased research data which measure comparative responses to variables needs to be collected and analyzed. Farmer/producer evaluations need to be recorded by unbiased observers and end users opinions need to be taken into consideration. The Project should seek additional ways to involve students and faculty from regional agriculture universities and INTA technicians in systematic applied research evaluation of many varieties, hybrids and production practices. Even carefully monitored and recorded paired plot tests would add significantly to an essential body of knowledge. QPM as a factor in quality and ultimate use must be monitored, tested and verified according to internationally recognized standards.”

It is interesting to note that many of the concerns and projections cited in 2004 have become integral components of the program as it currently exists.

When the seed project was initiated the decision was made to focus its efforts on the production of Quality Protein Maize (QPM) to take advantage of the enhanced nutritional qualities associated with its increased lysine. Lysine is one of the essential amino acids necessary in adequate quantities in dietary protein for normal growth and development in animals with a single stomach, i.e. humans, swine, chickens, etc.

Normal maize contains roughly half as much available lysine as QPM. The higher lysine content in QPM greatly enhances its nutritional value which is especially important for children and other growing animals. The unique qualities of QPM result from the expression of a recessive gene in the plant whereas in normal maize the dominant version of this gene is expressed and limits the lysine content of the grain. Unless the QPM seed is produced in genetic isolation the pollen from normal maize can obscure the expression of the high lysine characteristic.

In QPM production seed certification takes on an important additional value dimension. Contamination of a QPM seed production field by normal pollen reduces the relative nutritional value of QPM. Small amounts of normal pollen contamination would be difficult to detect by simple chemical analysis on a bulk sample. In 2009, nine individual ears were selected from a commercial harvest of QPM variety, Nutrader, that had been planted with certified seed. When the selected samples were analyzed individually and compared to a bulk sample of normal commercial maize all of the selected ears were determined to be “high lysine”. Lysine, as a percent of total sample averaged 3.0% whereas the normal sample averaged 1.8%, in line with expectations. QPM grown from certified seed should maintain its enhanced lysine level through many generations of reproduction.

The challenge is to produce seed with high germination and vigor characteristics and also genetically free from normal maize genes to sustain the high lysine content.

Initial seed production focused on the variety Obatampa, a variety selected in Africa from Mexican seed stocks. Obatampa was vastly superior to local varieties, had good stalk strength and produced well in the humid tropical environments of east and southeastern Nicaragua. It had also been selected for the QPM characteristic. Most of the seed was sold in 25 kilo bags to match the needs of small farmers. The variety was heavily promoted in national field trials conducted by the Nicaraguan Institute for Agriculture Technology (INTA), the Ministry of Agriculture and Forestry (MAGFOR) and through the private voluntary organizations (PVO's) and other non-governmental organizations (NGO's). Its qualities were recognized and approved for certification by MAGFOR and the variety entered into the national approved seed registry. It remained in production until 2006 when it was succeeded by newer QPM varieties and hybrids produced by INTA.

### **EVOLUTION of a NEW SEED BANK MODEL**

Purchasing maize seed in a subsistence agricultural economy is not a common practice. The prevailing custom is to save seed from a previous harvest or at the time of harvest selected ears are set aside to be used as seed in subsequent production cycles. Seed marketing opportunities in an isolated region such as Melchorita were greatly restricted because of these traditions. Production of "Certified Seed" was a means of opening up new opportunities for local entrepreneurs as well as a means to sell in a national market.

Certified seed production requires rigid adherence to production norms developed by MAGFOR which included isolation, freedom from disease, approved production field management practices and specific drying and post-harvest management. During the growing period MAGFOR conducts on-site inspections and post-harvest seed quality evaluations. On-site inspections are conducted by trained specialists at the expense of the producer. "Certification" is authorized only after the required production standards have been met.

Adhering to these production standards represented a significant challenge to meet required advancements in production technology on the part of the Seed Bank participants. During the early development period the number of active participants in the Seed Bank fluctuated. The production costs of seed increased dramatically and it was necessary for SHI to increase the availability of money to finance seed production.

### **Availability of New Varieties and Hybrids**

INTA plant breeding programs tested and released for production new varieties with the QPM qualities. These releases, especially Nutrader, were superior to the older Obatampa and enjoyed an increased demand in the national market. The Seed Bank moved aggressively to enter this market with Nutrader. The value of certified seed for an open pollinated variety was 22 dollars per hundredweight for clean, bagged and fungicide-treated seed. The seed was packaged in multiple layered paper bags in 25 and 50 kilo sizes.



**Figure 1. A hybrid seed production field showing two detasseled rows of a female parent and a single row of the male parent.**

a selected genotype to be used as the male parent. At the time of tasseling the tassels of the plants in the female rows are removed and discarded prior to pollen shedding. This is done by hand and must be done precisely and in a timely manner. Tassels in the male rows are allowed to mature and to fertilize the kernels, i.e. silks, on the female rows. The hybrid seed that is marketed is harvested only from the female rows. Seed on the male rows is discarded or used for animal feed.

There are other complicating factors in the production of hybrid maize seed in Nicaragua. The hybrids currently available are made from three inbred lines. For example line “A” is crossed with line “B” to make a single cross hybrid. This single cross is used as the female parent and crossed to a third inbred line i.e. “C” which becomes the male parent. Therefore:  $(A \times B) \times C$  describes the 3 way hybrid. Problems can arise since a single cross is more vigorous and grows more rapidly than an inbred line. In a seed production field it becomes necessary to plant the male row first, leave space for the female rows and plant the seed for the female rows 3-5 days later than the male rows. This is calculated to have both parents of the cross flowering (tasseling and silking) at the same time to assure maximum seed set. The educational component of hybrid seed production is significantly greater than that for the production of open-pollinated varieties.

Seed production activities at the Melchorita Seed Bank during the period 2004-2008 are summarized in Table 1.

During the past five years the Project has progressed from production of open pollinated QPM seed to higher-producing QPM hybrid seed. In the national market the prices for hybrid seed was 42 dollars per hundredweight or roughly double that of a variety. However, hybrid seed production is more complex and requires increased production management, discipline and expense than open pollinated seed. In 2005, a one manzana hybrid seed production field was established at Melchorita, as a demonstration and training tool.

Typical hybrid seed production field in Nicaragua will consists of a repeating cycle of two or four rows of a selected genotypes which become the female parent in the cross and a single row of

Table 1. Summary of the maize seed production activities at the Melchorita Seed Bank during the period 2004-2008. (Adapted from report by Jorge Campos)

	2004	2005	2006	2007	2008
Number of producers	10	9	11	15	19
Acres of QPM variety production	56	27	27	35	39
Acres of QPM hybrid seed production	0	1*	10	12	7
Quantity of QPM variety seed produced	750 cwt.**	593 cwt.	395 cwt.	433 cwt.	598 cwt.
Quantity of QPM hybrid seed produced	0	18 cwt.	220 cwt.	311 cwt.	115 cwt.
Market value of variety seed in dollars per cwt.	20	22	22	41	42
Market value of hybrid seed in dollars per cwt.	-	not sold	40	59	60
Total value of seed sold in dollars	15,000	12,324	17,085	36,102	31,000 (est.)
Seed production credit extended by SHI in dollars	2617	9110	5184	8580	4278***

\*a one manzana demonstration/education hybrid seed production plot.

\*\*cwt. equals hundredweight.

\*\*\*\$1900 supplied by SHI and \$2378 by the Red SICTA regional project.

### Impact of the Melchorita Seed Bank

The Melchorita Seed Bank has become a dynamic force for change and a symbol of change in Rio San Juan state. A partial listing of the accomplishments would include:

- The use of QPM as an enhanced nutritional quality maize in the diets of hundreds of people as well as livestock.
- The use of improved varieties as an investment in increased productivity.
- The use of chemical weed control paired with hand spading or animal traction for field preparation.
- The application of chemical fertilizers (mainly nitrogen) to increase productivity.
- The education, training and discipline necessary to produce and market high quality maize seed.
- The application of specialized production practices required to produce hybrid maize seed.
- The processing, treatment, packaging and sale of seed as a means of income generation.
- Developing a national versus only a local seed marketing strategy.
- The use of metal storage bins to protect the crop post-harvest from fungal, rodent and insect losses.

None of these accomplishments have arisen *de novo*. Each has been the product of good leadership, hands-on demonstrations and a clear vision of the purpose and value of the task. Ing. Jorge Campos has been a major driving force behind this program. His leadership and educational skills have been instrumental in the emergence of a successful Melchorita Seed Bank. The magnitude of the social impact of some of these changes may easily be underestimated. The addition of hybrid seed maize to the Seed Bank's activities is an illustration of this. Hybrid seed is being produced by persons who had never grown even a commercial crop of hybrid maize and had no concept of controlling pollination between female and male parental stocks. Equally difficult to appreciate was the need to manage the delayed planting of one parent to match the flowering date of the other. The move from a simple subsistence production system to a precisely managed hybrid production system has not come easily.

It is useful to understand that in the Melchorita region 80% of the area used to grow maize is tilled by hand using a spade or hoe. The other 20% is plowed by oxen. Chemicals to control weeds before and after planting are applied with a backpack sprayer. Fertilizers are spread by hand once or in the case of seed production twice during the growing season. Fields are small, usually less than three acres, and are frequently rented, not owned. Insofar as possible production is dried on the stalk, in the field prior to harvest. Post-harvest drying takes place in the sun on a compact roadway or, if available, on an open air concrete floor. Harvesting by hand is followed by hand shelling of the grain. The Melchorita Seed Bank evolved in other ways also. In 2006 the production of seed of the original open pollinated variety, Obatampa, was terminated in favor of the newer and more productive variety, Nutrader. The new variety is not only more productive but is well adapted to the local environments and has a greater marketability.

Reality is that only a small amount of the seed produced is sold locally in the Melchorita area. Since a large portion of the maize grown is of the open pollinated variety type, farmers can and do save seed from their own fields for use the following season. It is difficult to measure the actual long-term impact of an improved seed source. It is known that a well managed, attractive field of maize will become a seed source for three or four neighbors. It has been estimated that in 1999 when the Seed Bank was first established that a good field of maize in the region would yield about 20 bushels per acre. In 2008, yields of 40 to 50 bushels were realized. This gain in

production cannot be attributed solely to the advent of new varieties but includes improved weed and insect control, fertilizer use and other factors. In 2009, some local entrepreneurs were experimenting with the commercial production of the “newly discovered” maize hybrids and obtaining estimated yields of 75 or more bushels per acre.

### Formation of Red SICTA

Starting in November 2007 the Institute for Interamerican Cooperation in Agriculture (IICA) together with the Foreign Development function of the Government of Switzerland initiating a new project focusing on enhanced production of dry beans and maize in Central America. Nicaragua became a participant in the project known as Red SICTA (System for Integration of Central American Technical Agriculture).

Red SICTA opened the door for the Melchorita Seed Bank to reorganize into a cooperative on the national registry, expand its membership and area of influences and to participate in funding available through Red SICTA. The reorganized Seed Bank has become cooperative COOPEMEL. In 2009 Self Help International agreed to sell its investments in the Melchorita Seed Bank to the newly organized, participant owned COOPEMEL.

In the spring of 2009 COOPEMEL was able to utilize funds from Red SICTA to purchase a gravity mill to sort seed on the basis of kernel density and sizing screens to separate round from flat kernels. This graded seed commands a higher price in the national market.

### SUMMARY

A conspicuous measure of success for the Melchorita Seed Bank project is its production, management and marketing of certified maize seed of both varieties and hybrids. Buried within these achievements are unmeasured investments in leadership, training, demonstration and technology acceptance. A core group of local farmers remained faithful to the vision even when some members became disenchanted or attempted to take advantage of the project for personal gain. The impact of improved human and animal nutrition through use of QPM grain is unmeasured but is substantial

The Melchorita region is a relatively isolated region of subsistence farmers. Small fields in hilly terrain are poorly suited to the development of commercial agriculture. A maize crop *per se* is not a traditional source of family cash income. It was only logical that ultimate success of the Seed Bank would come through the sale of a relatively high value product, i.e. seed. Even in the case of seed production the majority of the product had to be brokered into the national market inasmuch as local demand for even improved seed remained small. An inescapable lesson to be learned from this project is that a development activity must include opportunities for the participants to augment family income. To survive, even in an isolated setting, income is required for medicine, shelter, food items,



**Figure 2. Alfredo Estrada operating the newly acquired gravity mill used to grade seed.**

clothing, schooling of children and much more. The successful use of locally manufactured metal bins greatly enhances the capacity for long-term storage of maize in tropical environments. Effective storage contributes both to the maintenance of seed quality and the use of maize for human food and animal feed. Stored grain can also be marketed in the “off season” when prices are significantly higher.



**Figure 3. Smaller storage bins are frequently used during seed production or for household food use.**



**Figure 4. Metal storage bins holding 18 cwt. are major on-farm storage options.**



**Figure 5. Seed is dried in the field by doubling the plants over to protect the ears from rainfall.**



**Figure 6. Seed is commonly shelled by hand.**

The Seed Bank at Melchorita has made a major contribution to the development philosophy of Self Help International in Nicaragua. As SHI’s involvement with the initiative at Melchorita matures a major new seed bank is taking shape in Ochomogo on the west side of Lake Nicaragua. The climate, social and political environments differs greatly between the two locations but the development model at Ochomogo is likely to be strikingly similar.