



Photo: Conny Almekinders

Seed producer José Manuel in his bean field.

New bean seeds and the struggle for their dissemination

Conny Almekinders, Eduardo Aguilar and Rolando Herrera

Pueblo Nuevo and Condega are two small villages in the mountainous province of Segovia in northern Nicaragua, not far from the border with Honduras. This region has always been an important bean and maize producing area, although the cultivation of tobacco and tomato picked up after 1990, providing farmers with a cash income. Increased cultivation of these crops resulted in a serious increase of white fly populations (*Bemisia tabaci*), generally controlled with pesticides. These insects, however, soon became resistant to the pesticides commonly used, leading to a higher incidence of viruses in these and other crops. Widespread presence of the Golden Mosaic Virus (GMV) made it impossible to grow beans in the lower parts of the region. The local beans did not show any resistance to the virus, and only a modern variety ('DOR 364') could be planted. Developed by CIAT in Colombia and formally released in Nicaragua and other countries between 1990 and 1993, 'DOR 364' has a dark-black colour and does not have the culinary and commercial qualities of the light-red local bean varieties. As beans are one of the most important food crops in Central America, farmers in these villages were facing the serious problem of having to purchase them to feed the family.

This was the situation in 1999, when a pilot project on Participatory Plant Breeding was proposed by the *Centro para la Promoción, la Investigación y el Desarrollo Rural y Social* (CIPRES), a Managua-based NGO with an office in Pueblo Nuevo. Although the farmers had little clue of what they

were embarking on, they were very interested in this initiative because the beans they were planting did not yield well. The support of CIPRES and the involvement of a bean breeder from the National Agricultural Research Institute (INTA) convinced a group of 42 farmers to take part in this initiative that aimed to develop new bean varieties that would fit their ecological conditions and their own specific demands.

Developing a new variety

It was originally planned that farmers would identify a local variety that would be crossed with a variety "improved" by a bean breeder, and that, through selection, they would then develop a bean variety with the characteristics they preferred. But one of the first problems the project faced was that there were no seeds readily available that they could work with. This meant that at least a year would be necessary to produce the desired seeds with which the project could really start. The group of farmers, the NGO technician and the breeder agreed to run a pre-trial with some crosses of which the bean breeder had enough seed. They decided that five of the farmers would host the trials. The farms of those five farmers represented the variation in growing conditions in the area, ranging from the relative warm and dry valley areas at 600 m above sea level to the cooler and wetter mountainous parts at 1000 m above sea level. These five farmers started by planting 15 rows with seeds from 15 different progenies (or plant "families"). Thereafter, together with the breeder and taking into account the preferences of the other 40 farmers involved in the project, the five farmer-breeders selected seeds for their next planting.

This part of the process lasted two years, considering that self-pollinating species segregate (or produce seeds of varying genetic makeup) approximately six generations after crossing. At first, the farmers selected the families with the best looking and most resistant plants, and eliminated the progenies that did not show good overall resistance to GMV. From the progenies that did show good resistance, they selected seeds from the plants with an attractive architecture, and a good number of pods per plants and seeds per pod. Other important criteria for selection were plant growth and seed filling capacity in their drought stressed environment. Yield and grain size and colour were the selection criteria used during harvest. In the later plantings they selected the best families, while removing all the plants susceptible to GMV from these families. One could say that, in this way, each of the five farmer-breeders was running a small breeding program. They planted twice a year on average, applied hardly any fertilizer, but did irrigate (so as not to risk the loss of the experiments to drought). Although the five farmers took the group's criteria into consideration, their final selection very much reflected their personal preferences for plant type, pod load and seed filling performance. For example, one farmer was very keen to select beans that would still give him reasonably well-filled seeds even if the rains stopped early. Another farmer emphasised the ability of plants to remain standing after the torrential rains which typically follow short intense drought periods. After five plantings, each farmer had selected the seeds which performed best in his fields, and ended up with his own "champion" variety.

These "champion" varieties were then planted in a series of trials for comparison. The first round of comparisons consisted of a trial on each farmer's land. This meant that for the first time, they could compare their "champion" variety with the other four "champions" on their own farm. These trials showed how much the selections of the five farmers differed, despite the fact that they had all started with the same seed. Planting was "blind", meaning that there were no labels to indicate which variety was whose, although the farmer-breeders found it easy to recognise their own variety without any doubt. The results of the joint evaluation, involving the 40 other farmers as well, showed that these seeds were better than the varieties commonly used (see Table 1).

What followed was a total of 48 evaluation trials, run in collaboration with the breeder and the CIPRES technicians. Seeds were planted in the second planting season (*postrera*)

of 2002 and the first season (*primera*) of 2003. Based on these results, the farmers decided against selecting only one champion variety. They preferred to select two varieties for further seed multiplication: one that did best in the lower, drier areas and one that excelled at higher elevations. The farmers who selected them named them 'Pueblo Nuevo JM 12.7' and 'Santa Elena'. Farmers selected these varieties for their overall performance: they do well at low soil fertility levels, show a good resistance to Golden Mosaic Virus, are drought tolerant and are of a well-liked red colour. 'Pueblo Nuevo JM 12.7' is especially liked because of its culinary qualities. The farmers' aim was to distribute seeds of these varieties to other farmers and also to try to earn some cash income by selling the seed.

Registration and commercialisation of the seed

The commercialisation of their two "champion" varieties in the formal market meant following the official regulations, which start with an obligatory registration of the variety. This requires data on the performance of the genetic materials along with morphological descriptors, all of which was available from the 48 verification trials. But the farmers soon realised that presenting the data was not enough: they also needed to have a legal set-up under which the varieties could be registered. With the support of CIPRES, the farmers organised themselves into a co-operative, COSENU. This co-operative was founded in 2004 with 42 members, with the specific aim of controlling the quality of the seed and of commercialising it. In anticipation of the registration, the bean varieties were informally "launched" in a big celebration held in October 2004 in Pueblo Nuevo. The news reached the local radio and newspaper.

But this is where the process got stuck. Seed laws and their implications are difficult to understand, especially for a new and small organisation like COSENU. In addition, there is the difficulty of maintaining the variety. The "owner" of a variety is responsible for maintaining genetically pure, basic seed. Although the farmers are convinced that they can maintain the two new varieties, not everybody else shares this view. Additionally, the registration and the maintenance of pure seed implies yearly costs in visits to the fields by officers of the ministry of agriculture (which can cost up to US\$ 300 per year), as well as in inputs and infrastructure (like a storage facility to keep the seed) that are the responsibility of the "owner".

All together, this created a hazy picture that was not easily understood by the farmers and technicians. It was not quite

Table 1. Yield (kg/ha) of the five best families of beans selected by five farmer breeders in evaluation trials on their farm.

Farmer	Location of planting		Origin of the material (farmer)					Test variety
			Juan García	Jose M. González	Pedro Gómez	Santos L. Merlo	Jairo Videa	
Juan García	Santa Rosa	850 m	2005	1551	(#) 2717	2069	2127	1875
Jose M. González	Paso Hondo	630 m	969	(#) 2522	2134	2134	2263	1616
Pedro Gómez	La Lima	1000 m	969	839	(#) 1948	1098	1164	1551
Santos L. Merlo	El Rosario	650 m	1035	1016	1180	(#) 1722	1275	1057
Jairo Videa	Rio Abajo	600 m	2328	1616	1357	1482	(#) 2522	2269

(#) The selection with the highest yield in the trial

clear what information was missing and what was the next thing to do, nor who was going to do what. COSENUP farmers multiplied the seed for several seasons and in January 2005 they had a commercial volume of seeds of both varieties. But apart from selling seed to an NGO that planned to distribute it for evaluation trials in the south of Nicaragua, nobody has shown major interest in buying their seed. Of course, there has been interest from neighbouring farmers and family members, but the COSENUP farmers feel they cannot charge neighbours and friends commercial prices for the seed. So, in these cases they give or exchange seed. Apparently, one of the factors that discouraged farmers in other villages from buying seed was a government seed distribution programme which provided seed for free. As a result, the investments made by COSENUP and the farmer-breeders for the construction of silos to store the seed have so far not paid off. Farmers also invested time, energy and land in developing the varieties, and the lack of interest for their varieties is discouraging. This represents a dilemma: formal commercialisation of a new variety is not legal without an expensive registration process, while it is difficult from the beginning to know the potential demand for their seed. More than two years after the informal launching of the two new bean varieties, the National Seed Council (CONASEM) has now acknowledged that the provided information is sufficient, and has officially approved the registration of 'Pueblo Nuevo JM 12.7' as a bean variety in April 2007.

contact between the breeder and the farmers, and made sure the plantings were correctly followed through. He mobilised resources for irrigating the plots, made sure there were good bags to store the seeds between the seasons and, something the farmers saw as very important, he inspired the farmers when they got discouraged. He also helped out if there was a difficulty with the trials or when a family crisis had to be overcome.

Despite the time consuming efforts, the COSENUP farmers feel proud. The project has boosted their confidence because they now have more knowledge, understand where varieties come from, and what is involved. Bean yields have definitely increased, and farmers can again produce enough for their own consumption. Selling the surplus allows them to buy more meat for the family, extend their house, put on a new roof or buy a bicycle. An interesting observation is that not only the two "champion" varieties are grown by other farmers; they also like a third selection because of its drought resistance.

Future actions

Although the registration and marketing of the bean varieties took a long time and occasionally lessened the enthusiasm of the farmers, the fire did not extinguish. Several farmers have continued to work with the breeders of INTA. Some of them like to work with early generation bean families that are still segregating into different genotypes, others feel this is too time-consuming and prefer to select the best seeds from advanced, genetically stable families. Recently, breeders and farmers have started talking about evaluating bean varieties preferred by the Hispanic population in the United States, discussing what they would do differently in a new process (try out each others' materials at earlier stages; not wait three years before doing culinary tests). Other farmers have engaged in the development of better maize and sorghum varieties, and some have also asked INTA and CIPRES to bring them tomato varieties to work with.

In the meantime, the breeders at INTA have developed new varieties that have good grain colour and show resistance to the Golden Mosaic Virus. And although it does not look as if structural changes in the breeding and production of seeds will result, the interaction between the farmers and the breeders has changed, as they undeniably work more closely together. Maybe the changes in the interactions at the personal level are even more relevant than those in the procedures of the research institutions. In any case, despite the fact that sometimes steps are taken forwards, and at other times backwards, the overall feeling of all involved is that they are moving in a positive direction.



José Manuel Gonzalez and his father from Pueblo Nuevo, Nicaragua examine different varieties of their sixth generation bean seeds.

Lessons

The overall process took three years (six plantings) of selection and one additional year for evaluation trials. It was extremely time consuming and difficult at times, and the farmers acknowledge that they could not have managed without the breeder and the CIPRES technician. With the breeder they discussed the options and made the plans for the trials. Initially, he was seen as their instructor and teacher. But over the seasons, as the farmers increased their understanding of the selection process, the relationship between the breeder and the farmer-breeders developed into a partnership, in which they discussed the planning on an equal footing. The NGO technician was also crucial in the whole process. He co-ordinated the

Conny Almekinders. Department of Technology and Agrarian Development, Wageningen University, Hollandseweg 1, 6706 KN Wageningen, the Netherlands. E-mail: conny.almekinders@wur.nl

Eduardo Aguilar. Department of Plant and Environmental Sciences, Norwegian University of Life Sciences, UMB. P.O. Box 5003, Aas, N-1432 Norway.

Rolando Herrera. Centro para la Promoción, la Investigación y el Desarrollo Rural y Social, CIPRES. Pueblo Nuevo, Nicaragua

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