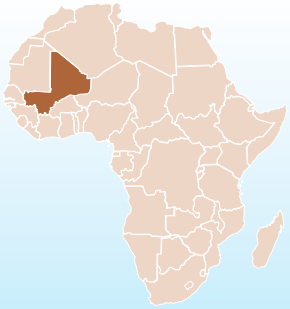
INTEGRATED WITCHWEED MANAGEMENT IN MALI



Location: Mopti Region, Mali

Following a locust infestation and drought in 2004 and 2005, researchers went to Central Mali's Mopti region to assist farmers. Local farmers identified witchweed as one of the most formidable threats they faced. Thereafter, farmer field schools were developed in Mopti and the neighboring Tominian area, where scientists introduced an integrated means of managing witchweed. Both farmers and scientists noted crop improvement and witchweed reduction upon first harvest.

CHALLENGE

With around 69 percent of its inhabitants living below the poverty line of $1.25/day[1] and only four percent of arable land, Mali's agricultural output must be optimized to achieve food security.

Among many farming constraints, *Striga hermonthica*—commonly known as witchweed—remains a particular challenge. Witchweed disrupts agricultural systems in Asia, Australia, and even parts of the United States, but it clearly wreaks the greatest damage in Africa, where it affects over 300 million people. The plant's delicate pink flowers belie its parasitic nature: it annually infects some 50 million hectares of maize, sorghum and millet crops in Africa. Witchweed infestation results in an estimated $7 billion in annual losses for farmers and regularly causes crop losses of 40 to 100 percent in infected fields.[2]

As stealthy as it is pretty, *Striga* does most of its damage underground before announcing its presence by sprouting violet petals on the soil surface. Attaching itself to the host root, *Striga* drains it of water and nutrients and produces hundreds of thousands of seeds per square mile; this leads to a colossal build-up in the soil that can remain active for years.[3] A mature plant, for example, can produce upwards of 200,000 seeds.[4] By the time the weed becomes visible, the attacked plant is usually terminally ill. Herbicides, which are often prohibitively expensive, cannot protect the crop once the damage has been done.

The continuous cultivation of staple crops exacerbates witchweed's effects, allowing it to grow uninterrupted. This causes a exponential growth of witchweed seed bank and drives a continuous downward cycle for farmers already struggling with recurrent droughts and soil erosion. Monocropping further degrades soil by depleting it of nitrogen, which creates an environment favorable to *Striga* proliferation.

In 2004, a locust infestation destroyed most of Mali's food harvest; the crisis was deepened by the drought that followed in 2005.[5] Responding to the severity of hunger that ensued, the Malian government and various organizations began distributing food and subsidizing grain sales. But the precariousness of central Mali's agricultural systems and their vulnerability to natural crises mandated long-term solutions.

RESPONSE

In 2006, staff from Catholic Relief Services, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the Institut d'Economie Rurale consulted with Mopti farmers, who said witchweed was one of the top problems they faced

in cultivating millet and cowpea.[6] The agencies helped establish farmer field schools in six villages, with about 150 farmers participating. Each village chose five representatives to become farmer-trainers. At the end of each week, these 30 farmers came together for trainer-instruction, learning how to set up, work with, and observe experimental fields, discussing subjects pertaining to the cultivation of millet and cowpea, and subsequently imparting their knowledge to local farmers. The training expanded in 2007 and 2008 to villages in the neighboring Tominian area where 375 farmers participated in field schools. Seventy-five of these farmers participated in a facilitator-training and then provided training to 300 other farmer participants.

The training focused on containing witchweed through Integrated Witchweed Management (IWM), developing more sustainable cropping systems and addressing other farmer needs in the central Mali region. The strategy had four main goals:

1. Increase yield and net returns from labor and organic inputs
2. Decrease the number of weeds and the size of the witchweed seed bank
3. Increase soil fertility and organic matter
4. Develop a more diversified and sustainable cropping systems

The initial training took place from June through November 2006. Farmers used botanical extracts from neem tree leaves and chili pepper for insect pest control during the cowpea crop's flowering stage.[7] Subsequent field experiments were conducted in four townships (Benena, Saneku, Tominian and Yasso) in 2008, which produced additional data on *Striga* plant and seed density.

The experimental fields typically contained two plots. The first juxtaposed standard farmer practices with the IWM package tactics; the second was dedicated to individually testing the management strategies to see which was the most effective. The IWM package in 2008 included the following tactics:

1. Intercropping millet-cowpea or millet-groundnut (0.4 m x 0.8 m). Intercropping is an effective means of controlling *Striga,* because of the shading, higher humidity and lower temperatures under intercrop canopies.[8]
2. Applying farmyard manure or compost (four tons per hectare) increases the soil's nitrogen content, thereby inhibiting *Striga* growth. It also creates an environment that is conducive to the proliferation of microorganisms, including *Fusarium Oxysporum*, a fungus that provides an effective means of *Striga* biocontrol.[9]
3. Applying reduced doses of mineral fertilizer (30 kg per hectare of nitrogen, phosphorus, potassium and urea) to millet planting holes at sowing time to inhibit *Striga* growth.
4. Manual weeding of witchweed plants at 15 Days After Sowing (DAS) and 90-100 DAS.
5. Weeding, with application of urea to millet rows (40 kg per hectare) and ridging at 40-50 DAS.

"I invested my extra earnings from the certified seed production into better food, schooling and health care for my three children."

– Aïssata Konaté, farmer and president of a local women's group

Farmer trainer writing down results of observations on Striga (counts) and crop development (height and number of leafs) in Wacoro village, Dioila district, Koulikoro region. ©Tom Van Mourik, ICRISAT-Bamako

Farmer trainers in Gaye village, Mali showing their interpretation of millet development and the Striga life cycle. ©Tom Van Mourik, ICRISAT-Bamako

"This has changed my status in the village. Here housing is normally the responsibility of men. Now the community can see how women can provide for their families too."

– Aïssata Konaté, farmer and president of a local women's group

The Mopti field school also experimented with sowing after the first rains rather than before, lowering organic application amendments to two tons per hectare and thinning millet plants to two rather than five plants/hole in order to encourage faster and more robust individual plant growth. In contrast, farmers' conventional practice included sowing pure millet crop (0.6 m x 0.8 m), applying farmyard manure or compost at four tons per hectare, and weeding at 15-20 DAS and again at 45-50 DAS.

As popularity for the farmer field schools have grown, so has the need for more skilled trainers. To address the growing demand, in 2012 ICRISAT and its partners in Niger, Nigeria, Ghana and Mali have developed series of in-depth farmer-to-farmer videos. Produced or translated in eight languages, over 20,000 DVDs have already been dispersed to various partners and individuals. In the first nine months over 15,000 people had already viewed the trainings.[10]

RESULTS

The following results were recorded from the farmers' experiments:

Weed management: Witchweed concentration was lower in the integrated plot, with continued manual pulling of witchweed proving to be indispensible. In both conventional and IWM plots, five to seven *Striga* plants per millet stand were counted approximately 45 DAS. However, 90 DAS, *Striga* plants had surged to between 12 and 17 plants per stand under conventional farmer practice, but had fallen to zero in the IWM plots. After one year, *Striga* seed bank density ranged between 13,000 and 25,000 seeds per square meter under conventional practice, compared to less than 4,000 seeds per square meter under IWM practices. [11]

Crop production: In the Mopti region, cowpea bean production was more or less the same in the two plots, but cowpea fodder production was considerably higher in the integrated plot. Millet grain production was much greater in the integrated plot despite a later sowing date. In the Tominian townships, millet yields were not significantly different between conventional and integrated practices (0.615 and 0.692 tons per hectare, respectively), but IWM produced additional grain and fodder from the cowpea and groundnut intercrop (0.22 tons of grain per hectare and 1,125 bundles fodder per hectare, respectively), which was lacking in the conventional pure millet plots. Not surprisingly, farmers preferred the integrated practice.[12]

Ecological literacy and human capital: The training process taught farmers how to manage weeds and crops, taking into account the larger agro-ecosystem context, as well as how to design, conduct and analyze results from on-farm experiments—components that support ecological literacy in an agricultural landscape.[13] Despite their low literacy levels, women farmers developed training and leadership skills[14] and gained the respect and support of community members.[15]

Economic opportunities and social capital: Close collaboration over the course of a field season enabled farmers to build relationships and gain confidence in collective action. Forming partnerships can be the first step toward increasing financial capital if it catalyzes farmers to form marketing groups and undertake other projects to secure additional income.[16] Farmers have formed groups that enabled them to send one person to market (about 100 km away) to purchase agricultural inputs for the group, saving the expense and effort incurred by individual travel.

Knowledge-sharing amongst farmers and scientists: Farmers' communication between villages in the region improved. The millet and cowpea seeds that were used in the experiments were bought from a local seed vendor in a participating village known for its variety and high quality seeds. The activity boosted demand for well-adapted, early, local variety of pearl millet seeds.

ICRISAT has since taken the local millet variety for multiplication and testing throughout the West African sub region. It is now being disseminated in Niger, where farmers prefer its early maturation and compact panicle (the latter makes it resistant to the headminer insect pest).[17]

Integrated Witchweed Management reduces both the *Striga* plant and its seed bank while diversifying intercropping systems and improving soil fertility. Increased organic soil matter supports better nutrient-holding capacity as well as water penetration and retention, thereby improving crop viability under drought conditions. Reduced crop vulnerability also reduces farmers' economic vulnerability.

ENDNOTES

1 World Food Programme. *8 Things to Know About Hunger In Mali*. https://www.wfp.org/stories/8-things-know-about-hunger-mali (accessed July 21, 2014).

2 "IITA Leads Bio-Control Effort Against Witch-weed." IITA, 2008. http://old.iita.org/cms/details/iita_news_details.aspx?articleid=1568&zoneid=363 (accessed July 21, 2014).

3 Berner, D.K. *et al*. "The role of biological control in integrated management of *Striga* species in Africa." in *Biological Control in IPM systems in Africa*. Oxon, CABI Publishing, 2003.

4 Van Mourik, Tom. Stomph, Tjeerd, and Alistair Murdoch. "Why high seed densities within buried mesh bags may overestimate depletion rates of soil seed banks," *Journal of Applied Ecology* 42, no. 2, (2005): 299-305.

5 World Food Programme. *Media Advisory: FAO/WFP joint reports on crop and food situation in four West African countries following locust threat*. http://www.wfp.org/news/news-release/media-advisory-faowfp-joint-reports-crop-and-food-situation-four-west-african-countries-following-lo (accessed July 21, 2014).

6 Van Mourik, Tom. "*Kaata* is making our plants wilt." The Rodale Institute, December 14, 2006. http://newfarm.rodaleinstitute.org/international/features/2006/1206/witchweed/vanmourik.shtml (accessed July 1, 21 2014).

7 *Ibid*.

8 Oswald, A. *et al*. "Intercropping controls striga in maize based farming systems." *Journal of Plant Physiology* 21, no. 5, (2002): 367-374.

9 IITA, "IITA Leads Bio-Control Effort Against Witch-weed", *Op. Cit.*

10 Hoeschle-Zeledon, Irmgard. *Sustainable Intensification of Key Farming Systems in the Sudan and Guinea Savanna of West Africa.* Africa Rising, 2013. https://cgspace.cgiar.org/bitstream/handle/10568/34300/WAreport_sep2013.pdf?sequence=5 (accessed July 1, 22 2014).

11 Van Mourik, Tom. "Cluster based farmer field schools for Integrated Striga Management and profitable millet crop systems in Mali." ICRISAT/IER/UACT, Mali, 2009.

12 Van Mourik, Tom. "Cluster based farmer field schools for Integrated Striga Management and profitable millet crop systems in Mali."*Op. Cit.*

13 Klemow, Kenneth M. "Basic Ecological Literacy: A First Cut." *Ecological Society of America Education Section Newsletter* 2, no. 1 (1991): 4-5, http://klemow.wilkes.edu/basic-lit.html (accessed July 1, 21 2014).

14 CIA. *World Fact Book: Mali*. https://www.cia.gov/library/publications/the-world-factbook/geos/ml.html (accessed July 1, 21 2014).

15 Van Mourik, Tom. "*Kaata* is making our plants wilt." *Op. Cit.*

16 *Ibid.*

17 Tom van Mourik, Project Scientist, Integrated Striga and Soil Fertility Management, Participatory Research Project, ICRISAT-Bamako, Pers comm. December 18, 2010.

FRONT PAGE PHOTO:
Pearl millet field in Gaye village, heavily infested by Striga. ©Tom Van Mourik, ICRISAT-Bamako

FOR MORE INFORMATION
www.oaklandinstitute.org