

Award Category: International IPM Program

Nominee Name: Larry Murdock

Nominee Title: Professor of Entomology

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Supporting Document: SUBMITTED

Vita:

Improving economic benefits related to IPM adoption: Checked

Reducing potential human health risks: Checked

Minimizing adverse environmental effects: Checked

Brief Summary of Nominee's or Program's Accomplishments (500 words or less):

Cowpea is an indigenous African legume rich in protein. It is a principle food grain and important source of income for many smallholder farmers in West and Central Africa. The biggest constraint to increasing production is devastating bruchid weevils that destroy about half the stored grain in a matter of months if not treated with relatively expensive and potentially risky pesticides. Weevils reduce grain biomass and quality, force farmers to sell their harvest when prices are low, and subject consumers to the risk of pesticides when used to prolong storage.

Dr. Larry Murdock, an entomologist at Purdue University, got involved in cowpea storage pest management in the mid 1980s as a member of the USAID funded Bean-Cowpea Collaborative Research Support Program. He knew that hermetic storage was an ancient technique that could control insects. His research showed that if cowpeas were stored in a dry, low oxygen environment insects could not survive and multiply. But there was no simple, cheap way to do hermetic storage in African villages. Most of the potentially airtight containers (e.g. metal drums, plastic jugs) were either too expensive or needed for other uses (e.g. carrying water). In response, he developed a three layer plastic bag, with an outer layer of woven polypropylene for robustness and two layers of heavy polyethylene to provided cost effective protection.

Respiration of insects living in seeds and stored in a closed space may, together with respiration of the grain itself, in combination with the limited free oxygen available, eventually reduce the oxygen and elevate the carbon dioxide levels to a point where the insects are unable to carry out their life processes normally. Weevils that survive in the grain presumably are inactive, and resume activity only when oxygen again becomes available. The method is simple, uses readily available materials, and low cost. When properly employed, this technology limits insect pest storage losses to almost zero!

The challenge was reaching farmers to demonstrate the potential of the technology, and establish a supply chain to produce and distribute the hermitic bags in a sustainable manner. The Gates Foundation agreed to support an implementation project in 2007 that would demonstrate the technology, and create a sustainable supply chain for producing and distributing the bags.

Hermetic storage technology has now been distributed and demonstrated in more than 30,000 villages in 10 countries in West and Central Africa with an average monetary benefit of US\$150 per household for about 3.4 million households (or about 48 million people). This benefit comes from reduced storage losses and increased market profitability; without hermetic storage many farmers sell cowpea at harvest when prices are low. In addition, there are benefits yet to be quantified from a reduction in pesticide poisonings with less insecticides being used in stored cowpeas.

This storage technology is being extended around the world, and evaluated for wide range of stored commodities.

Describe the goals of the program being nominated; why was the program conducted? What condition does this activity address? (250 words or less):

Each year, African farmers lose thousand of tons of cowpea and millions of dollars because of bruchid weevil storage pests. Losses in unprotected grain can be as high as 50%. Consequently, farmers often sell their grain at harvest when prices are low to avoid devastating storage losses, instead of taking risks, and waiting for off-season prices that double or triple. Farmers and consumers are also increasingly concerned about pesticide poisoning associated with stored cowpeas.

Larry Murdock and colleagues developed and demonstrated the efficacy of hermetic storage bags, then secured support from the Gates Foundation in 2007 to implement a five-year project to improve cowpea storage in West and Central Africa. The goal of the Purdue Improved Cowpea Storage (PICS) project is to have 50% of cowpea in West and Central Africa stored with hermetic bags by 2012 by disseminating the triple-layer bags to 28,000 villages in 10 countries including Nigeria, Niger, Burkina Faso, Ghana, Mali, Senegal, Cameroon, Benin, Togo and Chad.

Specific objectives include:

- 1) Determine the best design for a one-piece commercially available triple-layer plastic cowpea storage bag.
- 2) Disseminate information on non-chemical cowpea storage methods to extension services, non-governmental organizations (NGOs) and farmers.
- 3) Demonstrate the most effective cowpea storage methods in each village in the major cowpea producing areas of West and Central Africa.
- 4) Develop a supply chain for triple-layer plastic bags to make the technology available to farmers and provide opportunities to local businesses.

Describe the level of integration across pests, systems and/or disciplines that was involved. (250 words or less):

As with the development and implementation of any worthwhile IPM technology, this effort was necessarily a product of an integrated approach. Entomologists worked with agronomists, seed physiologists and food scientists to evaluate grain quality, and with economists to determine market values and improve the supply chain.

When Larry Murdock initiated the Bean-Cowpea CRSP storage project in 1987, his collaborator Moffi Ta' Ama had been experimenting with fumigants for the control of the cowpea weevils. This effort, like all other Bean-Cowpea CRSP projects, featured multidisciplinary research that integrated production components with health, nutrition and socio-economic components important in smallholder agricultural economies. This included pursuing research in traditional settings and field trials on small farms, and identifying mechanisms for transferring research results. Projects monitored impacts on

women and their families, and included a training component at the graduate level for host country nationals.

Likewise, the PICS project with support from the Gates Foundation is a joint collaborative effort involving partners from international agricultural research centers, international development NGOs, national agricultural research institutes, government agencies, local NGOs, private entrepreneurs, and farmers. Scientists at Purdue University from departments of Agricultural Economics, Entomology, Food Science, and Youth Development and Agricultural Education are also contributing to this integrated effort.

Describe the team building process; how did the program being nominated get partners involved? Education and awareness are essential in an IPM program. (250 words or less):

Following his first visit to Africa in the mid-1980s, Larry Murdock joined the USAID Bean-Cowpea CRSP project to work on cowpea storage pests. The original research was initiated as a collaboration between Murdock as US principal investigator, and Moffi Ta' Ama as host country principal investigator with collaborators from the Institute of Agricultural Research for Development (IRAD) in Cameroon. The team launched a series of initiatives to develop storage techniques that were: simple to use; employed materials available to low-resource farmers; prevented insect damage, insured quality; were economical and locally sustainable; and involved no chemical insecticides.

Murdock showed how hermetic storage technology could be effectively used for cowpea, and collaborated with universities, CGIAR centers, NGOs, national extension services and other technology transfer organizations to develop a supply chain to produce and distribute hermetic storage bags to smallholder farmers throughout the cowpea-producing region of West and Central Africa.

Partnerships were established with NGOs, plastics manufacturers, and public sector agricultural research and extension organizations to bring triple layer plastic storage bags to the market, teach farmers how to use them effectively and develop a distribution system for the bags. The Gates Foundation provided the support needed to implement the novel technology across the region by pursuing a pioneering public-private partnerships to get the technology into widespread use in a self-sustaining manner.

What outcome describes the greatest success of the program?:

The hermetic storage bag has been commercialized since 2008, but already millions of resource poor farmers are more food secure and have greater income opportunities as a result of affordable and widely distributed hermetic storage bag technology. Demonstrating the efficacy of these bags in villages throughout the cowpea production region has been an extremely effective and efficient method for transferring the technology. Stored cowpeas are no longer subject to destructive weevil pests that historically threatened production yields and limited access to markets when prices were more favorable. Families now generate more income, increase personal savings, pay school fees, and participate in microcredit markets with their pest-free grain. The storage technology also eliminates pesticide costs and risks, a concern that has become both a price and health premium in many markets. Storage bag production and distribution is now established and widely available throughout the cowpea production region as a sustainable component of the supply chain thanks to the innovation and leadership of Larry Murdock.

Provide evidence of change in knowledge, behavior or condition as a result of the program/individual. (250 words or less):

Since 2007, the PICS project has sold more than 1.5 million storage bags to 3.4 million households reaching an estimated 48 million people in 10 countries in West and Central Africa. The technology cut

weevil damage losses virtually to zero, increased grain value as pest-free stored food or sold as a commodity when needed, eliminated pesticide risks, and created new micro-credit markets with the grain as collateral. In short, the project reached or exceeded every goal and objective laid out in the implementation plan.

A study based on data collected in 2003 and 2004 showed that innovative cowpea storage technologies including hermetic storage bags will yield \$295 million of benefits in West and Central Africa by 2020 [Moussa et al., 2011. *J. Stored Products Research*]. With the widespread adoption of the PICS bags the benefits will be even greater. One early indicator comes from an adoption study by Moussa et al. in April 2010 in Niger and Burkina Faso. They found over 70% of cowpea stored on farms in Niger and Burkina Faso in hermetic containers. Both men and women farmers use hermetic storage, and adoption was significantly higher in villages that benefitted from PICS “in-village” demonstrations compared to those that did not [Moussa et al., poster presented at the World Cowpea Conference, Saly, Senegal, September, 2010].

Who or what should receive the most credit for the success of this program? (250 words or less):
Larry Murdock initiated the research and development that led to the current implementation effort with colleagues in the USAID-funded Bean-Cowpea CRSP. The original proof of concept work was done with a number of colleagues including Moffi Ta' Ama from the Institute of Agricultural Research for Development (IRAD) in Cameroon. More recent research and technology transfer initiatives were pursued with other colleagues and counterpart institutions in West Africa, particularly with Dr. Ibrahim Baoua and staff at the National Institute of Agricultural Research of Niger (INRAN). The current PICS implementation effort is supported with a grant from the Gates Foundation. The project is a joint collaborative effort with partners from international agricultural research centers, international development NGOs, national agricultural research systems (NARS), government agencies, local NGOs, private entrepreneurs, and farmers. Colleagues from four departments at Purdue University including Agricultural Economics, Entomology, Food Science, and Youth Development and Agricultural Education have also contributed to this interdisciplinary effort.

If selected, suggested Citation for Award Certificate (40 words or less):

Larry Murdock and colleagues have dramatically improved the food security and economic livelihood of millions of cowpea farmers with the cost effective hermetic storage bags they developed and demonstrated in 30,000 villages in 10 countries in West and Central Africa.