Projected Impacts of Papaya Ring Spot Virus Resistant (PRSV) Papaya in the Philippines

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Papaya is a major tropical fruit in the Philippines, ranking sixth in area and production. In 2003, domestic production reached 131,000 metric tons on 8,900 hectares. Export production of *Solo* papaya is rising in the southern part of the country. Only a little over 1 percent of global papaya production, estimated at 5.8 million tons, is contributed by the Philippines.

Mainly intended for the domestic market, papaya is predominantly grown by small-scale peasant producers with very little application of inputs. The average yield is low at only about 14 metric tons per hectare as compared to 70 to 90 metric tons per hectare under commercial/plantation scale production. Yield levels are also variable due primarily to insects, diseases, and viruses. Even yields of the newly developed high-yielding papaya varieties have remained low due to the growing incidence of the papaya ring spot virus (PRSV).

The PRSV problem in papaya and proposed solution

PRSV was first detected in 1982 in the Southern Tagalog and Bicol Regions where it caused substantial damage to papaya orchards. The virus is believed to be widespread in Luzon and Visayas and is increasing in Mindanao where papayas for export are grown by multinational companies. The PRSV affects all stages of plant growth from seedling to maturity. The most recognizable symptom is the appearance of green concentric ring spots on the fruit surface. Other symptoms include yellowing, mosaic, and deformed leaves. Papaya plants infected with the virus exhibit a dramatic decline in yield by as much as 60 to 100 percent. Only the *Sinta* variety developed in 1995 in the Philippines can provide moderate tolerance to the virus. However, that too must also be combined with other disease management practices to effectively prevent and reduce the spread of the PRSV.

In its search for varieties resistant to PRSV, the papaya biotechnology program was introduced in 1998 at the University of the Philippines-Los Banos (UPLB) to induce somatic embryogenesis in papaya for genetic engineering. The initial biotechnology research studies and training were supported by the Department of Science and Technology (DOST), the Philippine Council for Agricultural Research and Rural Development (PCARRD), ISAAA and the Australian Center for International Agricultural Research (ACIAR). Through *Agrobacterium*-mediated transformation, transgenic lines exhibiting resistance to PRSV have been produced and are now under confined field trials at the Institute of Plant Breeding, UPLB. The technology is in the regulatory phase and the process is being accelerated with the support of ABSP II and ISAAA.

Assessment approach

At present, little is known *a priori* about the potential economic impact of this technology once commercialized. To analyze the effects, papaya farmers were interviewed from the major growing provinces of Cavite, Laguna, Misamis Oriental, Davao del Sur, and South Cotabato. These structured interviews were supplemented by personal interviews with papaya scientists and industry experts on the possible effects on costs, yield, environment, and success in the development and commercialization of the technology. The farm level effects were determined by comparing the situations with and without the technology; for the market level effects, economic surplus analysis was completed.

Results

Without the PRSV resistance technology, the largest cost item in papaya production were fertilizers and hired labor, which represented 49 percent of the total cost per hectare. Expenditures on pesticides accounted for only 10 percent of total cost or PhP6,132 (USD113) per hectare. For a small scale operation in 2003, the total cost amounted to PhP64,529 (USD1,198) per hectare, or to PhP4.40 (USD0.08) per kilogram. Farms under the commercial or plantation scale can incur costs exceeding PhP300,000 (USD5,555) per hectare. Meanwhile, the PRSV resistance technology can reduce pesticide expenditures by as much as 21 percent, and overall total cost by 8 percent even with increased costs for seeds, hired labor and marketing. With an expected yield increase of 77 percent, the cost of production per kilogram decreases by 38 percent. These result to an increase in net income per hectare by PhP61,440 (USD1,378), or 275 percent over the common papaya varieties.

Using economic surplus analysis, and taking into account research and regulatory costs, the stream of net benefits discounted at 5 percent over 15 years amounted to PhP11.68 billion (USD216.3 million). Most if not all of these benefits would accrue to producers. The targeted date for commercializing the technology is 2007, but a five-year delay in commercialization would reduce expected net benefits by 63 percent; an increase in the initial adoption rate from 30 percent to 50 percent would increase expected net benefits by 18 percent. If yields were to increase by 95 percent, net benefits would increase by 31 percent.

Conclusion

Based on the above analysis, early commercialization of the PRSV resistance technology will provide substantial economic benefits to papaya producers through the combined effects of reduced production cost and increased yield. While the technology may be important because of severe PRSV damage in the country, commercialization must however be carried out with due consideration to expected price changes and seed distribution, geographical location, and varietal use. Although the technology has potential favorable economic effects in total, these effects may not be fully realized if seed prices increase more than projected, if there is low demand for the variety, or if PRSV incidence is minimal in a particular area.