RESEARCH BRIEF **May 2003**

Human Health, Environmental, and Economic Effects of Pesticide Use in Potato Production in Ecuador

David Yanggen, Donald Cole, Charles Crissman, and Steve Sherwood[1]

Introduction An interdisciplinary and interinstitutional team of scientists has led a research–intervention project dealing with pesticide impacts on agricultural production, human health, and the environment in Carchi, Ecuador. Carchi is the most important and most productive potato-growing zone in Ecuador. Smallholder households dominate production, and they sell the vast majority of output. They use high levels of inputs, notably pesticides for the control of the tuber-boring larva of the Andean weevil (*Premnotrypes vorax*) and the late blight fungus (*Phytophthora infestans*). Virtually all farmers apply class 1b highly toxic pesticides using hand pump backpack sprayers. Research concerning pesticides has examined: neurological impacts on farmers and their families; poisoning incidence; studies of farmers' attitudes, knowledge, and practices; economic impacts; and contamination of ground and surface water, clothing and body surfaces, food, and home areas. Intervention activities have included: farmer field schools, community meetings analyzing personal and household exposure pathways, promotion of safety measures, radio announcements, educational programs, and stakeholder workshops.

Findings: Farm Households' Knowledge and Use of Pesticides

- Farmers used pesticides on virtually all potato fields. On average, farmers applied seven pesticide applications containing 2.5 different products on each field each season.
- Carbofuran and metamidofos, WHO-classified 1b "highly toxic" pesticides were the dominant insecticides. Mancozeb, a mutagenic substance at the cellular level and a possible cause of cancer, dominated fungicide use.
- The marginal benefit of pesticide use was positive (i.e. an additional dollar spent on pesticides generated more that one additional dollar of income). Farmers were thus rational in their use of pesticides from a short-term purely financial point of view.
- Despite a near 90% literacy rate, more that 70% of men and 80% of women did not understand the color coding on pesticide labels indicating toxicity.
- Farmers' minimal use of protective clothing during pesticide preparation (gloves 14%, masks 8%, eye protection 3%) and application (plastic back cover 38%, poncho 26%, protective pants 26%) led to high rates of skin contact with pesticides (face 84%, hands 87%, legs 86%, feet 78%, back 73%).
- Farmers commonly believed that repeated exposures allow individuals to build up a resistance to pesticides. The ability to bear the nausea and other immediate effects of pesticide intoxications were generally associated with strength and manliness.

Findings: Contamination of Environment, Potatoes, Body, and Home

- Concentrations of carbofuran found in soils and in surface water were within the standard limits established by the U.S. Environmental Protection Agency.
- The analysis of pesticide residues on potatoes themselves found insignificant levels.
- Fluorescent tracers showed pesticide residues on applicators' bodies (hands, back, legs, etc.) and on non-workers, including children, who visited fumigated fields.
- Contamination pathways into the home included pesticide storage, the washing of application equipment and clothes, and applicators not showering and changing clothes. Cotton swabs rubbed on home areas and tested for pesticide residues and fluorescent tracers confirmed contamination in the home (kitchen table and floor, clothes washing area, patio, etc.).
- Cotton swabs rubbed on home areas and tested for pesticide residues as well as use of fluorescent tracers confirmed contamination in the home (kitchen table and floor, clothes washing area, patio, etc.).

[1] **David Yanggen Agricultural Economist, CIP d.yanggen@cgiar.org ♦ Donald Cole Epidemiologist, University of Toronto donald.cole@utoronto.ca ♦ Charles Crissman Agricultural Economist, CIP c.crissman@cgiar.org ♦ Steve Sherwood Agricultural Extensionist, World Neighbors sherwood@uio.satnet.net**

Findings: Impacts on Human Health

- Carchi had the highest level of pesticide intoxications in Ecuador and among the highest reported in the world. Pesticides were the principal cause of death after traffic accidents for both men and women. Frequent hospitalizations of women and children indicated that intoxications were not limited to men who applied the pesticides.
- Active vigilance studies found that hospital data only caught about 10% of the actual intoxication cases.
- The immediate costs of a typical intoxication (medical attention, medicines, days of recuperation, etc.) equaled the value of 11 days of lost wages.
- The standardized average neurological score of potato-growing households was nearly 1 standard deviation (SD) below the control population. Individual tests indicated that up to two-thirds of these household members showed significant neurological impairment.
- Mean minimum levels of neurological functions were 3 SDs below the control group level. This impairment level typically causes difficulties in carrying out basic physical tasks and farm management decisions. These levels compare to individuals considered neurologically disabled and who receive disability benefits in countries such as Canada.

Findings: Alternative Policies and Intervention Strategies

- Econometric analysis showed that farmers who had suffered significant neurological impairment were less productive than those not significantly affected.
- A tax on all pesticides would improve farmer health but reduce profitability. A tax on only highly toxic pesticides would improve both farmer health and profitability.
- Alternative technologies such as integrated pest management (IPM) and safety measures can increase both farmer health and profitability; IPM also reduces environmental contamination.
- In farmer field school (FFS) experimental plots, farmers innovated IPM technologies that substantially reduced costs while maintaining yields, leading to increased profitability.
- In a trial community, three-quarters of the FFS participants invested in specialized protective clothing. Farmers reported quick health improvement due to this change.
- At provincial and national level stakeholder meetings (with participants including key political leaders, farmer representatives, research and development organizations, government ministries, the media etc.) formal calls were made to prohibit class 1b pesticides and support alternative technologies.

Conclusions

- The health problems caused by pesticides are severe and are affecting a high percentage of the rural population of the Carchi Province in Ecuador.
- Technology and policy solutions exist that can substantially improve the health of the province's population and are economically viable.
- Despite the gravity of the problem, little progress has been made at the aggregate level. Government policies have long promoted the use of pesticides. A clear political will has not existed to date to reverse this situation.
- Research by the pesticide industry concluded that any company that could not ensure the safe use of highly toxic pesticides should remove them from the market and that it is almost impossible to achieve safe use of highly toxic pesticides among small farmers in developing countries. Our research in Ecuador concurs with these conclusions.

Selected References

Atkins, J. and K. Leisinger. 2000. Safe and Effective Use of Crop Protection Products in Developing Countries. CABI Publishing. New York, NY.

Crissman, C., J. Antle and S. Capalbo (eds.). 1998. Economic, Environmental and Health Tradeoffs in Agriculture: Pesticides and the Sustainability of Andean Potato Production. CIP (International Potato Center), Lima, Peru and Kluwer Academic Publishers. Dordrecht/Boston/London. 280 p.

Yanggen, D., C. Crissman, and P. Espinosa (eds.). 2003. Los Plaguicidas: Impactos en Producción, Salud y Medio Ambiente en Carchi, Ecuador. Centro Internacional de la Papa, Instituto Nacional Autónomo de Investigaciones Agropecuarias, y Ediciones Abya Yala. Quito, Ecuador. 197 p.