Rose red. Of concern to female workers are potential reproductive risks from pesticide exposures.

Greta Friedemann

Would a Rose

Each Valentine's day, when U.S. and other consumers purchase millions of flowers for their loved ones and deeply inhale the fresh aroma of roses and carnations, they rarely think about where the flowers come from or how they are produced. Yet, if these same people knew more about the high levels of agrochemicals used in flower production and the often less-than-rosy labor conditions under which flowers are produced, they might think twice about sinking their noses into the petals to smell the perfume. International environmental and worker advocacy groups charge the floriculture industry—which grows cut flowers in greenhouses—with exposing laborers to dangerous pesticides, with failing to provide health safeguards, and with damaging the environment from overuse of natural resources.

Problems Stem from the Cut Flower Industry

Not Smell As Sweet?

Cut flowers are often touted by national governments and international development agencies as alternatives to tropical crops with unstable prices, like coffee, bananas, and palm oil. Indeed, the nascent Colombian floriculture industry benefited from expert advice on exporting flowers as part of a 1965 project by the U.S. Agency for International Development. More recently, floriculture has been promoted as an alternative to growing coca, the source crop of cocaine. Colombia produces 11% of the world's cut flowers and is second only to Holland in output. Colombia's export business employs 75,000 people growing roses, carnations, and more than 50 other varieties of cut flowers. Exports in 2000 were valued at $580 million, according to Asocolflores, the trade association for the Colombian flower industry. Colombia's success in floriculture has spurred Kenya, Zimbabwe, Ecuador, India, Mexico, China, and Malaysia to take advantage of cheap labor and tropical sunlight to get started in floriculture. Floriculture now employs about 190,000 people in the developing world, according to International Social Standards for the International Flower Industry, a report by Frank Brassel and Cruz Emilia Rangel published by the Friedrich Ebert Foundation, the International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Workers, and the German section of the nongovernmental group FoodFirst Information and Action Network (FIAN).

Advocates of the growing floriculture business are quick to point out that the industry provides thousands of steady jobs, often paying above minimum wages, in places where any kind of job is scarce. According to the Brassel-Rangel report, the international cut flower industry generates $30 billion annually while using large quantities of labor and capital. Per hectare, greenhouses employ many more workers than does a typical traditional farm, and the jobs are much steadier. In Colombia, many floriculture jobs carry fringe benefits: employers seeking to retain skilled workers in an area of high employment provide medical clinics, transportation to work, child care, and pensions. Greta Friedemann, a doctoral candidate in the department of anthropology at the University of Minnesota studying the impact of the flower industry on women in her native Colombia, says, "The industry provides jobs, and in particular jobs to a segment of the Colombian population that doesn't have access to jobs

very easily, or to jobs that pay well." However, the economic gains may still come at a cost to worker and environmental health.

Pretty Flowers and Nasty Chemicals

Although statistics on pesticide use in the floriculture industry are rare, the industry is known to use a wide range of chemicals, including fertilizers, insecticides, fungicides, nematocides, and plant growth regulators, some with potential for serious harm to human health. Cut flowers also enjoy a peculiar regulatory status in the importing countries. Because they are an agricultural import, they must be pest-free to avoid introduction of plant diseases or insects. But because they are not an edible crop, they are exempt from regulations on pesticide residues and hence are not inspected for residues. In 1996, 342,000 tons of flowers were imported through the Miami airport—the largest port of entry in the United States, according to the Department of Agriculture. According to a 29 August 2001 article in the Guardian, one of every two flowers sold in the United States comes from the Savana region around Bogota, the Colombian capital.

The concern about pesticides arises because they can cause cancer, birth defects and other reproductive illnesses, and neurologic disease in humans. Workers may be exposed to these pesticides in a variety of ways. Workers who transplant, prune, cut, and pack flowers without protective garb may absorb pesticides through their skin. Dusting, spraying, and other applications of chemicals in enclosed spaces such as greenhouses may allow workers to inhale pesticides.

An influential study by M. Restrepo and colleagues at Colombia's National Institute of Health, published in the August 1990 issue of the *Scandinavian Journal of Work, Environment and Health* (*SJWEH*), stated that 127 chemicals were used in Colombian greenhouses. This statistic on chemical usage has been echoed repeatedly in subsequent reports on the industry. A newer study by Sandra Gomez-Arroyo, a biologist at the Center for Atmospheric Sciences at the National Autonomous University of Mexico, published in the March 2000 issue of Mutation Research reports that flower greenhouses in Morelos State, Mexico, applied 36 different chemicals, including the persistent organochlorines DDT, aldrin, and dieldrin.

In Costa Rica, which grows large quantities of leatherleaf ferns used as a green accent for flower arrangements, the expanding industry has run afoul of neighbors and raised charges of government malfeasance and ineptitude in protecting worker health.

From the savana to the supermarket. An estimated one of every two cut flowers sold in the United States originates on the Savana region surrounding Bogota, Colombia.

Arnold Greenwell/EHP

Claudette Mo, for example, studied the subject while she was a professor at the Regional Wildlife Management Program of the National University of Costa Rica between 1994 and 2000. She describes the occupational health situation in the Costa Rican floriculture industry as very poor. "Over 50% of respondents who worked in fern/flower farms reported at least one of the symptoms of pesticide exposure—headache, dizziness, nausea, diarrhea, skin eruptions, fainting, and so on," she says. Workers did not recognize these symptoms as pesticide exposure, she adds, and the doctors who treated them "did not disclose the information due to lack of knowledge themselves or because they worked for the fern company."

In Ecuador, a fast-growing competitor to Colombia in export flower production, Jaime Breilh, an epidemiologist who directs the Ecohealth Project of the Health Research and Advisory Center in Quito, says preliminary assessments reveal serious defects in current flower industry practices, including failures in handling toxic materials, storage and application of pesticides, educating workers of the dangers of pesticide exposure, provision of protective gear, dosage and application of pesticides, and reuse of pesticide-saturated greenhouse plastic for domestic purposes such as covering houses. Breilh is organizing a large, interdisciplinary investigation of the social and health implications of the floriculture industry.

Sylvie Joly, a television journalist with Radio-Canada, reported in February 2002 on some of the problems in Ecuador's floriculture industry. According to Joly, many of the pesticides used in the industry have been banned from use the United States or Canada, because of the hazard they present to humans. Regarding work practices, she says, "We had a lot of testimony from workers saying there is never a delay for reentry [into the greenhouse] after fumigation. We saw it, workers were going in and out. At a supposedly good greenhouse, there was a sign saying 'two hours delay' but some workers were telling us that in other greenhouses they are spraying while workers were inside." Joly says that because owners don't want to lose time by waiting for pesticides to dry or disperse: "Immediately when the spraying is finished, [workers] have to go back to cut roses while leaves are still wet with product." Joly does say, however, that the people actually applying the pesticides may have better protection than other workers. The Ecuadorians in her television documentary wore respirators, masks, gloves, and overalls as they drenched plants with chemicals from a spray hose.

Colombian cloud. A worker in a Colombian greenhouse is surrounded by a cloud of pesticide dust he is applying to roses.

Greta Friedemann

The cut flower industry has exploded recently in Tanzania, where pesticide poisoning was already common. In the 1980s, according to an International Labor Organization (ILO) report, 368,000 Tanzanian people were poisoned annually by pesticides. Tanzanian floriculture production soared from 98 million stems in 1994 to 322 million in 1998. A 2000 ILO report on the cut flower industry there cited a Tanzanian government study that listed the following deficiencies in pesticide handling: a shortage or lack of material safety data sheets and instruction manuals, worker ignorance of the identity and hazards of chemicals, improper storage of

The greenhouse effect. (left) Aerial views of floriculture operations in the Savana region near Bogota. (right) Workers who cut, sort, and box flowers using minimal or no safety gear and other safeguards are at risk of breathing pesticide residues and absorbing them through their skin.

Series on left: anonymous contributor; right: Jorge Tolosa

chemicals, lack of emergency treatment for accidental poisonings, no training for operators to recognize early signs of accidental poisoning, improper use and maintenance of personal protective equipment (when provided), and inadequate disposal of waste.

Worker and Environmental Health

Well-designed studies of floriculture workers are rare, and those that are available may be inconclusive because of methodologic problems. Tasks, conditions, pesticides, and protective measures vary widely across the industry and even among small groups of workers. Much of the concern focuses on greenhouses, site of most flower-growing operations. For example, in a study of five greenhouse workers in Italy, Cristina Aprea, chief of the Environmental Hygiene in Agriculture Section at Italy's National Sanitary Service, and colleagues wrote in the January–February 2001 issue of the *American Industrial Hygiene Association Journal*, "Comparison and characterization of the tasks monitored in this study is difficult because the workers did different tasks every day in different greenhouses treated with different quantities of the three active ingredients."

In a study of horticulture pesticides published in the November 2000 issue of *Occupational and Environmental Medicine*, Jesper B. Nielsen of the Institute of Public Health at the University of Southern Denmark found that the skin acts as a reservoir, slowly releasing chemicals. An *in vitro* experiment using human skin cells evaluated three commonly used pesticides, methiocarb, paclobutrazol, and primirarb, and showed that the lag time in dermal penetration for the latter two pesticides was more than 18 hours. Neilsen argued that because the lag time exceeds the workday, "biological monitoring at the end of the exposure may seriously underestimate the actual exposure."

Agricultural workers face neurotoxicity hazards because many insecticides, especially organophosphates, kill insects by interfering with nerve function. A Danish study by Finn Tuchsen of the Department of Epidemiology and Surveillance in the Denmark National Institute

of Occupational Health, and Allan Astrup Jensen, published in theDecember 2000 issue of *SJWEH* showed that agricultural and horticultural workers had an elevated risk of Parkinson's disease, presumably due to exposure to neurotoxic pesticides. In Ecuador, says Breilh, greenhouse workers show a very high neurotoxic impact of pesticide use. "Nearly 60% of the workers," he says, "manifested nervous system symptoms, including headaches, dizziness, hand trembling, and blurred vision."

Reproductive hazards have been a particular concern among scientists who have studied the floriculture industry. The 1990 Restrepo report on Colombia's cut flower industry found a "moderate increase in the prevalence of abortion, prematurity, and congenital malformations" among children conceived after either parent started working in floriculture. The severity of health problems correlated to the degree of pesticide exposure—an indication that the problem was linked to pesticides.

Greenhouse work also may interfere with conception. A study of 1,767 female members of the Danish Gardeners Trade Union by Annette Abell and colleagues at the Department of Occupational Medicine in the Aarhus University Hospital in Denmark, published in the April 2000 issue of *SJWEH*, concluded that "female workers in flower greenhouses may have reduced fecundability [ability to become pregnant in any given month, after terminating contraception] and that exposure to pesticides may be part of the causal chain." Risk factors included long hours handling plants, not using gloves, and operating pesticide sprayers.

Abell and colleagues also studied sperm formation among ornamental-flower greenhouse workers. The researchers reported in the December 2000 issue of *SJWEH* that median sperm concentration was 40% lower among men with more than 10 years of greenhouse experience than among men with less than 5 years' experience.

Evidence also indicates that exposure to pesticides may produce genotoxic effects in flower workers. The previously cited study by Gomez-Arroyo looked for indications of genetic damage among workers in Mexican greenhouses where "the application of chemicals to the flowers is uncontrolled." The study found an increase in several markers of DNA damage, including sister chromatid exchanges (swaps of genetic material between similar strands of DNA) and micronuclei (fragments of DNA occupying new, tiny nuclei in cells).

A study by researchers at the National Institute for Research on Cancer in Genoa, Italy, published in the August 1999 issue of *Environmental and Molecular Mutagenesis*, reported an association between flower greenhouse work and DNA adducts—chemical complexes between potential carcinogens and DNA that may represent an early stage of carcinogenesis. The authors wrote that the study "supports the adoption of measures ensuring pesticide exposure reduction in greenhouses."

The worker-health risks of the floriculture industry are often justified by an improvement in health that might be expected from a steady income. According to Breilh, however, "Contrary to prevailing arguments, the epidemiological profile of Cayambe [Valley, Ecuador, a major flower-production region] doesn't appear to show any consistent improvement as an effect of agro-industrial prosperity." Infant mortality held steady at 113 per 1,000 births between 1986 and 1996, despite what Breilh calls the "explosion" in floriculture in the valley. Malnutrition resulting from the displacement of traditional agriculture could play a role. Says Joly, urban workers in Ecuador who raise traditional crops

A budding market. A worker sorts flowers into a box in Naivasha, Kenya. The floriculture market is expanding throughout the developing world to countries with warm climates and cheap labor.

Curt Carnemark/World Bank

and livestock to supplement their diets are losing their land to greenhouses. Her television documentary showed dairy cows eating discarded flowers that were almost surely contaminated with agrochemical.

Floriculture, like other agricultural industries, exacts an environmental toll. "The flower industry produces all these flowers . . . but the externality is huge," says Friedemann. In addition to the use of pesticides, she asserts, "the amount of water used is incredible [although] no one knows how much, because the flower industry is secretive." She charges that floriculture use of groundwater has caused the water table to drop in the savanna around Bogota, where Colombia's flower production is concentrated. Al Bates, chief operating officer of Dole Fresh Flowers (a division of Dole Foods Company, Inc.), the world's largest grower of cut flowers, responds to this common assertion among critics by noting that the company is installing drip irrigation in its operations in Colombia and Ecuador. Says Bates, "We, like any other farming operation, want to use the most efficient means of irrigation." The company will also benefit, he says, by spending less money pumping water.

In Costa Rica's fern industry, Mo found a disturbing picture, including "direct discharge of pesticide residues into waterways, washing of pesticide equipment in waterways, runoff reaching important aquifer recharge areas, and some anecdotes of bird die-offs after application of granular pesticides." She says she began her research in 1994 because "important aquifers are located directly in areas with extensive ornamental plant cultivation."

A Research Focus on Floriculture

The intense focus on floriculture has potential to produce scientific benefits. New studies of the industry may be poised to produce vital knowledge about the occupational and environmental health effects of agricultural chemicals. Jorge Tolosa, an obstetrician-gynecologist at Thomas Jefferson University in Philadelphia, together with Marcela Varona, a researcher with the Colombian National Institute of Health in Bogota, has finished a pilot study of the industry (funded by Asocolflores and a private insurer working in the area of environmental and worker health) that attempted to fill gaping holes in basic data. "We are trying to determine what pesticides are being used . . . and how they are being used," he says. Research teams have visited farms in two regions of the country to question workers and administrators about chemicals, equipment, and procedures and to observe whether they comply with "standards of international or national agencies for controlling human exposures," Tolosa says. "We observed, in the field, the management, preparation, and distribution of pesticides, how workers are using safety equipment, [whether] it is provided in good condition, [whether] they are taking precautions after spraying."

Although Tolosa would not reveal the pilot study's exact findings, he indicated that it would reflect well on the Colombian industry. "The flower growers know that there is global scrutiny on the process of flower production in Colombia, including worker protection and health, as well as the impact the industry has on the environment." Asocoflores has, Tolosa

Greta Friedemann

When the bloom is off the rose. Workers at a flower producer near Bogota prepare waste plant matter for composting.

says, "a very solid program for the protection of subjects and of the environment. Can they improve? Yes, but did I find what I was hoping not to find, that they are using wrong pesticides, are abusing workers? No, that's not what I found. It was totally the opposite." At this point, Tolosa says, the two major needs are to find out why some workers do not use protective gear, even when available, and to identify biologic markers for agrochemical exposure. Studying a population that is exposed to such a bewildering variety and dose of chemicals hobbles efforts at epidemiology, he says.

Howard Frumkin, an epidemiologist and occupational health expert at Emory University, advised the Tolosa-Varona project. He notes that although floriculture is a relatively small industry, "it's an incredible study opportunity because pesticide exposure usually occurs among marginalized workers who are difficult to register and enumerate—farm workers. The beauty of floriculture is that it's an industrial organization of work, but these are agricultural exposures. The workers are enumerated, available, often tied into health care systems." Because workers are accessible to researchers, methods similar to those used in large occupational health studies in the United States can be used. Floriculture is "probably the best lab in world for the study of this issue—the high exposure level is not matched anywhere."

Regulating Behavior, Certifying Growers

Despite the headlines about conditions in the floriculture industry, governments in developing countries have been slow to issue and enforce guidelines and regulations for the industry. (Repeated calls by *EHP* to the Colombian Embassy in the United States for information on this issue were not returned.) Yet as international scrutiny continues, growers and critics alike are seeking ways to reduce negative impacts without harming the industry. The cut flower industry is now the subject of several competing and overlapping schemes variously intended to improve social conditions, worker health, and the environment. For example, several European human rights, nongovernmental organizations, including the FIAN, are promoting a "Flower Campaign" to establish "a humane and ecologically sustainable production of cut flowers." In 1998, the Flower Campaign issued an "International Code of Conduct" urging the industry to conform to ILO standards, the U.N. Universal Declaration of Human Rights, and basic environmental standards. Companies that comply can label their flowers so that consumers can support growers that heed the code. The Flower Label Program has been adopted by about 10% Ecuadorian floriculture businesses, according to Breilh.

The Rainforest Alliance and other members of the Sustainable Agriculture Network (SAN) are urging flower producers to join a separate certification and labeling scheme. Ximena Franco Villegas, a consultant with the Nature Foundation in Bogota, Colombia, which is serving as the local contact for the program, says the standards would prohibit any chemicals banned by the EPA, the European Union, the U.N. Food and Agricultural Organization, or the U.N. Environmental Program from being used in floriculture. Any product produced on a farm certified by any member of the SAN bears a seal with "Rainforest Alliance certified" on it. However, Villegas, who describes her job as facilitating "dialog between government and industry for these norms," admits that "producers are not willing to be qualified by third parties; they are not really hot about the idea."

Dole Fresh Flowers, which employs 11,133 workers in 700 hectares of greenhouses, says it is the first cut flower business certified for compliance with ISO (International Standards Organization) 14001, which is intended to improve the environmental responsibility of businesses. The certification program contains a list of 21 specific requirements regarding environmental training, planning, monitoring, and measurement. Bates says Dole used ISO 14001 to harmonize its floriculture operations in Colombia and Ecuador: "This became a real effective way of pulling them together, getting standard operating procedures, under a program that's recognized worldwide, registered and certified by an external body."

Asocoflores has established a voluntary program of environmental responsibility for members. The program, called Flor Verde (green flower), is dedicated to sustainable development, to reducing the use of pesticides, energy, and water, and to improving waste management. The number of workers at participating Flor Verde companies has grown from 6,471 in 1996–1997 to 38,964 today, Asocolflores says. According to the group's web site, member firms are developing programs such as teaching and personal development, care of workers, recreation, housing acquisition and repair, women's development programs, and health care programs. Because all of the efforts of Asocolflores are voluntary, some employers may be more conscientious than others. But even skeptics say some companies provide considerable fringe benefits to employees.

Camillo Perdomo, marketing manager for S.B. Talee de Colombia, an Italian firm with 21 hectares of greenhouses and 350 full-time employees in Colombia, says the Flor Verde program, although optional, does contain significant standards and inspections. Human resources inspectors, he says, check that workers are paid properly according to law and have proper preparation for the job. The chemicals inspector, he says, "sees that the right amount of pesticides are being used, that the concentration of active ingredients is not higher than 150 kilograms per hectare per year, for example." The environmental protection inspector investigates whether areas are well kept, walkways are clean, necessary danger signs are present, and "working accidents are minimal." The water inspector "sees to it that the water is not being withdrawn illegally from the rivers or streams, that the residual waters are being disposed of properly in what they call 'deactivator wells.' These wells receive the water and deactivate the chemicals in the water before disposing of the water itself." The safety inspector, among other things, ensures that after an area has been fumigated, no one can enter for 24 hours. Farms that fail inspections, Perdomo says, lose eligibility to display the Flor Verde label in their marketing.

Given the long-standing tension between flower growers and outsiders who want to change their ways, it may be surprising to learn that the cost of protecting environmental and worker health may be modest. "If we had no involvement with Flor Verde, I don't think our flowers would be much cheaper," says Perdomo. "We produce millions of stems per year, and the program, yes it's expensive, but it does not affect our price that much."

Publicity about industry problems has made a difference in Colombia, where even critics grant that some of today's ominous headlines reflect the past more than the present. "The industry has done incredible things to solve all the issues," says Friedemann. "There's been a lot of criticism, but farms are not what they were 10 years ago."

And even critics want reform, not abolition of the industry. "The people in Ecuador don't want this industry to stop," says Joly. "They don't want the type of story we're doing to make people not buy flowers. They want conditions to change."

David Tenenbaum