

Chapter 7 — Dermatologic Health Effects of Pesticides

Skin is the primary route of exposure to pesticides, particularly while spraying, but also while handling pesticides in other ways. Excluding acute pesticide intoxications, the most common adverse effect of pesticides is said to be contact dermatitis (1).

Contact dermatitis caused by pesticide exposure can be of either irritant or allergic type, and as well as exposure to pesticides, other coexisting or predisposing factors are important. These include individual susceptibility, other work-associated exposures such as to plant materials, solvents, fuels, rubber, cleansers, creams, moisture, and cold temperatures, physical abrasion of skin, as well as pre-existing skin disorders. Plant-related dermatitis is likely more common than pesticide dermatitis. Skin effects can be acute or sub-acute on top of chronic for any of the above factors.

Nature of dermatology literature

We did not locate any systematic reviews of pesticides and skin effects nor any summaries of the actual prevalence of dermatitis. Eleven of the twelve primary studies found were of adequate quality; one was excluded because of a low methodological quality score. All were cross-sectional, and examined the prevalence of dermatoses attributable to pesticide exposure. Three studies examined referral-based populations and considered only the positivity of patch tests for pesticides. The others were population based but frequently lacked specific exposure data and adequate descriptions of the populations and selection methods. The agricultural groups were heterogeneous including those working in general farming, floriculture, and fruit growing (including monocultures of products such as potatoes or bananas).

The most commonly described outcome was contact dermatitis but one study was of actinic keratoses. There were no Canadian studies, and the two US studies did not concern agriculture, but rather paraquat production and pet grooming applications (3, 7). The studies involved many types of exposures to various mixtures of organophosphates, carbamates and fungicides on most continents. Pesticides exposures varied depending on crop, climate, location, and regulatory requirements.

Methodological Issues

The most important difficulty with this area of study, with only cross-sectional data available, is the attribution of a “pesticide induced case” as distinct from the other coexisting, irritant and sensitizing exposures, especially to plants.

Contact allergic reactions are known for all pesticides tested except paraquat (9). Patch-tested subjects were also found to be allergic to various plant and other agricultural-based materials they had contact with, and studies which did not patch test for plants and other materials are difficult to interpret. Patch testing methods varied and standardized patch tests for many pesticides were not available. Patch tests can cause false positives due to irritation of the skin — the “excited skin syndrome.”

Exposure assessments in these studies were mainly based on self-reporting, questionnaires, job title, or area usage records. Only one of the studies (6) used a biomarker of exposure dose, RBC cholinesterase, and a graded system of exposure classification.

Prospective cohort studies would be most helpful in sorting out exposure relationships and also in avoiding underestimation of the true effect. Such underestimation is a problem in cross-sectional studies due to the “healthy worker effect,” the variable nature of the dermatitis, and the possibility that farmers may not seek medical care for skin complaints.

Skin outcomes found

Prevalence of dermatitis in agricultural settings ranged from 12% to 68%, but this represents dermatitis from all coexisting exposures, and does not clearly attribute pesticide effects. Irritant plant effects appeared to be common in two studies of floriculture (9) and bulbs (2), with both studies showing some cases of sensitization to both plant materials and pesticides. The strongest association was identified by Cole et al. (6), who showed a dose–response relationship between dermatitis and years of fungicide exposure, or poor application practices in potato farmers.

Patch testing was carried out in several studies and showed variable rates of allergic sensitization to pesticides, particularly fungicides. Results of patch testing indicated pesticide sensitivity among workers ranging from 2% in floriculture (9) to 28% in banana cultivation (10), and probably varied with the type of pesticides in use.

Paraquat is known to be a highly irritant pesticide, and one study (4) reported skin rash or burn in 53% of applicators using backpack sprayers under conditions lacking in use of personal protective gear.

Relevance to Canadians

Studies in agricultural settings in other countries and climates, especially where protective gear is little used, are largely not generalizable to Canadian “environmental” exposures, but may apply in some agricultural settings. Many of the pesticides examined, for instance, the insecticides carbofuran and methamidophos, are restricted or little used in Canada. Unfortunately, we found little specific data found in our review on pyrethroids, which are commonly used in Canada. In an American study rashes were reported in pet groomers who did more than 75 pyrethroid applications per month (3).

As dermal exposure and absorption of pesticides can occur, practices such as use of protective gear and/or washing well soon after intentional exposure are essential. A rash from an acute exposure to a pesticide may possibly be the only clinical indicator that a person has been exposed.

Irritant and/or allergic skin effects of pesticides are potential problems, depending on the type of pesticide and individual susceptibility, both constitutional and due to coexisting environmental circumstances. The prevalence of this problem in Canada, even among the occupationally exposed, has not been studied. It can be assumed that sub-populations such as allergic individuals may develop irritant dermatitis from applications or residues of pesticides, most likely in an occupational setting, however the extent of the problem is unknown.

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References

Review Study: not systematic

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Primary Studies

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10. Penagos HG. Contact dermatitis caused by pesticides among banana plantation workers in Panama. *Int J Occup Environ Health* 2002;8:14–18.
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Excluded Study

12. Bener A, Lestringant GG, Beshwari MM, Pasha MAH. 1999. Respiratory Symptoms, Skin Disorders and Serum IgE Levels in Farm Workers. *Allerg Immunol (Paris)* XXXI(2):52–56.

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Table

<u>Reference</u>	<u>Population Description</u>	<u>Pesticides Type and Exposure Assessment</u>	<u>Covariates</u>	<u>Health Outcomes & Measurement (for non-cancer papers)</u>	<u>Statistical Analysis</u>	<u>Measures of Association and Values</u>	<u>Global Rating</u>
Bruynzeel (1993)	The Netherlands. 103 bulb growers and employees exposed to pesticides for more than 10 years . 49 controls were not employed in the bulb growing industry. Age matched, all male.	Self-report/ questionnaire, records 50 different pesticides, mostly soil disinfection		HX & PHYS EXAM: major dermatitis (eczema: erythema, papules, vesicles fissures) or minor dermatitis (ery-thema, slight chapping, scaling). PATCH TESTS for pesticides & bulb extracts.	Chi square	Hx of pesticide related skin complaints in 13 of 103 growers. Minor dermatitis in 30% of the bulb growers and 8% of controls, P < 0.01, most likely attributed to narcissus sap.	2.4 CHANGED to 4,4 (only useful data is prevalence of approx. 9% by history alone of pesticide related symptoms)
Bukowski J et al (1996). "Prevalence of and potential risk factors for symptoms associated with insecticide use among animal growers" in <i>Journal of Occupational & Environmental Medicine</i> , 38, 528–534	New Jersey, USA; 278 veterinary and licensed pet pesticide applicators, 75 % female, age 35 (17–70) Population was 28% of those who received anonymous, volunteer, mail in survey.	OP/Carbamate and pyrethrins Self-report /questionnaire	Age, sex, types of pesticides, types of, and numbers of applications, protective usage, applicator status	Surveyed for 17 symptoms potentially ass'd with pesticide exposure.	Univariate analysis & chi square for symptoms. Logistic regression for ORs of risks of sx.	Prevalence of rash 15.7%. For skin symptoms >75 Pyrethroid treatments the OR was 2.04 (1.02–4.09). For eye symptoms, highest quartile total treatments per season, the OR was 4.75 (1.14–18.23)	4,4 (CHANGED was 5, 2/3) (several confounders were uncontrolled, view cautiously)
Castro-Gutierrez N et al (1997).	Nicaragua	Paraquat	Hx of skin rash/burn,	Proportion of exposed workers reporting		53% of exposed workers reported rash/burn from	5,6

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"Respiratory symptoms, spirometry and chronic occupational paraquat exposure" in <i>Scandinavian Journal of Work, Environment, & Health</i> , 23, 421–427	134 paraquat knapsack sprayers on banana plantation and 152 unexposed workers, M and F	Self-report /questionnaire based on 24 cumulative months. Rash or burn used as surrogate for exp. Intensity.	unexposed, low exposed, high exposed, age, sex	having experienced a skin rash or burn from paraquat exp proportion of exposed workers reporting having experienced a skin rash or burn from paraquat exp		paraquat exposure. Epistaxis 25%, nail damage 58%, eyes splashed 42%.	
Cellini A and Offidani A. "An Epidemiological Study on the Cutaneous Diseases of Agricultural Workers Authorized to use Pesticides" in <i>Dermatology</i> 1994;189:129–132	Italy 426 agricultural workers authorized to use pesticides & 100 matched controls subjects described as "the entire rural population"	No data other than "agricultural workers authorized to use pesticides," and "many" reported systemic sx due to preparation, application & after use of pesticides	—	History of dermatoses & link to biological, plant or pesticide causes & exam by 2 dermatologists for prevalence of skin disorders. Patch tests but no specific data.	—	Sx reported from use of pesticides, eyelids: 2.5%, conjunctiva: 6.5%, tearing: 2%, irritative dermatitis hands: 1%, red face: 1%, itching lips: 0.4%, Contact dermatitis of mixed causes was seen in 12% cases vs 6% control.	4,4 Only value is prevalence data on agricultural contact dermatitis
Cole DC et al (1997). "Dermatitis in Ecuadorean farm workers" in <i>Contact Dermatitis</i> , 37, 1–8	Ecuador From a farm population census, potato farm workers: 123 applicators, 28 exposed field workers, 23 consumers. 72 urban age, sex, education	Fungicides: 80% maneb. Insecticides: (both restricted in Canada) 47% carbofuran, 43% methamidophos 66 different pesticides in use. Self-report/questionnaire, records, lab AChE	age, sex, education, other skin hx, solvent exp, # pesticide poisonings, AChE, exposure amount & type	clinical skin exam, hx of med dx'd skin/ allergic disorders dermatitis. If reported maneb aggravation-patch tests (n=17)	Chi square for difference in proportions of skin findings with exposures. Logistic regression	Dermatitis 68% of exposed, 55% applicators, 31% controls p<0.001. 5% positive to maneb patch testing. ORs for dermatitis per year using fungicides 1.12, indicating a dose response relationship from chronic fungicide exposure.	6,6

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	matched controls	levels, other tests.			for predictors and ORs.		
Cooper SP et al (1994). "A survey of actinic keratoses among paraquat production workers and a nonexposed friend reference group" in <i>American Journal of Industrial Medicine</i> , 25, 335–347	Texas All 112 paraquat production plant workers and 232 matched friend controls 80% male	Intermediates in paraquat production, in closed automated plant with prob low exposure. Technicians rotated through stages. Exp classification system graded 1–6 used as well as duration.	workers, friends, high & low exposure age, skin type (Fitzpatrick), freckling before age 16, tanning past yr, sunscreen, residential sun exp as adult, PAH occupational exposure	Blinded, full body derm exam for presence of 1 or more actinic keratoses on sun-exposed body areas excluding the trunk, (endpoint 1) and 2 or more (endpoint 2)	prevalence proportions and likelihood ratio. chi -square and logistic regression	Prevalence proportion endpoint 1, friends 0.28, workers 0.30; for endpoint 2, friends 0.2, workers 0.20. On regression, endpoint 1, OR for high exposed was 1.9 (CI 0.9-4.2), and for endpoint 2, OR was 2.2(CI 0.9-5.3).	5, 5/6 well done study but non sig effect of exposure on health outcome. Exp may have been low. Not generalizable in comm. exposure sense.
Guo YL et al (1996). "Prevalence of dermatoses and skin sensitisation associated with use of pesticides in fruit farmers of southern Taiwan" in <i>Occupational and Environmental Medicine</i> , 53, 427–431	Taiwan 122 fruit farmers from Fruit Farmers Production Assoc'n and 63 printer controls. Included all member farmers from 3 of 6 villages, randomly selected.	Ops, carbamates, glyphosate, paraquat, others. Some use still of banned toxic Captofol, Folpet and Captan Self-report/questionnaire	Sensitized farmers, sensitized controls, patch test agents, farmers, controls, allergic reaction	skin diseases & srandomly selected from all members of the Fruit Farmers Production A by hx, derm exam, photographs of hands (for blinded confirmation) & patch tests	chi square	Farmers dermatitis 30.3%; farmers sensitized to agri chemicals 40%, controls 19%, p=0.004, but most frequently to the 3 banned fungicides. No dermatitis prevalence for controls provided.	5,3 CHANGED to 4,4
Paulsen E (1998).	Denmark	Self-report /questionnaire	—	Clinical exam for eczema and patch	—	13 of the 250 with skin symptoms had positive	4,2/3

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“Occupational dermatitis in Danish gardeners and greenhouse workers (II). Etiological factors” in <i>Contact Dermatitis</i> , 38, 14–19	252 gardeners and greenhouse workers with occupational skin sx & 52 without invited from postal questionnaire from part I of study. Random selection of controls.	Only info is pesticide types based on recorded freq exposures #1, Bemonyl, #2 captan and #8 maneb		tests for chemicals and 9 plant families		reactions to fungicides, 10 to captan, 3 to maneb. Reactions to plants were far more common. Prev. reported prevalence of occup'nl dermatitis was 19.6%	CHANGED to 4,4 Need prior Paulsen paper, (really part I to this one) to obtain prevalence. This paper shows low sensitization from pesticides thus attributing derm effects to plants or other irritant effects.
Penagos H (2002) “Contact Dermatitis Caused by Pesticides among Banana Plantation Workers in Panama” in <i>Int J Occup Environ Health</i> , 8(1), 14–18	Panama 281: all the workers (field or packing station) with skin injuries who consulted the departments of occupational medicine of the 2 hospitals in the 2 districts.	Questionnaire aerial aerosols: propiconazole, maneb, chlorothalonil, dithane, and backback: dalaphon, ametrine, gramoxone. Packing station: imazilal, thiabendazole, Al(OH) ₃ , formaldehyde	—	Questionnaire, exam and patch tests for plant (banana leaf), standard series, and pesticide series customized for freq use in area.	—	Contact dermatitis was allergic with pos patch tests in 27.8%, mainly due to fungicides esp chlorothalonil. The remainder were irritant type dermatitis which can be due to irritant effects of pesticides. Pesticide patch trays are incomplete.	4,4 Useful to show proportion of contact dermatitis that is allergic, but patch testing may underestimate due to incompleteness or overestimate due to irritant effects of the patch.
Rademaker M (1998). “Occupational contact dermatitis among New Zealand farmers” in <i>Australasian Journal of Dermatology</i> , 39, 164–167	New Zealand 46 farmers referred for patch testing from a hosp based derm clinic	Records, none revealed except occupation as farmers	—	Patch tests for sensitivities to standard series, agricultural series and others	—	28 farmers (61%) had one or more positive patch test, 8 to fungicides inc CuSO ₄ , captofol, maneb, and mancozeb	4,2 CHANGED to 4.4 shows proportion of referred cases who have allergic component inc to pesticides