

Pesticide contact dermatitis in fruit and vegetable farmers of Himachal Pradesh (India)

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Background: Not many studies on pesticide allergic contact dermatitis are available from Himachal Pradesh (India).

Objective: We studied the role of commonly used pesticides in causing allergic contact dermatitis in fruit and vegetable farmers in the region.

Methods: 30 fruit and vegetable farmer patients having dermatitis involving face, neck, hands, and feet and 20 controls comprising 2 groups of 10 subjects each: Group-1 had history of exposure to pesticides but no dermatitis and Group-2 having neither dermatitis nor history of exposure to pesticides, were patch tested with 10 most common pesticides used in the region.

Results and Conclusion: These 30 patients (M : F 21 : 9) were between 22–81 years of age having dermatitis for 4 days to 20 years with relapses and remissions. 21 patients had seasonal exacerbation. 10 patients attributed exacerbation of dermatitis to exposure to pesticides. Positive patch test reactions from pesticides were observed in 8 patients only. Captan was the most common sensitizer (5 patients), 2 patients were sensitive to propargite. Chlorpyrifos, tree spray oil and thiuram gave positive reaction in 1 patient each. 3 controls from Group-1 showed positive reactions to multiple pesticides. Pesticide related contact dermatitis appears more common than expected.

Key words: captan; chlorpyrifos; India; occupational dermatitis; propargite; thiuram; tree spray oil.
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Pesticides comprising insecticides, herbicides, fungicides, rodenticides, nematocides, and fumigants are used extensively both in developing as well as developed countries in agriculture, horticulture, and cultivation of vegetables (olericulture). Commercial floriculture, fruit packaging, and forestry have further expanded horizon for their extensive use. They are known to produce dermatoses such as urticaria, erythema multiforme, toxic epidermal necrolysis, discoloration of hair and nails, chloracne, skin hypopigmentation, porphyria cutanea tarda and both allergic, and irritant contact dermatitis. They are also important cause of contact dermatitis among hobby gardeners. According to Cronin (1), pesticides perhaps cause dermatitis more often than is reported. However, pesticide contact dermatitis in agricultural workers has not received much attention until recently as it has been thought to be rare. Moreover, considerations for their systemic toxicity often overshadow this aspect.

Pesticide dermatitis may be either because of solvents, impurities or the chemical itself. Exposure to pesticides occurs either by direct contact while mixing them or through airborne route while spraying especially when recommended protective measures are not observed. Sowing of pesticide preserved seeds, weeding, and harvesting previously sprayed crops may also contaminate the skin and produce pesticide dermatitis (2). Blanco et al. (3) showed that wet clothes because of sweat, wet weather or muddy worksite (resulting in increased permeability for water-soluble pesticides), pesticide spraying with leaky and/or hand-pressurized-backpack spray equipments, work practices such as repairing the spray nozzles bare handedly, mixing the concentrated pesticide solution with hands or inserting hands into the pesticide tanks or splashing the feet while pesticide spraying, and lack of good hygiene practices such as blocking a leakage with bare hands, wiping the

sweat off the face with cloth or shirt while spraying are the most important determinants for dermal pesticide exposure/skin contamination in developing countries while wearing long-sleeved shirts, long pants or shoes, and good hygiene practices are protective.

Diagnosis of pesticide-related contact dermatitis is often difficult because of constant changes in the pesticides used at a given time and place. Sensitization to them may also last for many years or reappear eventually because of cross-reactions with a new structurally related pesticide. Additionally, contact dermatitis because of crops, weeds, fertilizers, rubber, medicaments, and pesticide residue in many products of daily use may also mask accurate cause of dermatitis.

Pesticides identified frequently to cause contact dermatitis are propargite, benomyl, sulfur, captan, dithiocarbamates (maneb, thiram, zineb, and ziram), chlorothalonil, pyrethroids, and chlorophenoxy- and organophosphorous compounds (4–7). However, results of patch testing vary across regions as a number of pesticides are used in different parts of the world depending upon the type of crops. Non-availability of standard pesticide patch test series for universal use further compounds this variability of results. The usage pattern also keeps changing with time as older pesticides are withdrawn and newer ones are introduced. For instance in Panamanian banana plantation workers, chlorothalonil, thiabendazole, imazalil, and aluminum hydroxide were the commonest cause of pesticide contact dermatitis in 2002, while these were carbaryl, benomyl, ethoprophos in 2004 (4, 8). Similarly, Matsushita et al. (9) in a study of 216 Japanese farmer patients found sensitivity to captan/difoltan (28.7%), sulfurs (18.5%), organophosphate (18.1%), and chlorinated hydrocarbons (9.7%) while Lisi et al. (10) reported thiophthalamides (captan, folpet, and captan) being the commonest cause of contact dermatitis in 46 of 652 Italian farmer patients.

Himachal Pradesh, a North-western hill state of India (30°N, 70°E), represents a unique cohort of people involved primarily in agriculture/horticulture, oliculture or related occupations. The terrain is mostly high mountains in greater Himalayas to semi foothills/plains in the outer Himalayas. Depending upon climatic conditions the crop patterns vary from traditional wheat, maize, and paddy in the plains, seasonal/off-seasonal vegetables and stone fruits in mid hills, and apple, pear, and cherry in the high hills. Pattern and number of pesticides used also vary accordingly. However, there is a complete lack of data on pesticide contact dermatitis in the region. This study was carried out during April 2005 to May 2006 to evaluate the role of commonly

used pesticides in causing contact dermatitis in fruit and vegetable farmers in this region.

Materials and Methods

30 fruit and vegetable farmers having dermatitis of face, neck, and/or hands attending the Out Patient Dermatology Department of Indira Gandhi Medical College, Shimla, were included in the study. 2 groups of controls comprising 10 subjects each were selected from farmer-patients having minor dermatoses other than dermatitis. The Group-1 had subjects with history of exposure to pesticides but no signs and symptoms of contact dermatitis. Group-2 subjects had no apparent exposure to pesticides at all.

A patch test series comprising 10 commonly used pesticides in the region (Table 1) along with standard Indian patch test Series (purchased from Systopic India Ltd., Bangalore, India) (11) were patch tested by Finn Chamber method. The patch test guidelines for pesticide testing given by Fisher (12) were followed. Finn Chambers were applied on upper back and the patients returned for determination of results after both 2 D and 3 D. Results were graded according to the International Contact Dermatitis Research Group criteria (13). The whole of the pesticide series was initially tested on 5 healthy human volunteers without any dermatitis or apparent exposure to pesticides. As hexaconazole 1% produced severe irritant contact dermatitis in first 2 volunteers, it was deleted from the patch test series used subsequently in other volunteers/patients and controls.

Table 1. 10 most common pesticides used by fruit and vegetable farmers in the region^a

Serial no.	
	Fungicides
1	Mancozeb (0.5% and 1% aq. sol.)
2	Copper oxychloride (0.5% aq. sol.)
3	Carbendazim (0.5% aq. sol.)
4	Ziram (0.5% and 1% aq. sol.)
5	Hexaconazole (0.25% and 0.5% aq. sol.)
6	Captan (0.5% and 1% aq. sol.)
	Insecticides
7	Chlorpyrifos (0.5% aq. sol.)
8	Tree spray oil/petroleum oils (0.5% aq. sol.)
9	Endosulfan (0.5% aq. sol.)
10	Propargite (0.5% and 1% aq. sol.)

no., number; aq., aqueous; sol., solution.

^aThese pesticides were procured from Regional Horticulture Research Station, Shimla and patch test series was prepared in the Institute's laboratory by selecting standard concentrations suggested by Cronin (1). Aqueous solutions were used for patch testing as these pesticides are being used routinely after mixing with water. Additionally, thiuram mix 1% and mercaptobenzothiazole 2% included in the standard Indian patch test series are also used as pesticides.

Results

These 30 patients (M : F 21 : 9) were between 22–81 years (mean 52.3 years) of age. They were engaged in horticultural/olericultural activities tending apple or other fruit orchards and various vegetables crops. Duration of dermatitis at the time of presentation ranged from 4 days to 20 years with relapses and remissions. 9 patients had aggravation of their dermatitis during summers and in 2 patients it was worse in winters. 19 patients stated no seasonal variation. 4 patients attributed their aggravations to *Parthenium hysterophorus*. 10 patients reported exacerbation of dermatitis after exposure to pesticides but were not literate enough to name/identify these pesticides. 3 of them, however, showed positive patch test reaction to captan, propargite, and chlorpyrifos (Table 2).

Positive patch test reactions because of pesticides were observed in 8 patients (M : F 6 : 2). Table 2 shows clinical patterns of dermatitis and pesticide patch test results. Palm (hand) dermatitis was the commonest presentation (4 patients) followed by face and neck involvement (2 patients). 1 patient each had airborne contact dermatitis (ABCD)-pattern, and dorsal hands and feet (acral)-dermatitis. All these patients had history of occupational exposure to pesticides while spraying them without any protective measures such as gloves, goggles, hats, long coats, and face masks. In Group-1 controls, 3 subjects showed positive reaction to multiple pesticides (Table 3). None of the Group-2 controls had any positive patch test reaction.

7 of these 8 patients also had positive patch test reactions to nickel, *P. hysterophorus*, *p*-phenylenediamine, potassium dichromate, cobalt, thiuram mix, balsam of Peru, fragrance mix, benzocain, and neomycin from Indian standard patch test series (Table 2). 4 of these patients showed sensitivity to ≥ 2 antigens.

Discussion

The pesticide allergic contact dermatitis is considered uncommon and perhaps remains under reported. Its reported prevalence varied between 39% and 55% in 2 large studies of farm workers from Japan and California (9, 14). The exact prevalence of pesticide dermatitis in India is not known but 36.6% of 30 farmer patients had positive pesticide positive reactions in an isolated report (6) while our 26.7% patients showed positive patch test reactions to pesticides. The pesticide related dermatitis (allergic or irritant) may be localized to the site of contact, clinically manifesting mostly as hand dermatitis, acral, acrofacial or airborne contact dermatitis; and some of them may even

Table 2. Pesticide contact dermatitis: clinical pattern and patch test results

Age and sex	Duration of dermatitis	Clinical pattern of dermatitis	Pesticide patch test positivity (<i>n</i> = 8)						Sensitivity to allergens from Indian patch test series (5)		
			Captan		Propargite		Chlorpyrifos			Tree-spray oil	Thiuram mix
			0.5%	1%	0.5%	1%	0.5%	1%			
70M	2 years	Palm (hand) dermatitis	2+	2+	–	–	–	–	–	Benzocain (1%) 2+	
30M	8 years	Palm (hand) dermatitis	2+	2+	–	–	–	–	–	Potassium dichromate (0.5%) 2+	
44M	2 months	Face and neck dermatitis	–	–	–	–	–	2+	–	Fragrance-mix (8%) 2+ PPD (1%) 3+	
44F	1½ years	Face and neck dermatitis	–	–	–	–	–	–	2+	–	
22M	4 days	Hands and feet (dorsal aspects)	–	2+	–	2+	–	–	–	Black rubber mix (0.6%) 1+	
52F ^a	4 years	i.e. acral-dermatitis	–	–	–	–	–	–	–	<i>Parthenium hysterophorus</i> 2+	
		Airborne contact dermatitis (ABCD)- pattern	–	–	–	2+	–	–	–	–	
58M ^a	6 months	Palm (hand) dermatitis	–	2+	–	–	–	2+	–	Fragrance-mix (8%) 1+	
62M ^a	6 months	Palm (hand) dermatitis	–	1+	–	–	–	–	–	Nickel (5%) 2+	

M, male; F, female; –, negative; +, positive; PPD, *p*-paraphenylenediamine.

^aThese 3 patients had history of exacerbation of their dermatitis after exposure to pesticides.

Table 3. Pesticide patch test results in Group 1 controls

Age and sex	Pesticide patch test positivity (<i>n</i> = 3)										
	Carbendazim	Ziram		Hexaconazole		Chlorpyrifos	Mercaptobenzothiazole	Endosulfan	Propargite		Captan
	0.5%	0.5%	1%	0.25%	0.5%	0.5%	2%	0.5%	0.5%	1%	1%
45M	—	—	—	—	—	—	—	1+	—	2+	2+
60M	2+	1+	—	2+	2+	2+	2+	—	—	—	—
65M	—	—	—	—	—	—	—	1+	1+	1+	—

M, male; –, negative; +, positive.

produce phototoxic or photo allergic reactions (10, 15–17). In general, hands (palm and back), feet (instep), back and legs (front) get affected more often than forearms, legs (back), and thighs (front), which are usually covered with clothes (3). Localization of dermatitis mainly over exposed body parts especially hands in our 5 patients implies that direct contact with them is a major factor in causing pesticide dermatitis and signifies importance of protective measures.

Captan is used to prevent fungal diseases in crops of apple, pome fruit, peach, cherries, apricots, plums, citrus fruits, potatoes, tomatoes, carrots, and ornamental plants. It is also used for maize seed treatment and as root dip in ornamentals, vegetables, and other crops. It is 1 of the most common causes of allergic contact dermatitis and may even cause photo contact dermatitis (18). Propargite is an insecticide/acaricide for many crop mites of vines, fruit trees, vegetables, and ornamentals. It is a frequently identified cutaneous sensitizer (19). Chlorpyrifos, another insecticide, controls Coleoptera, Diptera, Homoptera and Lepidoptera in soil and foliage in various crops, fruits, vegetables, cereals, and ornamentals. It is mildly irritant and may cause allergic contact dermatitis (4). Tree spray oils or mineral oils consist of aliphatic hydrocarbons, both saturated and unsaturated, are ovicidal insecticides, acaricide, and herbicide for glass house crops, pome fruit, stone fruit, citrus fruit, vines, olives, bananas, and ornamental trees. They also find use as surfactants and adjuvant to herbicides. They are not known contact sensitizers. Captan was the most common sensitizer (16.7%) followed by propargite (6.7%) in our study. Chlorpyrifos, tree spray oil and thiuram-mix were other sensitizers (3.3%). In a previous Indian series from Chandigarh by Sharma and Kaur (6) carbamates (23.3%), organic phosphorus compounds (13.3%), dichlorophenoxy 2,4-D acetic acid, fenvalerate-a synthetic pyrethroid (10% each) and antibiotic streptomycin (6.6%) were the most frequent sensitizers. This variability could be as a result of different pesticides tested or being used for wheat, paddy, and citrus fruits in that region. The contact sen-

sitivity to propargite (6.7%) in our patients is comparable with 8.3% reported in California nursery workers by Malley et al. (20), while that because of tree spray oil appears to be more from its impurities. Polysensitivity to captan and propargite or chlorpyrifos and captan seen in 2 patients, respectively appears more because of their own sensitizing potential as they are not known to cross-react. However, allergic reaction to impurities or perhaps some amount of their cross-sensitizing potential cannot really be ruled out. Rubber chemicals like thiuram-mix, mercaptobenzothiazole, and carbamates also find use as fungicides, animal repellents, and seed disinfectants. Sensitization because of these chemicals is probably more of non-occupational nature from articles of daily use like oils, paints, soaps, and products made of rubber and plastics (21). Positive reaction to thiuram mix in 1 of our patient appears to be of non-occupational sensitization.

Dermatitis in about two third of the farmers could also be because of sensitivity to the other agricultural chemicals or ingredients of products of daily use (22). Nickel, *P. hystrophorus*, *p*-paraphenylenediamine (PPD), potassium dichromate, cobalt, balsam of Peru, fragrance mix, benzocain, and neomycin in our report are known sensitizers in this occupational group as well (23, 24).

Pesticide sensitivity reported in controls by various studies (4, 6, 25) as well as in our 3 subjects from Group-1 but not in Group-2 controls suggests that pesticide sensitization can occur without clinically apparent dermatitis in occupationally exposed individuals. Penagos et al. (4) also made similar observations wherein the pesticides, which gave positive patch test reactions in controls were different from the ones associated with their assigned work. A past episode of mild pesticide contact dermatitis in this set of controls, however, cannot be ruled out with impunity.

Despite the limitations of small number of patients and pesticides tested, this study showed that pesticides are not so uncommon cause of occupational contact dermatitis in this region. Though, initial testing of our pesticide patch test series in 5 healthy volunteers and Group-2 controls was

somewhat helpful for its subsequent use in our patients, however, a thorough testing in large number of control subjects is desirable for selection of vehicle and establishing optimal test concentrations. This is also important in view of hexaconazole 1% concentration causing irritant reaction in 2 healthy volunteers during initial testing and no irritant or allergic reaction in lower concentrations. We tend to agree with Blanco et al. (3) that importance of maintenance of equipment, the correct techniques when using manual spraying, the type of clothes worn, particularly the use of gloves (considering frequent hand contact with pesticides) and avoidance of direct contact with pesticides while mixing, transporting, spraying or handling of equipment should be emphasized especially in view of widespread use of pesticides, and frequent lack of protective measures taken.

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