Farmers and farm workers.

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150 Farmers and Farmworkers

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Core Messages

- Farming is one of the occupations with the highest risk of occupational skin disease (OSD). Up to one third of farmers complain of work-related skin problems.
- The incidence of OSD in farmers may be four times higher than in nonfarming occupations, and up to 40 times higher than incidence of occupational respiratory diseases.
- Farmwork-related hazards to the skin include irritants, haptens, and allergens of plant, animal, microbial, and chemical origin, infectious microbes, parasites, and carcinogens.
- Farmwork-related exposures are complex and variable, which makes them difficult to identify, define, measure, and analyze in objective scientific terms, and thus result in major difficulties when assessing the causal relationship between farmwork and skin disease.
- In many countries self-employed farmers do not undergo prophylactic (preemployment or periodic) health checks, which significantly compromises the possibility of primary and secondary prevention of OSD in farmers.
- As traditional farms combine functions of workplace and dwelling, farmer's children become exposed to occupational hazards in early life, which may lead to the development of farmwork-related OSD even before their first formal employment.
- Risk factors for early development of a farmwork-related skin disease are presented in order to enable identification of people at particular risk of occupational skin disease.

1 Introduction

Agriculture belongs to the oldest and most basic forms of economic activities, which played a pivotal role in shaping of human civilization. Its beginnings are placed around 10000 B.C. in Syria and Egypt. Yet, it was not until the beginning of the eighteenth century that Bernardino Ramazzini (1633–1714) first described skin diseases related to working on the farm in the chapter titled *De agricolarum morbis* of his book *De morbis artificum diatriba*. While primeval health risks of farming, for example, prevailing outdoor work, large share of physical work, or close contact with geophilic and zoophilic pathogens still persist, the technological progress has added new potent hazards to the profession, for example, agrochemicals, disinfectants and detergents, veterinary drugs, and animal feed additives.

For the purpose of the present overview, the terms "farmer," "farmworker," and "agricultural worker" will be regarded as synonyms – all referring to people who grow crop plants and/or breed livestock animals as the main activity to make one's living. The type of agricultural production may be roughly divided into crop, animal, and mixed farming. Traditional farms typically follow the pattern of mixed plant and animal production. There is also a variety of specialized types of production, which is placed within the scope of agricultural production due to tradition, similarity of technologies used, or legal regulations. Occupations with activities and exposures overlapping with those of farmers, like gardeners, veterinarians, foresters, woodworkers, and employees of food processing industry, will not be addressed in this chapter.

2 Farmwork-Related Risk of Occupational Skin Diseases

Working on the farm is burdened with a high risk for occupational skin disease. In Finland (known from its exemplary surveillance system of occupational diseases), farmers amount to as many as 21% workers with acknowledged occupational skin disease (OSD), even though they constitute only 7% of the total workforce. This indicates that the risk of OSD among Finnish farmers is three times higher than in remaining professions altogether (Susitaival 1996). Among North American farmers, the incidence of OSD is four times higher than the mean incidence in nonfarming occupations; moreover, it is up

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to 40 times higher than for occupational respiratory diseases (Demers and Rosenstock 1991). Nevertheless, the magnitude of the problem does not seem to be reflected in the intensity of research and published scientific output (Table 150.1).

Results of comparative studies demonstrate that frequency of dermatitis and other skin symptoms in farmers is significantly higher than in nonfarmers (Table 150.2), with work frequently indicated by farmers as the major cause of their skin problems (Table 150.3). The spectrum of hazards to the skin that are present in the agricultural environment is shown in Table 150.4.

3 The Farm as Work Environment

Farmwork-related exposures are complex and variable, which makes them difficult to identify, define, measure, and analyze in objective scientific terms. This results in major difficulties when assessing the causal relationship between farmwork and skin disease. Some activities and resulting exposures follow the cycles of plant vegetation, and would be executed only at certain time points, moreover, they may change from 1 year to another following, for example, the crop rotation scheme or changes in market demand for particular products. The production profile of the farm and implemented technologies are further

Table 150.1

A comparison of the incidence rates of occupational skin and lung diseases in agriculture versus other industry branches, and the volume of published research devoted to these topics

	Incidence occupational skin diseases[a] (new cases/10,000 employees/year)		Number of scientific articles devoted to the topics[b]	
	Farmers	Nonfarmers	Farmers	Nonfarmers
Occupational skin diseases	38.3	9.8	1,274	27,071
Occupational lung diseases	0.9	0.5	1,314	33,772

[a]Data from Demers and Rosenstock (1991)
[b]PubMed search (April 2010)

Table 150.2

The frequency of skin complaints and symptoms reported by farmers

Country	Skin complaints/Symptoms	Farmers (%)	Nonfarmers (%)	Authors
United Arab Emirates	Self-reported pruritus	25.5	7.1	Bener et al. 1999
	Self-reported contact dermatitis	22.4	9.2	
	Self-reported tinea	12.2	6.1	
Greece	Self-reported itchy rash	37.5	15.0	Chatzi et al. 2006
California	Physician diagnosed eczematous rashes (point prevalence)	10	–	McCurdy et al. 1989
California	Physician diagnosed lichenified hand dermatitis	13.6	–	Gamsky et al. 1992
	Physician diagnosed contact dermatitis	2.0	–	
	Self-reported history of rash lasting for $\geq$ 2 days in previous 12 months	11.9	–	
Finland	Self-reported hand dermatoses in previous 12 months	7.1 (men)	–	Susitaival et al. 1994
		16.1 (women)		
Iowa	Self-reported dermatitis in previous 12 months	9 (men)	–	Susitaival et al. 1998
		14 (women)		
California	Self-reported dermatitis in previous 12 months	8.9 (men)	–	Susitaival et al. 2004
		15.8 (women)		

Table 150.3

The frequency of skin complaints and symptoms associated with work activities

Country	Work-related skin complaints/symptoms	Farmers (%)	Nonfarmers (%)	Authors
Italy	Self-reported plant dermatitis	35.5	4.0	Cellini and Offidani 1994
Greece	Self-reported work-related itchy rash	15.8	2.0	Chatzi et al. 2006
Poland	Self-reported work-related skin symptoms of any kind	24.8	–	Spiewak 2001
	Self-reported dermatitis of uncovered skin areas	13.1	–	
	Self-reported pruritus of uncovered skin areas	4.8	–	
	Self-reported hand dermatitis	4.1	–	
	Self-reported urticaria	2.0	–	
Poland	Self-reported work-related skin symptoms of any kind	19.2	–	Spiewak et al. 2001b
	Self-reported pruritus of uncovered skin areas	11.0	–	
	Self-reported hand dermatitis	6.8	–	
	Self-reported airborne dermatitis	5.5	–	

Table 150.4

Agents hazardous to the skin in agricultural settings

Occupational agents	Examples	Resulting diseases, dysfunctions, or professional marks
Physical hazards		
• Mechanical force	Prolonged pressure due to manual work, friction, microtrauma	Hyperkeratoses, clavi, friction dermatitis
• Temperature	Hot climate, cold climate, heat from working machinery, solar thermal radiation	Telangiectasias, thermal burns, chilblains (perniosis)
• Ultraviolet (UV) radiation	Solar UV exposure	Elastosis (Favre-Racouchot), actinic keratoses, skin cancer, endogenous and exogenous photodermatoses
Chemical hazards		
• Corrosives	Urea and lime fertilizers	Chemical burns, acute toxic dermatitis
• Irritants	*Table 150.5*	Irritant contact (airborne) dermatitis, toxic dermatitis
• Haptens and photohaptens	Pesticides (*Table 150.6*) veterinary drugs and feed additives (*Table 150.7*) rubber additives	Allergic contact (airborne) dermatitis, photoallergic contact dermatitis
• Comedogens	Chloroorganic pesticides and their impurities, mineral oils	Occupational acne
• Carcinogens	Arsenic pesticides, maneb, paraquat	Skin cancer
Biological hazards, inanimate matter		
• Irritants	Plant irritants (*Table 150.8*) animal irritants (urine, manure, other excreta)	Irritant (contact or airborne) dermatitis, nonimmunologic contact urticaria
	Microbial irritants	
• Allergens	Plant allergens (*Table 150.8*) farm animal allergens (*Table 150.9*)	Allergic/protein (contact or airborne) dermatitis, immunologically mediated contact urticaria
	Arthropod allergens (*Table 150.10*)	
	Microbial allergens	

Table 150.4 (Continued)

Occupational agents	Examples	Resulting diseases, dysfunctions, or professional marks
• Haptens and photohaptens	Sesquiterpene lactones plant resins	Allergic contact dermatitis, airborne dermatitis, photoallergic dermatitis
• Phototoxic agents	Psoralens	Phototoxic dermatitis
Live biohazards		
• Microbes	Zoophilic and geophilic dermatophytes (*Table 150.11*) Other fungi, bacteria, and viruses (*Table 150.12*)	Zoophilic and geophilic tinea, sporotrichosis, erysipeloid, milker's nodules, orf
• Parasites	Arthropods (*Table 150.10*), larva migrans	Zoophilic scabies, animal flea bites, cutaneous larva migrans

Table 150.5
Irritants to the skin in agricultural settings

• Water (wet work)
• Soaps, detergents, cleaning agents
• Disinfectants
• Animal feed preservatives (e.g., propionic acid)
• Gasoline (petrol), Diesel oil, kerosene
• Organic solvents and thinners
• Abrasives (e.g., silica, sand, organic dust)
• Artificial fertilizers (e.g., calcium nitrate, urea, calcium ammonium nitrate)
• Lime
• Soil
• Pesticides (e.g., sulfur, triphenyltin hydroxide, captan)
• Ammonia (e.g., from decomposing manure)
• Cement
• Plant irritants
• Animal secretions
• Caterpillars
• Beetles
• Moths

relevant factors determining work-related exposures: On traditional farms, workers are involved in a broad range of activities, including seeding, harvesting and threshing crops, milking, assisting animal labor, treating livestock diseases, applying fertilizers and pesticides, repairing machinery, etc. In this type of mixed production, exposures to hazardous agents are diversified, which partly prevents the workers from cumulating high doses of particular agents. However, such diversity of occupational activities may also result in lacking routine and experience, thus leading to an increased risk of accident or disease. Other agricultural workers may specialize in very specific tasks like spraying pesticides, milking cows, or picking tea leaves, which means that their training and experience may be thorough and more likely to embrace issues of work safety. On the other hand, however, their cumulative exposure to noxious agents or repetitive trauma may be considerably higher.

As farming is predominantly an outdoor occupation, the climate is a further factor of importance for the risk of OSD. Farmers are exposed to extreme air temperatures and humidity, wind (excessive cooling or exsiccation of the skin), and finally ultraviolet (UV) radiation. Chilblains (perniosis) may serve as an example of skin condition precipitated by low temperature that is more prevalent among farmers. Repetitive physical trauma may cause in farmers chronic dermatitis and nail deformities (Cellini and Offidani 1994). Agricultural dust contains hard particles (e.g., silica) that may cause so-called friction dermatitis, but it is also a source of irritants, haptens, and allergens. A frequently overlooked type of skin sensitizers in agricultural dust are antigens of noninvasive airborne microbes typical for farm environment, for example, *Saccharopolyspora rectivirgula*, *Pantoea agglomerans*, or *Aspergillus fumigatus* (Spiewak et al. 2001a). Exposure to infectious microbes and parasites from livestock, plants, soil, manure, and irrigation water depends on the local climatic, ecological, and epidemiological circumstances (Do et al. 2007). Technological advances may either decrease (automation, protective devices), or increase ("chemization," vibration, electromagnetic fields) the risk of occupational skin diseases in farmers. The risk for skin cancer is higher in farmers than in the general population: Increased relative risk ratios for skin cancer

Table 150.6

An overview of agricultural pesticides with well-documented sensitizing properties

Substance	IUPAC name	Chemical group	Use	Clinical picture	Patch test preparations (%)
Acephate	(*RS*)-(*O,S*-dimethyl acetylphosphoramidothioate)	Phosphoramidothioate insecticide	I	ACD, airborne ACD	0.05 pet.
Alachlor	2-chloro-2′,6′-diethyl-*N*-methoxymethylacetanilide	Chloroacetanilide herbicides	H	ACD	1 pet.
					0.2 aq.
Anilazine	4,6-dichloro-*N*-(2-chlorophenyl)-1,3,5-triazin-2-amine	Triazine fungicides	F	ACD	0.05 pet.
Antu	1-(1-naphthyl)-2-thiourea	Thiourea rodenticides	R	ACD	1 pet.
Benomyl	Methyl 1-(butylcarbamoyl)benzimidazol-2-ylcarbamate	Carbamate acaricides	A, F, N	ACD	1 pet.
		Benzimidazole fungicides			
		Carbamate nematicides			
Captafol	*N*-(1,1,2,2-tetrachloroethylthio)cyclohex-4-ene-1,2-dicarboximide	Phthalimide fungicides	F	ACD	0.1 pet.
Captan	*N*-(trichloromethylthio)cyclohex-4-ene-1,2-dicarboximide	Phthalimide fungicides	F	ACD	0.5, 1 pet.
Carbaryl	1-naphthyl methylcarbamate	Carbamate acaricides	A, I, P	ACD	1 pet.
		Carbamate insecticides			
		Plant growth regulators			
Carbendazim	Methyl benzimidazol-2-ylcarbamate	Benzimidazole fungicides	F	ACD	1 pet./ac.
Chlorothalonil	Tetrachloroisophthalonitrile	Aromatic fungicides	F	ACD	0.001 iso.
				Pigmented CD, Photo ACD	0.001 ac.; 0.001 aq. + UV[a]
Chlorpyrifos	*O,O*-diethyl *O*-3,5,6-trichloro-2-pyridyl phosphorothioate	Organothiophosphate acaricides	A, I, N	ACD	1 pet.
		Pyridine organothiophosphate insecticides			
		Organothiophosphate nematicides			
Copper oxychloride	Dicopper chloride trihydroxide	Bird repellents	B, F	ACD	2.5 pet.
		Copper fungicides			
Copper sulfate	Copper(II) tetraoxosulfate	Copper fungicides	F, H	ACD	1 pet.
		Inorganic herbicides			
Cypermethrin	(*RS*)-α-cyano-3-phenoxybenzyl (1*RS*,3*RS*;1*RS*,3*SR*)-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropanecarboxylate	Pyrethroid ester acaricides	A, I	ACD	0.005 pet.
		Pyrethroid ester insecticides			

Table 150.6 (Continued)

Substance	IUPAC name	Chemical group	Use	Clinical picture	Patch test preparations (%)
2,4-D	(2,4-dichlorophenoxy)acetic acid	Phenoxyacetic herbicides	H, P	ACD	1 pet.
		Plant growth regulators			
1,3-Dichloropropene	(*EZ*)-1,3-dichloropropene	Unclassified nematicides	N	ACD	1 pet.
Dinocap	(*RS*)-2,6-dinitro-4-octylphenyl crotonates and (*RS*)-2,4-dinitro-6-octylphenyl crotonates	Dinitrophenol acaricides	A, F	ACD	0.5 pet.
		Dinitrophenol fungicides			
Ditalimfos	*O,O*-diethyl phthalimidophosphonothioate	Organophosphorus fungicides; phthalimide fungicides	F	ACD	0.1 pet.
Endosulfan	1,4,5,6,7,7-hexachloro-8,9,10-trinorborn-5-en-2,3-ylenebismethylene sulfite	Organochlorine acaricides	A, I	ACD	0.5 pet.
		Cyclodiene insecticides			
Ethoprophos	*O*-ethyl *S,S*-dipropyl phosphorodithioate	Organothiophosphate insecticides	I, N	ACD	0.01 pet.
		Organothiophosphate nematicides			
Fenitrothion	*O,O*-dimethyl *O*-4-nitro-*m*-tolyl phosphorothioate	Phenyl organothiophosphate insecticides	I	PhototACD	0.01 aq. +8.7 J/cm^2 UVA
Fenpropimorph	*cis*-4-[(*RS*)-3-(4-*tert*-butylphenyl)-2-methylpropyl]-2,6-dimethylmorpholine	Morpholine fungicides	F	ACD	1 pet.
Fentin acetate	Triphenyltin acetate	Organotin fungicides	F	ACD	0.25 pet.
Fentin hydroxide	Triphenyltin hydroxide	Organotin fungicides	F	ACD	0.25 pet.
Fenvalerate	(*RS*)-α-cyano-3-phenoxybenzyl (*RS*)-2-(4-chlorophenyl)-3-methylbutyrate	Pyrethroid ester acaricides	A, I	ACD	1 pet.
		Pyrethroid ester insecticides			
Ferbam	Iron(III) dimethyldithiocarbamate	Dithiocarbamate fungicides	F	ACD	1 pet.
Fluazinam	3-chloro-*N*-(3-chloro-5-trifluoromethyl-2-pyridyl)-α,α,α-trifluoro-2,6-dinitro-*p*-toluidine	Piridine fungicides	F	ACD	0.5 pet.
Folpet	*N*-(trichloromethylthio)phthalimide	Phthalimide fungicides	F	ACD	0.1 pet.
Glyphosate	*N*-(phosphonomethyl)glycine	Organophosphorus herbicides	H	ACD	1 aq., 10% aq.
Imazalil	(*RS*)-1-(β-allyloxy-2,4-dichlorophenethyl)imidazole	Conazole fungicides	F	ACD	1 pet.
Iprodione	3-(3,5-dichlorophenyl)-*N*-isopropyl-2,4-dioxoimidazolidine-1-carboxamide	Imidazole fungicides	F	ACD	1 pet.

Lenacil	3-cyclohexyl-1,5,6,7-tetrahydrocyclopentapyrimidine-2,4(3*H*)-dione	Uracil herbicides	H	ACD	1 pet.
Lindane	1α,2α,3β,4α,5α,6β-hexachlorocyclohexane	Organochlorine acaricides	A, I, R	ACD	1 pet.
		Organochlorine insecticides			
		Organochlorine rodenticides			
Malathion	Diethyl (dimethoxyphosphinothioylthio)succinate	Organothiophosphate acaricides	A, I	ACD	0.5 pet.
		Aliphatic organothiophosphate insecticides			
Mancozeb	Manganese ethylenebis(dithiocarbamate) (polymeric) complex with zinc salt	Polymeric dithiocarbamate fungicides	F	ACD, PhotoACD	1 pet.; 0.002 aq. +UVA & UVB
Maneb	Manganese ethylenebis(dithiocarbamate) (polymeric)	Polymeric dithiocarbamate fungicides	F	ACD, PhotoACD	1 pet.; 0.01 aq. +8.7 J/cm^2 UVA
Metam-sodium	Sodium methyldithiocarbamate	dithiocarbamate fungicides	F, H, N	ACD	0.3 pet.
		dithiocarbamate herbicides			
		unclassified nematicides			
Methamidophos	(*RS*)-(*O,S*-dimethyl phosphoramidothioate)	Phosphoramidothioate acaricides	A, I	ACD	0.5 prop./aq.
		Phosphoramidothioate insecticides			
Methoxychlor	1,1,1-trichloro-2,2-bis(4-methoxyphenyl)ethane	Organochlorine insecticides	I	ACD	0.5 pet.
Methyl isothiocyanate	Methyl isothiocyanate	Unclassified	F, H, N	ACD	0.01 pet.
Metiram	Zinc ammoniate ethylenebis(dithiocarbamate) – poly (ethylenethiuram disulfide)	Polymeric dithiocarbamate fungicides	F	ACD	1 pet.
Mevinphos	(*EZ*)-2-methoxycarbonyl-1-methylvinyl dimethyl phosphate	Organophosphate acaricides	A, I	ACD	0.25 pet.
		Organophosphate insecticides			
Oxyfluorfen	2-chloro-α,α,α-trifluoro-*p*-tolyl 3-ethoxy-4-nitrophenyl ether	Nitrophenyl ether	H	ACD	0.01 iso.
Paraquat	1,1′-dimethyl-4,4′-bipyridinium	Quaternary ammonium herbicides	H	ACD	0.1 aq./pet.
Parathion-methyl	*O,O*-dimethyl *O*-4-nitrophenyl phosphorothioate	Phenyl organothiophosphate	I	ACD	1 pet.
Phoxim	*O,O*-diethyl α-cyanobenzylideneaminooxyphosphonothioate	Organothiophosphate acaricides	A, I	PhotoACD	0.1 aq. + 5 J/cm^2 UVA
		Oxime organothiophosphate insecticides			
Pirimicarb	2-dimethylamino-5,6-dimethylpyrimidin-4-yl dimethylcarbamate	Dimethylcarbamate insecticides	I	ACD	0.5 pet.

Table 150.6 (Continued)

Substance	IUPAC name	Chemical group	Use	Clinical picture	Patch test preparations (%)
Promecarb	5-methyl-*m*-cumenyl methylcarbamate	Phenyl methylcarbamate insecticides	I	ACD	0.1 pet.
Propargite	(1*RS*,2*RS*;1*RS*,2*SR*)-2-(4-*tert*-butylphenoxy)cyclohexyl prop-2-ynyl sulfite	Sulfite ester acaricide	A	ACD	1 pet.
Propiconazole	(2*RS*,4*RS*;2*RS*,4*SR*)-1-[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-ylmethyl]-1*H*-1,2,4-triazole	Conazole fungicides	F	ACD	0.5 iso.
Propineb	Polymeric zinc propylenebis(dithiocarbamate)	Polymeric dithiocarbamate	F	ACD	1 pet.
Pyrethrins	Mixture of plant-derived pyrethrins, cinerins, and jasmolins	Botanical insecticides	I	ACD	2 pet.
Thiabendazole	2-(thiazol-4-yl)benzimidazole	Benzimidazole fungicides, thiazole fungicides	F	ACD	0.1 pet.
Thiuram (Thiram)	Tetramethylthiuram disulfide	Dithiocarbamate fungicides	B, F	ACD	1 pet.
Triadimefon	(*RS*)-1-(4-chlorophenoxy)-3,3-dimethyl-1-(1*H*-1,2,4-triazol-1-yl) butan-2-one	Conazole fungicides	F	ACD	1 pet.
Triadimenol	(1*RS*,2*RS*;1*RS*,2*SR*)-1-(4-chlorophenoxy)-3,3-dimethyl-1-(1*H*-1,2,4-triazol-1-yl)butan-2-ol	Conazole fungicides	F	ACD	1 pet.
Tridemorph	Reaction mixture of 4-alkyl-2,6-dimethylmorpholines	Morpholine fungicides	F	ACD	0.02 pet.
Triforine	*N*,*N*′-{piperazine-1,4-diylbis[(trichloromethyl)methylene]} diformamide	Amide fungicides	F	ACD	0.05 aq.
Warfarin	4-hydroxy-3-[(1*RS*)-3-oxo-1-phenylbutyl]coumarin	Coumarin rodenticides	R	ACD	0.05 pet.
Zineb	Zinc ethylenebis(dithiocarbamate) (polymeric)	Polymeric dithiocarbamate fungicides	F	ACD	1 pet.
Ziram	Zinc bis(dimethyldithiocarbamate)	Dithiocarbamate fungicides	B, F	ACD	1 pet.

ACD allergic contact dermatitis, *PhotoACD* photoallergic contact dermatitis, *A* acaricide, *B* bird repellent, *F* fungicide, *H* herbicide, *I* insecticide, *N* nematocide, *P* plant growth regulator, *R* rodenticide, *ac*. acetone, *aq*. aqua, *iso*. isobutane, *pet*. petrolatum, *IUPAC* International Union of Pure and Applied Chemistry. Only pesticides were selected, whose sensitizing activity has been verified by a positive and clinically relevant patch test, and specificity of the reactions has been demonstrated by means of a negative patch test results in controls. The IUPAC names and classification are according to Wood (2010)

[a]Frequent unspecific/phototoxic reactions observed

Table 150.7

Examples of veterinary drugs and feed additives documented as causes of occupational skin diseases in farmers, with an inventory of confirmatory tests successfully used in confirming the allergic mechanism (causation)

Sensitizer	Use	Skin diseases reported	Patch test preparations (%)
Alkylammonium amidobenzoate	Biocide (udder cream)	ACD	0.1 pet.
Avoparcin	Veterinary antibiotic, feed additive/growth stimulant	ACD	1–5 aq.
Azaperone	Sedative	ACD, PhotoACD	1 aq.
Benzalkonium chloride	Disinfectant	Airborne ACD, hand dermatitis	0.01 aq.
Chlorpromazine	Pig sedative	Photoaggravated ACD	0.5 pet.
Etisazole	Veterinary antimycotic	ACD	2 pet.
Furaltadone	Animal feed additive	Airborne ACD, ACD	1 pet.
Furazolidone	Antibiotic, *Escherichia coli* control in piglets	Hand ACD	2 alc.[a]
Nitrofurazone	Antibiotic, animal feed additive	Hand and face ACD	1 pet.
Neomycin	Antibiotic, feed additive/growth stimulant	ACD	20 pet.
Olaquindox	Pig feed additive/growth stimulant	Photo ACD, persistent light reactions	0.5 pet
Penicillin/streptomycin	Mix of antibiotics	ACD	5 pet.
Potassium peroxymonosulfate	Disinfectant	ACD	2 pet.
Quindoxin (quinoxaline dioxide)	Pig feed additive/growth stimulant	Photoaggravated ACD, PhotoACD	0.1 pet., 0.5 pet.[b]
Spectinomycin	Antibiotic	Hand and face ACD	20 pet.
Spiramycin	Antibiotic	ACD	10 aq., 5 pet.
Tylosin	Macrolide antibiotic for veterinary use	ACD, airborne ACD	5 pet., 1 aq., 2 aq. 10 aq., 20 aq., 30 aq.
Zoalene (3,5-dinitro-O-toluamide = 2-methyl-3,5-dinitrobenzamide)	Coccidiosis control	Hand dermatitis	1 pet.

[a]Patch test with furazolidone 2% pet. appeared negative

[b]The authors observed very strong reactions and suggested a concentration of 0.01% pet. for future patch testing

and lip cancer (1.04–1.15 and 1.95–2.08, respectively) are mostly attributed to pesticide exposure (Blair and Freeman 2009). This seems supported by the observation that herbicide applicators are conspicuously at risk for skin cancer, with standardized mortality ratio (SMR) amounting to 357.4 (95% CI: 115.1–827.0); however, a part of the risk may also be due to excessive sunlight (UV) exposure (Swaen et al. 2004). Apart from skin cancer, exposure to pesticides may also cause pigmentation disorders and damage to skin appendages: In an Ecuadorian study, melasma, vitiligo, and leukoderma were observed in 25% of pesticide applicators and exposed farmworkers, as compared to 10% controls (Cole et al. 1997). Permanent nail dystrophy due to pesticides (diquat, paraquat, and dinitroorthocresol) was also documented (Baran 1974).

4 Specific Risks for Occupational Skin Disease Related to Farmwork

On traditional farms, there is a typical overlap of working and living space – animal houses, crop barns, silos, agrochemical stores, garages – all may be located within a small distance from the farmer's house, resulting in the possibility of contaminating the domestic environment.

Table 150.8

An overview of crop plants causing occupational skin diseases in farmers, with an inventory of confirmatory tests successfully used in confirming the allergic mechanism (causation)

Plant	Skin diseases reported	Skin tests[a]	In vitro tests
Allium cepa (onion)	ICD	PT: as is, fresh juice, 50% ol., extr.;	
Allium porrum (leek)	PCD	SPT: leaf as is;	IgE-IB: leaf extr.
		PT: leaf as is	
Allium sativum (garlic)	ICD, ACD, Airborne ACD	PT: as is; fresh juice; garlic powder 10% ar.; garlic 50% ol.; garlic 10% aq.; extr.	
Apium graveolens (celery)	ACD, Phototoxic CD	PT: as is	
Asparagus officinalis (asparagus)	ICD, PCD	SPT: p2p	IgE FEIA: com. antig.
Avena sativa (oat)	ICD, ACD	PT: rolled oats	
Brassica oleracea cultivar (cabbage)	PCD, CU	SPT: as is; PT: as is	
Brassica oleracea cultivar (cauliflower)	ACD, CU	PT: fresh juice, extr.	
Brassica rapa var. rapa (turnip)	ACD	PT: fresh juice	
Cichorium endivia (endive)	PCD	Scratch: fresh sap;	sIgE-ELISA: extr.; IB: extr.
		SPT: p2p; Open test: fresh sap;	
		PT: leaf as is	
Cichorium intybus (chicory)	PCD	SPT: p2p	sIgE-ELISA: extr.; IB: extr.
		PT: leaf as is, root as is, leaf extract;	
Citrullus lanatus (watermelon)	ACD	PT: fresh juice	
Colocasia esculenta (taro)	ACD	PT: fresh juice	
Coriandrum sativum (coriander)	ACD	PT: fresh juice	
Cucurbita maxima (squash)	ACD	PT: fresh juice	
Cucumis melo (melon)	ACD, PCD	SPT: pulp as is, skin as is; melon hair extr.	sIgE-FEIA: com. antig.; IB
Cucumis sativus (cucumber)	ICD, ACD	PT: leaf, stem, fresh juice	
Cynara scolymus (globe artichoke)	CU	SPT: extr.;	RAST: extr.
		Rub: leaf as is.	
Daucus carota (carrot)	ACD	PT: as is, fresh juice	
Helianthus annuus (sunflower)	ACD, airborne ACD	PT: leaf as is, leaf extr., flower as is, flower extr.	
Hibiscus esculentus (okra, lady's finger)	ACD	PT: fresh juice, extr.	
Hordeum vulgare (barley)	ICD, ACD, PCD	PT: barley dust; barley meal, rolled barley	RAST: com. antig.
Humulus lupulus (hop)	Airborne ACD, PCD, CU	Scratch: extr.;	sIgE-FEIA: extr., com. antig.
		SPT: fresh and dried hop cone as is, cone extr., leaf extr.;	
		i.c. extr.;	
		PT: fresh hop cone as is; hop dust; cone extr., leaf extr.	

Table 150.8 (Continued)

Plant	Skin diseases reported	Skin tests[a]	In vitro tests
Lactuca sativa (lettuce)	PCD, CU	Open test: fresh sap;	HRT: extracts; RAST: extr.; sIgE-ELISA: extr.; IB: extr.
		SPT: extracts, p2p, leaf/stem as is; PT: leaf/stem as is, leaf extr., lactucin;	
		Scratch: fresh sap;	
		Scratch-chamber: sap as is;	
		ROAT: crushed leaf, sap	
Luffa acutangula (angled luffa, smooth luffa, vegetable gourd, silk squash)	ACD	PT: fresh juice	
Momordica dioica (teasle gourd)	ACD	PT: fresh juice	
Nicotiana spp. (tobacco)	ICD, ACD	PT: fresh leaf, dry leaf, cured leaf, extr.	FEIA: com. antig.
Oryza sativa (rice)	CU	SPT: extr.	sIgE-FEIA: com. antig.
			HRT: extr.
			IB: extr.
Pastinaca sativa (parsnip)	ACD, Phototoxic dermatitis, PACD (rare)	PT: leaf as is, extr.;	
Petroselinum spp. (parsley)	ACD	PT: as is	
Phaseolus vulgaris (bean)	ICD, (airborne) ACD	PT: leaf as is	
Pisum sativum var. arvense (protein pea)	ACD	PT: fresh juice	
Psophocarpus tetragonolobus (winged bean)	CU	i.c.: extr.	
Raphanus sativus (radish)	ACD	PT: root as is, fresh juice	
Ricinus communis (castor oil bean)	PCD, CU	Scratch: castor bean as is, shredded bean;	RAST: extr.
		Scratch-chamber: crushed castor bean;	
		PT: crushed castor bean;	
Secale cereale (rye)	PCD, airborne PCD		RAST: com. antig.
Solanum lycopersicum (tomato)	ACD	PT: fresh juice	
Solanum melongena (eggplant, aubergine, brinjal)	ACD	PT: fresh juice	
Spinacia oleracea (spinach)	ACD	PT: fresh juice	
Solanum tuberosum (potato)	ACD, PCD, CU	SPT: potato flesh, p2p; Rub: pulp;	sIgE-FEIA: com. antig.
		PT: fresh juice, potato flesh	
Thymus vulgaris (thyme)	Airborne ICD, ACD	PT: as is	
Triticum spp. (wheat)	PCD		RAST: com. antig.
Vicia faba (broad bean)	ACD	PT: fresh juice	
Zea mays (maize)	ICD, ACD	PT: as is	
Zingiber officinale (ginger)	ACD	PT: fresh juice	

SPT skin prick test, *p2p* "prick to prick" technique, *PT* patch test, *extr*. extract (various extraction techniques and solvents), *com. antig*. commercial antigens, *ol*. olive oil, *ar*. arachis oil, *HRT* histamine release test, **IB** immunoblot. Please note: This table is a compilation of most relevant literature reports. For an extensive catalogue of plants that may cause skin disease, please refer to (Mitchell and Rook 1979), or the book's updated internet version (Schmidt 2010)

[a]These are techniques tried by various authors with positive results that deemed as confirmation of an allergic sensitization, which does not imply that they are the most suitable ones in the light of the modern knowledge

Table 150.9

Examples of farm animals causing occupational skin diseases in farmers, with an inventory of confirmatory tests successfully used in confirming the allergic mechanism (causation)

Farm animal	Material	Skin diseases reported	In vivo tests[a]	In vitro tests
Bos primigenius (Cattle)	Saliva	ACD	i.c.: as is	
			PT: as is	
	Milk	PCD		sIgE RAST whole milk
	Epithelium/ dander	PCD, CU, airborne PCD	i.c.: extr.; scratch: dander;	sIgE RAST com. antig.;
			SPT: com. prep.	sIgE-FEIA: com. antig.
			Scratch-chamber: dander as is;	IB: hair extr.
			PT: dander/epithelium as is;	CRIE: hair extr.
	Hair	CU, PCD	PT: cow hair as is.;	
			i.c.: extr.; scratch: hair	
	Amniotic fluid	PCD	i.c.: as is; PT: as is	
Capra aegagrus hircus (Goat)	Dander	CU	Workplace exposure	
Equus ferus caballus (Horse)	Hair	CU, PCD	PT: horse hair; i.c.: extr.	
	Saliva	CU	SPT: sterilized saliva; scratch-patch: sterilized saliva; i.c.: sterilized saliva	sIgE-RAST: saliva; crossed immune electophoresis (precipitating antibodies): saliva
Ovis aries (Sheep)	Wool	ACD, PCD; allergic purpura	Rub: as is	
			PT: as is	
			PUT: wool dust as is	
	Wool alcohols	ACD	PT: com. prep.	
Sus domestica (Pig)	Pig epithelium	ACD, Airborne ACD, PCD, CU	PT: epithelia	sIgE-FEIA: com. antig.

ACD allergic contact dermatitis, *PCD* protein contact dermatitis (term used only if the type I allergic reaction was demonstrated), *CU* contact urticaria, *i.c.* intracutaneous test, *SPT* skin prick test, *PT* patch test, *Rub* rub test, *extr.* extract, *com. prep.* commercially available allergen preparation, *CRIE* crossed radioimmunoelectrophoresis

[a]Some of in vivo tests (e.g., intracutaneous tests with animal excreta) should be discouraged due to patient's safety concerns

Hazardous substances may be "smuggled" into house on the farmer's work clothes, skin, or hair (Spiewak and Dutkiewicz 2002). As a result, farmers are continuously exposed to occupational agents, also while off work. Moreover, members of the family who are not directly involved in farmwork also become exposed in this way (Arcury et al. 2007). Farmers' children are at risk from a very early age. Initially, the exposure occurs through living in contaminated area and playing with contaminated items. A full-scale "occupational" exposure to agricultural hazards starts when children become involved in farmwork, which happens relatively early on family farms: Some farmer's children operate heavy agricultural machinery or spray agrochemicals already at the age of 10–12 years (Spiewak 2002a). This early exposure may result in children developing a farmwork-related skin disease long before their first formal employment.

5 Problems with Prevention of Farmwork-Related Skin Diseases

The measures of *primary prevention* are aimed at not allowing for the initiation of a disease by avoiding of the

Table 150.10

Examples of arthropods causing occupational skin diseases in farmers, with an inventory of confirmatory tests successfully used in confirming the allergic mechanism (causation)

Species	Sources on the farm	Skin diseases reported	In vivo tests	In vitro tests
Ceratophyllus gallinae (hen flea)	Chicken, other poultry	Bite reactions: erythema, pruritus, vesicles	–	Microscopic identification of the ectoparasite
Cheyletiella parasitivorax (rabbit fur mite)	Rabbits	Bite reactions: erythema, pruritus, vesicles	–	Microscopic identification of the ectoparasite
Dermanyssus gallinae (red mite)	Poultry	Bite reactions: erythema, pruritus, vesicles	–	Microscopic identification of the ectoparasite
Haematopinus suis (hog louse)	Pigs	Bite reactions: erythema, pruritus, vesicles	–	Microscopic identification of the ectoparasite
Neotrombicula autumnalis	Plants in open spaces (meadows, grain fields, etc.)	Bite reactions: erythema, pruritus	–	Microscopic identification of the ectoparasite
Panonychus ulmi (European red mite)	Fruit plants, grapevine	Dermatitis, urticaria	SPT: extr.	IgE RAST: extr.
Pyemotes ventriculosus (grain itch mite, straw itch mite, hay itch mite, barley itch mite)	Grain, straw, hay	Bite reactions: dermatitis, urticaria, vesicular (varicelliform) pruritic rash	–	Microscopic identification of the ectoparasite
Sarcoptes scabiei var.bovis	Cattle	Pseudoscabies (''dairy man's itch,'' ''buffaloman's itch'')	–	Microscopic identification of the ectoparasite
Sarcoptes scabiei var. suis	Pigs	Pseudoscabies	–	Microscopic identification of the ectoparasite
Spilopsyllus cuniculi (rabbit flea)	Rabbits	Bite reactions: erythema, pruritus, vesicles	–	Microscopic identification of the ectoparasite
Rhizoglyphus hyacinthi	Onion	Dermatitis	–	Microscopic identification of the ectoparasite
Tetranychus urticae (red spider mite)	Most vegetables and food crops	PCD, CU	SPT: extr.	IgE enzyme allergosorbent test (EAST): extr.;
			PT: extr.	SDS-PAGE IB: extr.
Tyrophagus putrescentiae	Stored crops, hay, grain, soil	Airborne PCD	SPT: com. alerg.;	IgE FEIA: com. antig.
			PT: extr.	

exposure to causative agents by a susceptible individual. This may be achieved through:

- Removal of known hazardous agents from the production process (e.g., withdrawal of pesticides or feed additives with recognized irritating, sensitizing, or carcinogenic potential; combating livestock diseases to prevent zoonotic infections)
- Providing effective barriers to keep hazardous agents away from the skin (e.g., protective clothing, masks,

Table 150.11
An overview of zoophilic and geophilic dermatophytes transmissible to farmers

Fungus	Symptoms	Infection sources on the farm
Chrysopodium keratinophilum	Tinea corporis, tinea pedum, tinea manuum, onychomycosis	Soil
Microsporum canis	Tinea corporis, tinea capitis, tinea barbae profunda, onychomycosis	Sheep, pigs, horses, rabbits
Microsporum equinum	Tinea corporis, tinea capitis	Horses
Microsporum fulvum	Tinea corporis, tinea profunda, tinea capitis, kerion, favus	Soil
Microsporum gypseum (M. pratense)	Tinea corporis, blepharitis, tinea capitis, tinea barbae profunda, kerion, onychomycosis	Soil, cattle, horses, pigs
Microsporum nanum	Tinea corporis, tinea barbae profunda, tinea capitis, onychomycosis	Pigs, other farm animals
Trichophyton equinum	Tinea capitis, tinea corporis, onychomycosis	Horses, other animals
Trichophyton gallinae (Achorion gallinae, Microsporum gallinae)	Tinea superficialis, onychomycosis	Chickens, turkeys, other poultry
Trichophyton mentagrophytes var. *granulosum (asteroides, mentagrophytes)*	Tinea trichophytica profunda, tinea corporis, tinea capitis, onychomycosis	Cattle, horses, pigs, goats, sheep, rabbits, chinchillas, deers, other animals
Trichophyton quinckeanum (Trichophyton mentagrophytes var. *quinckeanum)*	Tinea corporis, tinea capitis, onychomycosis	Soil, rodents, other animals
Trichophyton terrestre	Tinea corporis, tinea capitis, tinea pedum, onychomycosis	Soil
Trichophyton verrucosum	Superficial mycoses, tinea corporis, tinea barbae, tinea capitis, onychomycosis	Cattle, horses, pigs, sheep, goats, donkeys, other animals

and respirators protecting both airways and facial skin, pressurized and air-conditioned cabins in field machinery, automation)

- Changes in technology to prevent spreading of hazardous agents (e.g., feeding animals with moist instead of dry feed to prevent formation of allergenic dusts that might cause airborne dermatitis)

A complementary strategy of primary prevention involves the identification of individuals at increased risk for OSD and counseling them to seek a safer profession whenever possible. Taking into account the above-discussed early occupational exposure of farmers' children, these measures should be undertaken as early as possible. A critical moment for this kind of prevention is at the beginning of vocational training, as many students of agricultural schools (who typically are farmers' children) carry already at this time certain burden of occupational exposure. A study of last-grade students of agricultural schools in Poland revealed that more than 80% of them have had regularly worked on the farm prior to undertaking their vocational training. Five percent of those students were diagnosed with work-related eczema and 3% with work-related contact urticaria even before graduating from the school (Spiewak 2002b). This study also demonstrated that students at risk for developing farmwork-related OSD can be easily identified by asking a few questions aimed at their medical history (*Table 150.13*). These observations demonstrate the importance of preschool and preemployment screening for the primary prevention of OSD in farmers.

The status of the farm as workplace is an important factor that determines the effectiveness of prophylactic measures: In large, specialized enterprises with hired workforce, employers are typically obliged by labor laws to ensure appropriate work safety, including identification and monitoring of hazards. In contrast to this, self-employed farmers in many countries lack the status, obligations, and privileges of an employee, which means among others that no prophylactic health checks are

Table 150.12

Primarily cutaneous infections contracted by farmers from livestock or farming environment

Infectious agent	Skin disease	Source of infection, vectors, entry mode
Bacillus anthracis	Cutaneous anthrax	Transmitted through contact with infected cattle, airborne spread possible
Erysipelothrix rhusiopathiae	Erysipeloid (localized cutaneous infection), diffuse cutaneous form (less frequent)	*Erysipelothrix rhusiopathiae* is a widespread ethiological agent of swine erysipelas that can also cause diseases in sheep, poultry, and other farm animals. The micoorganism is relatively resistant and can persist for long periods in the environment. Infections occur as a result from contact with infected animals, their products or excreta
Francisella tularensis	Ulceroglandular tularemia	Wild animals, insects, farming environment (soil, hay)
Mycobacterium bovis	Skin tuberculosis (lupus vulgaris)	Transmitted through close contact with infected cattle. Slow progression (years, decades)
Sporothrix schenckii	Sporotrichosis	The fungus is a geophilic saprophyte, ubiquitous in soil, decaying plant material, timber, hay. Direct contact with the contaminated material results in the development of a primary lesion (ulcerated, verrucous or nodular), which may be followed by a lymphocutaneous spread
Cow pox virus *(Poxvirus bovis), Poxviridae*	Cowpox	Transmitted through close contact with infected animals. The entry site are small lesions, typically on the hands or face. Typical is a single lesion; spreading via hands or lymphatic vessels also possible. Skin lesions may be accompanied by malaise and fever. Typically observed in warm months
Milker's nodule virus (MNV, *Paravaccinia virus), Poxviridae*	Milkers' nodules	Transmitted through close contact with cattle (especially with infected cow udders)
Orf virus, *Poxviridae*	Orf	Sore-mouth disease in sheep, transmitted through direct (hands) or indirect contact with oral and nasal mucosae of infected animals. Autoinoculation and human-to-human transmissions possible. Typically self-limiting, may cause severe damage of the eyes
Parapoxvirus, *Poxviridae*	Bovine papular stomatitis	Transmitted through close contact with infected cattle, sheep, or goats. May manifests as papular lesions on the hands or (rarely) in the mouth

required by law. Moreover, traditional family-owned farms typically are not subjected to safety inspections, which greatly limits the possibilities for primary prevention through identifying hazards at workplace (Spiewak 2003). The only remaining possibility for primary prevention is to increase farmers' awareness through education in vocational schools, counseling centers, and media. In rural areas, occupational medicine services including preemployment and periodic health checks are not (or hardly) available, which compromises both primary and secondary prevention (see below) of OSD in farmers. In Germany, self-employed farmers are encouraged by state subventions to utilize services of occupational physicians. Another feasible solution to this problem could be adequate training of rural-based general practitioners and contracting from them occupational health checks for farmers.

Secondary prevention is aimed at detection of occupational diseases at early stage, before a worker would normally seek medical care. Again, in contrast to most other industries, lack of obligatory health checks for self-employed farmers compromises the effectiveness of the secondary prevention. As a result, the time lapse between the emergence of an OSD and its actual diagnosis may in

Table 150.13
Risk factors for farmwork-related eczema in young farmers (Spiewak 2002b)

Factor	Students with work-related eczema (%)	Remaining students (%)	*p* (Chi²)	OR (95%CI)
Past history of asthma and allergic rhinitis	18.2	2.2	<0.001	10.0 (2.8–35.9)
Past history of asthma	31.8	5.7	<0.001	7.7 (2.8–20.6)
Past history of itchy rash provoked by detergents	36.4	7.9	<0.05	6.7 (2.6–17.0)
Past history of itchy rash provoked by metals	36.4	12.0	NS	4.2 (1.7–10.5)
Past history of allergic rhinitis	31.8	10.8	<0.01	3.9 (1.5–10.0)
Past history of nonoccupational ACD	36.4	14.4	<0.05	3.4 (1.4–8.5)
Family history of skin disease	36.4	16.0	<0.05	3.0 (1.2–7.4)

some cases exceed over a decade (Spiewak 2004; Spiewak and Dutkiewicz 2004). The aims of *tertiary prevention* is to deliver appropriate medical care and rehabilitation to the diseased individuals in order to limit their disability. At present, the burden of farmers' OSD is shifted too much toward the tertiary prevention, which by definition implies high cost and limited effectiveness. It is not rare that a farmer first seeks an occupational physician when the loss of work ability is already irreversible. An effective decrease of the economical and humane burden of OSD in farmers would require a reinforcement of the primary and secondary prevention through appropriate regulatory actions (e.g., obligatory health checks and work safety training for farmers, monitoring of farms by work safety inspectors), as well as intensive education of farmers, agricultural counselors, general practitioners, and occupational medicine professionals about the high risk of occupational skin diseases in agriculture.

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