PENINSULA TECHNIKON

Occupational allergy and asthma among table grape farm workers in the Hex-river Valley, Western Cape.

Thesis submitted in fulfillment of the requirements for the degree of Masters of Technology in Environmental Health.

FACULTY OF SCIENCE
DEPARTMENT OF HEALTH SCIENCES

By:
Roslynn Baatjies
9818235

Internal Supervisor:
Emmanuel Rusford

External Supervisors:
Mohamed F Jeebhay
Andreas L Lopata

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ABSTRACT

Recent studies have reported an increased prevalence (19%) of respiratory symptoms among farm workers exposed to pesticides. International studies suggest excessive pesticide use and biological factors such as outdoor mites as important factors responsible for asthma symptoms. Studies in Korea suggest that spider mites may be responsible for allergic asthma symptoms among workers on fruit (citrus, apple, and pear) farms. The farming of wine and table grapes in South Africa involves about 3000 farms employing over 50,000 workers. Workers on table grape farms, in contrast to other fruit farms have not been previously investigated for occupational respiratory allergy to spider mites.

Objectives

- To determine the spectrum and prevalence of work-related allergy and asthma among table grape farm workers
- To determine the environmental and host factors associated with work-related symptoms and allergic outcomes.

Methods: A cross-sectional study was conducted on 207 workers employed on nine table grape farms in the Hex River valley of South Africa. A modified European Community Respiratory Health Survey questionnaire was used to interview workers. Skin prick tests used 8 commercial extracts of common airborne allergens (ALK) and potential occupational allergens, which included grape mould *(Botrytis cinerea)* and an in-house extract of spider mite, *Tetranychus urticae.* Specific IgE *to Tetranychus urticae* was determined using enzyme-linked immunosorbent assay (ELISA) and to

house dust mite (*Dermatophagoides Pteronyssinus*) and storage mite (*Lepidoglyphus Destructor)* using Pharmacia CAPRAST.

Results: The mean age of the workers was 36 years with a standard deviation of 11 years. A large proportion of the workers was permanent workers (86%). The average duration of employment on these grape farms was 15 years, with 12% of workers involved primarily in pesticide crop spraying. The study found that the prevalence of work-related wheezing (26%) and ocular-nasal symptoms (24%) was more common than urticaria/skin symptoms (15%). Importantly, work-related symptoms were more prevalent when working in orchards than in the store-rooms ($p<0.001$). Skin reactivity to spider mite *T. urticae* (monosensitivity: 7%) was more common (22%) than to house dust mite (16%). However, mite-specific IgE determinations demonstrated the highest prevalence of workers with elevated IgE levels against house dust mite (20%) followed by storage mite (13%) and spider mite (6%). House dust mite RAST was strongly correlated with storage mite RAST (Spearman $R = 0.71$, $p<0.001$), however it was only modestly correlated with spider mite ELISA (Spearman $R = 0.28$, $p<0.001$). This study found that pesticide crop sprayers were more likely (OR=3.5) to report work-related skin symptoms, including urticaria symptoms. Sensitization to house dust mite (OR=3.2) and being a pesticide crop sprayer (OR=3.5) were significant predictors of work-related ocular-nasal symptoms. On the other hand, workers with work-related wheeze were more likely to have elevated specific IgE levels to spider mite (OR=5.8) and to a lesser extent to storage mite (OR=2.4). Atopic workers were found to be more likely to develop spider mite (OR = 9.27) and storage mite (OR = 29.84) respiratory allergy. Borderline associations were found between pesticide crop sprayers and spider mite allergic rhinoconjunctivits (OR = 4.32) and probable asthma (OR = 4.47).

Conclusion: Spider mite, *Tetranychus urticae,* is an important outdoor allergen responsible for allergic symptoms such as rhinoconjunctivitis and asthma among table grape farm workers in South Africa. Increased risk of exposure and sensitization to spider mite may be related to pesticide crop spraying in table grape farm orchards.

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1.1 INTRODUCTION

Respiratory diseases associated with agriculture were one of the first-recognized occupational hazards. As early as 1555, Olaus Magnus warned about the dangers of inhaling grain dusts, and the risk was again noted in 1700 by Ramazzini in his seminal work *De Morbis Artificum*.[1] Yet, despite this early recognition of respiratory hazards in agriculture, it has only been in the 20th century that this problem has been carefully studied and documented. In general, the investigation of agricultural respiratory hazards has lagged behind the investigation of hazards in mining and other heavy industries. These agricultural hazards, however, are of serious concern. Because agriculture is so intimately tied to the land, it has generated many myths about the health of farmers.[2] The long-standing "agrarian myth" was exemplified in Thomas Jefferson's declaration that "Cultivators of the earth are the most valuable citizens. They are the most vigorous, the most independent, the most virtuous, and they are tied to their country and wedded to its liberty and interests by the most lasting bonds".[3] Unfortunately, the myth of the robust, reliably healthy farmer was in actuality a myth that does not correspond with the realities of agricultural life. Ample data confirm the magnitude and severity of respiratory and other hazards in agriculture.

Respiratory disease is today an important clinical problem for agricultural workers. Numerous studies, have demonstrated a significantly increased risk of respiratory morbidity and mortality among farmers and farm workers. This risk persists despite the lower prevalence of smoking among them, compared with the general population, thus further implicating occupational risk factors for respiratory disease. Agricultural respiratory disease is also an important public health problem.

An *agricultural worker* is defined by the World Health Organization (WHO) 1962 as any person engaged either permanently or temporarily, irrespective of legal status, in activities related to agriculture.[4] *Agriculture* is in turn defined as embracing all forms of activity connected with growing, harvesting, and primary processing of all types of crops; breeding, raising, and caring for animals; and tending gardens and nurseries. Thus, the term comprises a spectrum of pursuits, from growing to processing, and a wide range of commodities.

Work in modern agriculture impacts on the respiratory system as a result of many different exposures. While most exposures such as those to dusts, bacteria, endotoxins and spores are primarily in the workplace (both outdoors and within animal confinement and other facilities), hazards such as storage mites, may be encountered within the workplace or home, similarly exposure to various chemicals may occur in the field, yard, garden or home. The impact on the respiratory system may vary considerably. Organic exposures may affect the airways and, depending on the antigenicity of the material and host susceptibility may result in asthma, asthma-like syndrome or chronic obstructive airway disease.

Recent studies among farm workers suggest that excessive pesticide use as well as biological factors such as outdoor mites may be responsible for asthma symptoms experienced by workers. There have been few epidemiological studies among workers on fruit farms that have focussed on the factors determining the incidence/prevalence of occupational allergy and asthma in specific exposure settings; the spectrum of allergens involved; and the patterns of immunological responses observed. Grape farms, in contrast to fruit farms, have not been previously investigated for occupational respiratory allergy to spider mites. The intensive use of anti-mite pesticides in table grape farms made this group of workers the preferred target group. The main objective of this study was to determine the spectrum of allergic sensitization to various allergens and the prevalence of work-related allergic health outcomes (rhino-conjunctivitis, urticaria/dermatitis and asthma) among workers in table grape farms by means of questionnaires and immunological tests.

1.2 THE PROBLEM AND ITS SETTING

Respiratory disease is a well-recognized occupational health problem among agricultural workers. Routinely collected statistics suggest that farmers have a higher morbidity and mortality from certain respiratory disorders than the general population and other occupational groups, despite lower prevalence of smoking.[5,6]

Recent studies demonstrate an increased prevalence of chest complaints and wheezing among workers exposed to pesticides (paraquat and organophosphates) in the Western Cape province of South Africa and in the USA.[7,8]

1.3 STATEMENT OF THE PROBLEM

The purpose of this study was to determine the prevalence of sensitization and allergy among table grape farm workers with reference to exposure to occupational allergens and work-related allergic outcomes in order to develop appropriate monitoring and medical surveillance techniques for monitoring health of workers.

1.4 STATEMENT OF THE SUB-PROBLEM

1.4.1 Sub-problem one

To determine the spectrum of allergic sensitization to various allergens among farm workers in order to identify the most common sensitizing insects/mites to which workers are exposed.

1.4.2 Sub-problem two

To determine the prevalence of work-related allergic health outcomes (rhinoconjunctivitis, uriticaria/dermatitis and asthma) among table grape farm workers in order to determine the extent of occupational allergy among table grape farm workers.

1.4.3 Sub-problem three

To evaluate the risk factors associated with occupational respiratory allergy among table grape farm workers in order to develop appropriate monitoring and medical surveillance techniques for monitoring health of workers.

1.5 HYPOTHESES FORMULATION

1.5.1 Hypothesis one

It is hypothesized that farm workers have a high risk of becoming sensitized to occupational allergens in their work environment.

1.5.2 Hypothesis two

It is hypothesized that there is a high prevalence of work-related allergic health outcomes among table grape farm workers.

1.5.3 Hypothesis three

It is hypothesized that exposure to occupational allergens is associated with increased risk of developing allergic health outcomes such as occupational rhinoconjunctivitis, uriticaria/dermatitis and asthma.

1.6 DELIMITATIONS

- This study was limited to table grape farm workers employed in randomly selected vineyards in the Hex-river Valley in the region of Worcester.

- The study population consisted of all table grape farm workers employed in the selected farms during the period of the study.

1.7 ASSUMPTIONS

The assumptions underlying the study were as follows:

1. The responses obtained from questionnaires from farm workers sampled would be representative of workers on all table grape farms.
2. All procedures used with reference to questionnaires and skin prick testing were reliable and valid indicators of health outcomes experienced by workers.

1.8 DELIMINATIONS/DEFINITIONS OF TERMS AND ABBREVIATIONS

Agriculture - embraces all forms of activity connected with growing, harvesting, and primary processing of all types of crops; with breeding, raising, and caring for animals; and with tending gardens and nurseries. refers to the science or practice of farming.

Agricultural worker - Any person engaged either permanently or temporarily, irrespective of legal status, in activities related to agriculture. (WHO, 1962).

Risk - is the likelihood that harm may be caused by an agent under usual circumstances of use.

Skin Prick tests - Skin prick test introduces a small amount of allergen extract intradermally on the volar aspect of the forearm. A wheal and flare reaction is observed after 15 – 20 minutes. This is indicative of a type I allergic reaction.

RAST - This test measures the amount of specific Immunoglobulin E antibodies (IgE) in sera to various environmental and food allergens.

ELISA - Enzyme-linked immunosorbent assay, is a serological assay in which bound antigen or antibody is detected by a linked enzyme that converts a colourless substrate into a coloured product. The ELISA is widely used in biology and medicine as well immunology.

Allergens - are antigens (molecules that react with antibodies) that elicit hypersensitivity or allergic reactions

Allergy - allergy is a hypersensitivity reaction initiated by immunologic mechanisms

Atopy - Atopy is an inherited feature, which in turn makes individuals more likely to develop an allergic disease. A subject is considered to be atopic if there is positive skin reactivity to one or more common inhalant allergens.

Sensitization - allergic reactions require prior immunization, called sensitization, by the allergen that elicits the acute response. Allergic reactions only occur in sensitized individuals.

Work-related - Symptoms were considered work-related if it was reported by the farm workers to occur when working in the orchards or in the stores

IgE	-	Immunoglobin E, which is an antibody that is produced when a person comes into contact with a particular allergen
Dematographism	-	Skin prick test responses to all extracts including the negative control

1.9 IMPORTANCE OF THE STUDY

Allergic diseases caused by indoor mites are a major health problem worldwide. Several studies conducted during the past few years have demonstrated that storage mites are major sensitizing allergens among farmers. Spider mites were negligible pests in fruit cultivation before the World War II. However, these mites have increased in the fruit-cultivation industry since pesticides were introduced to eliminate fruit moths 40 years ago.[9]

Occupational allergies and asthma due to arthropods such as insects and other storage pests are recognized as an important occupational health problem. However, studies on the factors determining the incidence/prevalence of the disease in specific exposure settings; the spectrum of allergens involved; and the patterns of immunological responses observed, are limited.

The farming of wine and table grapes is one of the biggest source of incomes in the Western-Cape with over 3000 wine farms employing over 50,000 workers, most of whom are women who do seasonal work. The deciduous fruit sector in the Western-Cape, including apple and citrus, are also affected by spider mites, employing over 250,000 workers. These workers are mainly women and live under poor socio-economic conditions. The potential negative consequences of adverse health outcomes such as allergies and asthma on human resource development and productivity, coupled with the intensive use of anti-mite pesticides in these farms, made this an ideal setting for investigating mite allergy and asthma among workers in these farm settings.

By characterizing the occupational exposures among this high risk working population, the study would contribute towards a better understanding of mite allergy and asthma among symptomatic individuals in the local general population. The proposed study also sought to identify risk factors for allergic sensitization to occupational mite allergens and to develop appropriate medical surveillance protocols for monitoring the health of workers, on these farms. This would enable occupational health services to develop the capacity to identify unrecognized cases of occupational mite allergy using more sensitive immunologic markers for early diagnosis. In this manner the pattern of occupational mite allergy on fruit farms in the Western Cape would be better characterized thereby spurring the development of preventive measures to protect the health of workers. Currently, no legal imperatives exist for occupational allergen exposure in agriculture, this study would aim to address this issue.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Globally, agriculture is the overwhelmingly dominant occupation, far eclipsing mining, manufacturing and service industries. Agriculture continues to play a fundamental role in the economy and daily existence of the populations of developing countries, commonly representing both occupation and lifestyle for entire families. Agricultural output is also the primary source of foreign currency for various industrial products. The size of the agricultural workforce globally is therefore substantial.[10]

2.1 HAZARDOUS EXPOSURES IN AGRICULTURAL POPULATIONS AFFECTING RESPIRATORY HEALTH

Farming is a complex industry. Agricultural products include dairy products, poultry, soybeans, grains, fruit, nuts, vegetables and flowers. Inhalation exposures occur in a variety of farm settings, including fields, grain storage, confined animal feeding operations and greenhouses. Agents present in these settings consist of the crops and farm animals themselves as well as micro-organisms and insects. Farms are becoming larger and more specialized in many parts of the world, intensifying chemical exposures that can cause respiratory disorders. Agricultural environments are associated with a number of respiratory tract disorders that include asthma and allergic rhino-conjunctivitis as well as disorders such as acute bronchitis, chronic bronchitis and the asthma-like syndrome.[11,12]

Respiratory disease is therefore a well-recognized occupational problem among agricultural workers. Asthma and other respiratory health problems among farm workers may be either due to excessive agri-chemical use, biological factors (animal, vegetable or micro-organisms and their contaminants such as endotoxins) or in all likelihood a combination of both (Table 2.1).

Table 2.1 Agricultural respiratory disease common exposure and effects

Respiratory Region	Principle Exposure	Diseases/Syndromes
Nose and nasopharynx	Vegetable dusts Aeroallergens **Mites** Endotoxins Ammonia	Allergy and nonallergic rhinitis Organic dust toxic syndrome (ODTS)
Conducting airways	Vegetable dusts **Mites** **Insect antigens** Aeroallergens Oxides Oxides of nitrogen Hydrogen sulfide	Bronchitis Asthma Asthma-like syndrome ODTS
Terminal bronchioles and alveoli	Vegetable dusts Endotoxins Mycotoxins Bacteria and fungi Hydrogen sulfide Oxides of nitrogen Paraquat Inorganic dusts (silica, sillicates	ODTS Pulmonary edema/adult respiratory distress syndrome Bronchiolitis obliterans Hypersensitivity pneumonitis Interstitial fibrosis

Source: American Thoracic Society. Respiratory health hazards in agriculture. Am J Respir Crit Care Med 1998; 158: S1 – S76

2.1.1 Agrichemicals / pesticides

Insecticides, primarily cholinesterase-inhibiting compounds, may contribute to respiratory symptoms among agricultural workers.[13,14] Organophosphate insecticides have been associated with occupational asthma in case reports and in a population-based survey of farmers.[15,16] Paraquat herbicide, is the only individual pesticide that has been studied in population-based settings. Even though inhalation can be an important route of pesticide exposure, there are few documented instances of direct respiratory effects. An important exception is the herbicide paraquat, of special interest because its site of toxic action is primarily the lung. Because paraquat's vapour pressure is extremely low, however, exposure is rarely respiratory in nature, except for applicators who may inhale spray aerosols. Exposure is primarily through ingestion (unintentional or suicidal). According to Pasi, "lung effects frequently appear only after a latent period of several days when the poisoned patient has already started to recover from the toxic effects of the chemical on other organs.[17]

Epidemiological studies have demonstrated that paraquat exposure is associated with increased wheeze among Nicaraguan banana workers and decreased lung function among South African deciduous fruit farm workers.[18,19] Senthilselvan et al demonstrated a significant increased risk of asthma associated with use of carbamate insecticides (OR:1.8, 95% confidence interval: 1.1 to 3.1, $p = 0.02$).[20] Recent studies demonstrate an increased prevalence of chest complaints and wheezing (19%) among workers exposed to pesticides (paraquat and organophosphates).[7] Of the few epidemiologic studies investigating respiratory symptoms Gutierrez et al, found exposure to herbicide to be related to respiratory symptoms.[18] Other studies were unable to demonstrate an association between symptoms, spirometry and gas transfer.[21,22,23]

Health hazards experienced by vineyard and orchard workers have not been frequently studied, although as an occupational group they are at risk of lung disease caused by the inhalation of noxious agents.[24,25] Studies in vineyard and orchard workers refer to sporadic respiratory disease due to the effects of pesticides in wine and grape growers.[26,27] Pimentel and Marques (1969) described a case of "vineyard sprayer's lung" as an occupational disease.[28] In Portugal, cases of this disease have been shown to be due to the inhalation of "Bordeaux mixture" pesticide, used for spraying grape vines to prevent the development of mildew.[29,30] Finally, epidemiologic studies by Gamsky et al document reduced force vital capacity (FVC) in California grape workers, suggesting exposure to inorganic dust, possibly silica, in addition to organic agents and pesticides.[31]

Farm workers with the highest levels of exposure are those involved in mixing and loading. Several studies are available that report inhalatory exposure to a range of pesticides.[32,33,34,35] A second important group is applicators. Numerous studies of these workers have demonstrated that low-volatility compounds, including many herbicides, do not contribute significantly to worker respiratory exposure. [36,37,34,35] Not surprisingly, granular insecticides, which have inherently low volatility, contribute very little to respiratory exposure.[38,39,40] Greenhouse application is considered a high exposure risk due to the confined spaces in these establishments.[41,42]

2.1.2 Bioallergens

Allergic reactions can be defined as hypersensitivity reactions resulting from immunologic sensitization toward a specific agent or component, called the allergen. In principle, all macromolecules of nonhuman origin, animal, plant or microbial can be immunogenic in humans, and each immunogenic compound may also act as an allergen inducing adverse reactions upon re-exposure.

The phylum Arthropoda is divided into three main classes, Insecta, Arachnida, and Crustacea, and approximately 30% of individuals who are exposed become sensitized to them. Domestic mites such as house dust mite and storage mites which are included in the class Arachnida, are the most important allergens in the development of asthma and allergic diseases worldwide.[43] The family of mites can be basically described as belonging to the phylum Arthropoda, class Arachnida and order Acari (Table 2.2).[44] Among this family there are major sub-categories such as Astigmata (house dust mite and storage mites) and Prostigmata (spider mites). Studies on the ecology and distribution of domestic mites and their contribution to allergic diseases indicate that they are generally found in homes located in geographical regions with more humid climates.[45]

Table 2.2 Family relationship between house dust mites, storage mites and spider mites

Suborder	**Family**	**Genus**	**Species**
Astigmata	Pyroglyphidae (house dust mites)	*Dermatophagoides*	*D. pteronyssinus* *D. farinae*
		Euroglyphus	*E. maynei*
	Glycyphagidae (storage mites)	*Glycyphagus*	*G. domesticus*
		Lepidoglyphus	*L. destructor*
		Blomia tropicalis	*B. tropicalis*
	Acaridae (storage mites)	*Acarus*	*A. siro*
		Tyrophagus	*T. putrescentiae*
Prostigmata	Tetranychidae (spider mites)	*Tetranychus*	*T. urticae*
		Panonychus	*P. ulmi* *P. citris*

Adapted from Kim YK et al, J Allergy Clin Immunol 1999; 104:1285-1292

Allergic diseases are increasing worldwide and mites are one of the most common causes of allergy. Mites are normal inhabitants in the environment and play an important role in the biological recycling process by breaking down waste products of organic materials. They frequently occur in the indoor environment in house dust as well as other environments such as barns and grain stores. About 40 000 different species are thought to exist. Storage mites are predominantly found in agricultural environments where they can cause occupational allergy in farmers and grain handlers, but are now also being recognized as important contributors to the allergen content in the house dust from urban dwellings.[46] The term dust mites is now commonly used to describe mites in the indoor environment, including both house dust mites and storage mites. Mites feed on a variety of protein-rich substances, house dusts mites primarily on shed human skin scales, while storage mites feed on plants and microorganisms. The existence of storage mites in house dust is often connected with damp housing conditions, which also favours the growth of moulds that provide an important source of food.[47]

Among the domestic mites, both house dust mites and storage mites have been implicated in causing allergic symptoms in farming and non-farming populations, despite farmers showing relatively lower prevalence of sensitization to most common inhalants.[48] In the occupational context, house dust mites have been implicated in causing allergic symptoms and asthma among woodworkers, avian mites among poultry workers and storage mites among bakery and grain mill workers.[49] More recently, outdoor mites such as spider mites have emerged as an important allergen causing allergic diseases, including asthma among farming and surrounding non-farming populations.[50] The farming population is unique in that domestic and outdoor mites may both be important sources of allergens as most workers work and live on the farm, thereby blurring the distinction between occupational and non-occupational factors contributing towards allergic symptoms and asthma.

2.1.2.1 House dust mite allergy

Exposure to house dust mite allergens is the most commonly encountered cause of allergic reactions in sensitized patients (Figure 2.1). In community-based studies, sensitization to house dust mites, as ascertained by a positive skin test or by an increased allergen-specific IgE level in serum, is associated with both diminished lung function and enhanced airway hyperresponsiveness. Sensitization to house-dust mite is an independent risk factor for the development of asthma, especially in areas which favour the growth of house dust mites.[51] In the general population, the prevalence of house dust mite sensitization is 9 – 16%; for some groups, the prevalence locally may amount to 26 – 43%.[52,53,54] House dust mite sensitization may give rise to rhinitis in half of the cases, and it markedly increases the risk of asthma.

2.1.2.2 Storage mite allergy

Since the mid 1960's, when it was established that the pyroglyphid mites were mainly responsible for house dust allergy, these species have been extensively studied regarding their role in allergic disease[55] (Figure 2.2). Maunsell indicated the potential allergenic importance of storage mites already in 1968.[56] Furthermore, a study by Spieksma in 1969 showed that of 200 house dust allergic patients, 83 were also sensitized to *Lepidoglyphus destructor (L. destructor)*, 68 to *Tyrophagus putrescentiae (T. Putrescentiae)* and 68 to *Acarus siro (A. siro)*.[57] However, it was not until 10 – 15 years later that these mites were acknowledged as important sources of allergens in different parts of the world. Studies in different parts of Europe as well as in the United States have shown that storage mites are found in stored hay and flour and may cause respiratory allergy among farm workers and bakers.[58,59]

The pathogenic relevance of storage mite exposure has been recognized since Ingram and co-workers reported a high prevalence of sensitization among Scottish farm workers with respiratory "barn allergy" and confirmed the causal relation by specific storage mite allergen bronchial provocation.[60] A high prevalence of storage mite sensitization, particularly among farmers with self-reported or physician-diagnosed respiratory symptoms or disorders, were found in several other population studies in various countries.[61,62,63] A complicating factor in investigations on the pathogenic role of storage mite exposure is the presumed cross-reactivity of its allergens with house dust mite allergens, although results regarding cross-reactivity obtained in different populations are apparently contradictory and evidence for co-sensitization of house dust and storage mites is limited.[64,65] In an epidemiological study, it was found that 6,2% of 2578 Swedish farmers have allergy to storage mites.[66]

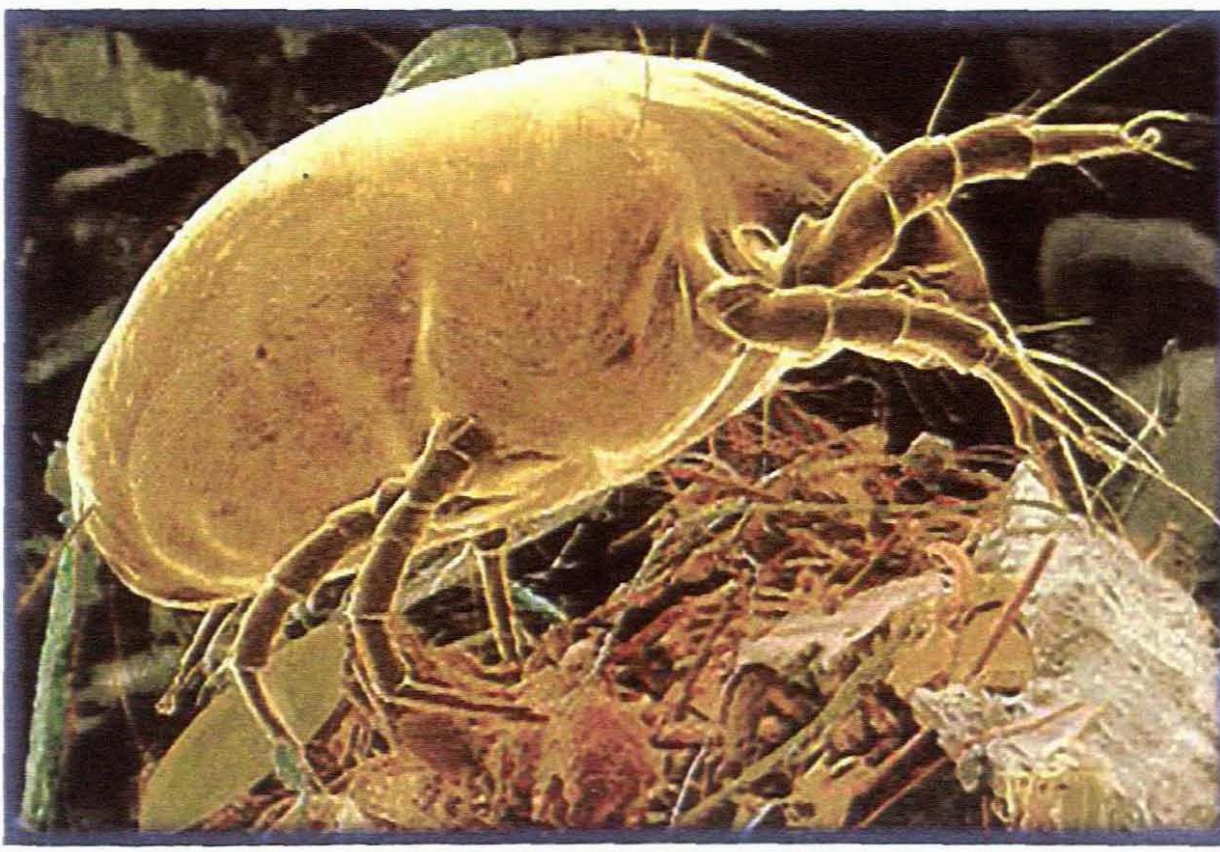

Figure 2.1 House dust mite *Dermatophagoides pteronyssinus* [67]
Source: http://www.healthy-house.co.uk/ dustalle.htm

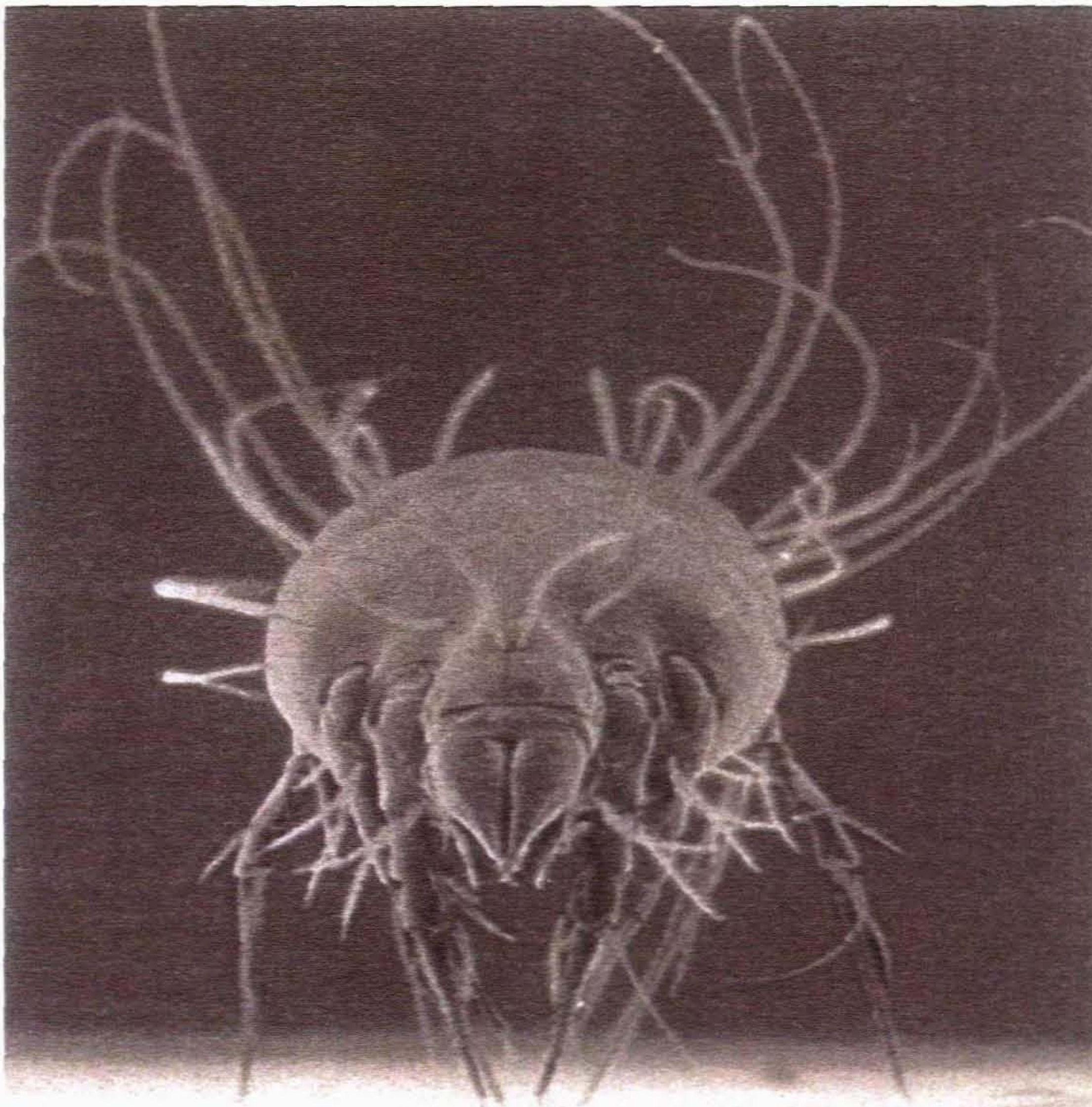

Figure 2.2 Storage mite *Lepidoglyphus Destructor* [68]
Source: http://www.hno-news.de/ vorratsmilben.htm

2.1.2.3 Other allergens

Agricultural dust may also contain allergens that are not specific to the farm environment, including well-known common allergens (e.g. house dust mites, grass or tree pollens, or from common pets like cats or dogs). Other compounds might be more specifically associated with agriculture, and thus be considered as potential occupational allergens such as proteins derived from domestic animals such as cows, pigs, horses, and poultry, or from plants or plant material such as grain, soy, or corn, etc. Mould exposure is not an exclusive feature of agriculture. Although mainly known as a cause of type III allergies, many of the IgG-inducing moulds can also induce specific IgE sensitization. Mould spore exposure can be very high in agriculture. Prevalence of atopic sensitization to moulds is however low in farmers and not enhanced compared to urban populations. Thus, mould exposure does not appear to be an important cause of type I allergic symptoms in agriculture. Modern developments in agriculture (e.g., breeding of new crops or previously undomesticated animals, and the use of specific insects, predator mites, etc., in biologic pest control) are new sources of sometimes very potent but previously unknown allergens of biologic origin.[69]

Isolated case reports of occupational allergies and asthma due to micro-organisms such as *Diplotaxis erucoides* (Wall Rocket) a plant allergen, Crucifera plant or vine pollen, *Vitis vinifera*; as well as arthropods such as insects (e.g. fruit moths) have been reported.[70,71] An agricultural disease associated with vineyards called winegrower's lung has also been reported. This is an alveolitis of exogenous allergic origin triggered by *Botrytis cinerea* spores described by Popp et al.[72] Recently, sensitization to the predatory mite *Ambyseius cucumeris* have been reported among greenhouse workers.[73] Although farmers, like other inhabitants of rural areas, are exposed to enhanced levels of pollens from grasses, weeds, and trees, the prevalence of pollenosis is certainly not higher and possibly lower than urban populations, as is found in studies of atopy.[64]

2.2 RESPIRATORY DISORDERS AMONG FARMWORKERS

Although hypersensitivity pneumonitis such as farmer's lung is the most frequently recognized lung disease among farmers, airway diseases are more common. The upper airways are often affected, causing considerable discomfort to patients. Many substances in the farming environment clearly aggravate asthma, and some can cause asthma. Diagnosis and treatment of asthma in farmers pose a special problem since farmers often live in the same environment as their workplace.[74] The prevalence of asthma in farmers and the long-term consequences of the disease are unknown. The term "asthma-like syndrome" is used to describe nonallergic, acute, reversible airway reaction to exposure to inhaled agents such as agricultural dusts. Severe airway injury from toxic gas inhalation may result in long-term complications, including bronchiectasis, reactive airways dysfunction syndrome, bronchiolitis obliterans, and chronic airflow limitation. These can occur in farmers exposed to high concentrations of irritant gases encountered in the agricultural environment. A higher prevalence of chronic bronchitis and chronic airflow obstruction has been documented among certain farming populations, such as grain and animal feed workers, compared with control subjects. With repeated exposures, acute airway disorders in agricultural workers may lead to the development of chronic airflow obstruction. Despite the progress of research in agricultural health, there are still considerable gaps in our knowledge, particularly in relation to the pathogenesis and natural history of diseases and in the understanding of multiple environmental risk factors, their interactions, and their control.

2.2.1 Rhinitis

Rhinitis is defined as inflammation of the nasal mucosa, whether the result of a direct irritant effect (irritant rhinitis) or as a specific immune reaction (allergic rhinitis). The prevalence and incidence of irritant rhinitis in the agricultural sector is unknown. Allergic rhinitis requires prior sensitization to the offending agent(s). Sensitization occurs most commonly in the atopic portion of the population, estimated to be between 10 and 20% of the total population. This proportion of the agricultural workforce may therefore be expected to have a higher risk of becoming sensitized to organic dusts when suitably exposed. A recent survey of occupational rhinitis in Finland reported that 20% of all rhinitis cases were occupational, and the most common exposures were from agricultural environments: flour, wood dust, animal dander, and vegetable fibers (e.g. cotton).[75] Swedish surveys of pig and dairy farmers have reported irritation of eyes, nose, and throat in excess of 20%.[76]

2.2.2 Asthma

Agents in the agricultural sector clearly aggravate and may cause asthma. A large number of agents in the farming environment are capable of causing occupational asthma[77] (Table 2.3). However, most cases of occupational asthma from these exposures affect workers in the manufacturing sector rather than in the agricultural setting. In general, these agents can be divided into three groups: plant-, animal-, and arthropod-derived materials. Exposure to plant-derived materials, such as grain dust and cotton dust, mainly give rise to asthma-like syndrome rather than asthma.[77,78] However, farmers have been shown to become sensitized to barn and storage mites in grain dust and developed asthma.[79,80,81] Table 2.3 summarizes the findings of a few epidemiological surveys of occupational asthma in agricultural workers. This table illustrates the importance of occupational asthma due to exposure to allergens among agricultural workers. Risk estimates depend on exposure and on outcome measure (symptoms, physician diagnosis, bronchial challenge testing, RAST or skin prick test). However, the prevalence of asthma diagnosed by a doctor or treated with medication has generally been ~3-10%. Very few studies give comparative figures from the general population or other working groups. The prevalence of asthma symptoms (wheeze, shortness of breath) varied between 3 – 18%. Agricultural workers from vineyards, however, have not been investigated for occupational asthma.

2.2.3 Chronic bronchitis

There is evidence that agricultural exposures are associated with the development of chronic airway disease, as distinct from asthma and asthma-like reversible airway changes. The range in prevalence of chronic bronchitis in the farming population is wide, from 2% to 32%, compared to the range in non-farming control groups from 0.7% to 11.6%.[82,83] The prevalence of chronic bronchitis seems to be increased, also when compared with prevalence data from general population studies from Scandinavia 3.0 – 4.6%.[84,85,86] Longitudinal studies of chronic bronchitis in farming populations suggest that the disease is work-related in farmers.[87]

2.2.4 Organic dust toxic syndrome (ODTS)

The syndrome known as ODTS is an acute inflammatory reaction in the airways and alveoli. Although the main features of aetiology and pathology have been defined, the precise mechanisms remain unclear. The agents best documented to be associated with ODTS are endotoxins. ODTS appears to be very common in farmers. Because of its self-limiting nature, ODTS does not feature in routinely collected statistics and most information about the scale of the problem comes from epidemiologic surveys in farming populations. Among Swedish farmers, the lifetime prevalence of ODTS has been estimated at 6% and the annual incidence at 1%.[88]

2.2.5 Asthma-like syndrome/ acute non-allergic respiratory symptoms

Inhalation of organic dust in the agricultural environment may also give rise to another non-allergic respiratory response, which has been described as "asthma-like syndrome". Grain and cotton dusts are well-established causes, but ammonia and endotoxins have also been implicated. Although the symptoms of chest tightness, cough, and dyspnea are usually mild and self-limiting at the onset, there is evidence to suggest that cross-shift changes associated with these symptoms predict longitudinal decline in lung function in affected individuals.[89]

Table 2.3 Epidemiological surveys of occupational asthma in agricultural workers

Country	Year of study	Population	Outcome measure	Prevalence (%) Asthma	Prevalence (%) Pos. SPT Pos. RAST	Prevalence (%) Symptoms
Scotland	NS	Cattle farmers	Self-reported asthma RAST test and SPT for storage mites	15	Pos. SPT 37.2 Pos. RAST = 17.4	
Finland	1980	Urban versus rural (farming)	Diagnosed asthma Periodic wheeze	4.1 (urban) 2.7 (rural)		Periodic wheeze = 15.2(urban), 17.5(rural)
Denmark	NS	Farmers	Self-reported asthma Asthma medication Asthmatic symptoms	7.7		Medication = 3.5 SOB = 13.7 Cough = 22.1 Wheese = 16.3

Country	Year of study	Population	Outcome measure	Prevalence (%) Asthma	Prevalence (%) Pos. SPT Pos. RAST	Prevalence (%) Symptoms
France	1992	Farmers, farm workers (retired)	Current asthma Lifetime asthma	5.9 (current) 9.3 (lifetime)		
Sweden	1994	Farmers	Physician-diagnosed asthma RAST test for common airway allergens, storage mites, cow epithelium	Diagnosed asthma = 10.5(general population in region = 6) One-third of asthmatic farmers had pos. RAST test to any one allergen	Pos RAST = one-third of asthmatic farmers	

Country	Year of study	Population	Outcome measure	Prevalence (%) Asthma	Prevalence (%) Pos. SPT Pos. RAST	Prevalence (%) Symptoms
New Zealand	NS	Farmers, farm workers	Wheeze, BHR			OR for prevalence of wheeze = 4.27 (95% CI = 1.28 – 14.29)
Norway	1991	Farmers and spouses	Self-reported asthma	6.3 (lifetime)		
France	1994	Dairy farmers	Self-reported asthma Physician-diagnosed asthma	Asthma 5.3 Physician-diagnosed asthma = 4.9		
Denmark	1992-1994	Farming students	Self-reported asthma, BHR	Asthma = 5.4 – 21.0* (Asthma and BHR) = 15.4 – 50.0*		

Country	Year of study	Population	Outcome measure	Prevalence (%) Asthma	Prevalence (%) Pos. SPT Pos. RAST	Prevalence (%) Symptoms
Denmark, Germany, Switzerland, Spain	1995-1997	Cattle, pig, poultry and sheep farmers	Self-reported asthma, asthmatic symptoms	Asthma = 2.8		SOB = 5.1 Wheeze = 14.1

NS = not stated; OR = odds ratio; BHR = bronchial hyperresponsiveness; SB = shortness of breath; SPT = skin prick test;

RAST = radioallergosorbent test; pos.= positive

*Range according to smoking status and gender

Source: Respiratory illness in agricultural workers. Occup Med 2002; 451 - 459

2.3 OCCUPATIONAL ALLERGY AND ASTHMA DUE TO SPIDER MITE

2.3.1 The spider *mite* family

Spider mites belonging to Prostigmata, suborder are outdoor phytophagous mites that colonise leaves of fruit trees, herbaceous plants and greenhouse crops causing damage to fruit leaves and in some cases defoliation[50] (Table 2.2). One generation of spider mites requires approximately 2 weeks at desired spring temperatures of between 19 and 30 °C. This results in 10 - 12 generations of spider mites per year. [90] Various species of spider mites exists, the most common being *Tetranychus urticae*, *Panonychus ulmi* and *Panonychus citri* (Table 2.2).

Although predaceous mites attack spider mites, the predator complex does not usually control spider mites, particularly when spray programmes of organo phosphates or sulphur upset natural control.[91] Ecological surveys indicate that while the European red mite (*P. ulmi*) and the two-spotted spider mite (*T. urticae*) are commonly found on apple farms, T. urticae is the most common pest found on pear farms, green-houses and herbaceous plants. The citrus red mite (*P. citri*) is most commonly found on citrus farms.[50] *Tetranychus urticae* is a microscopic mite (commonly known as red spider) which usually parasitises fruit trees, herbaceous plants and greenhouse crops worldwide[92] (Figure 2.3).

Figure 2.3 Two-spotted spider mite *Tetranychus urticae Koch* brown to orange-red in colour and 0.4mm in length [92]
Source: http://creatures.ifas.ufl.edu/orn/twospotted_mite.htm

2.3.2 Epidemiology of asthma due to spider mite

Farm workers, particularly on fruit farms, have been frequently found to be sensitised to a new allergen source, spider mites.[93,94] The spider mite, *Tetranychus* urticae, has been considered the cause of occupational IgE-mediated disease in greenhouse and outdoor farm workers.[95,96,97] Reunala *et al* first described allergic reactions to *T. urticae* in two patients suffering from rhinitis, conjunctivitis and contact urticaria, who worked in a greenhouse.[98] A study of patients working in a fruit growing area demonstrated positive sensitization to spider mite in workers with clinical symptoms (rhinitis, conjunctivitis, erythema and asthma).[99] Subsequently, Delgado *et al* described a case of *T. urticae*-induced occupational asthma and rhino-conjunctivitis confirmed by specific bronchial challenge.[96] After these cases reports, the first case of *Panonychus citri*-induced occupational asthma was confirmed by specific bronchial challenge, and the clinical characteristics of 16 patients were described.[100]

Recently, cross-sectional studies have demonstrated that spider mites such as the European red mite (*Panonychus ulmi*) and the twospotted spider mite (*Tetranychus urticae*) are important allergens in the development of work-related asthma and rhinitis symptoms.[94,101] *T. urticae* has also been shown to be directly responsible for recurrent dermatitis, caused by a different immune-mediated mechanism, in farm workers.[102]

A cross-sectional study conducted amongst citrus farm workers in Korea found a prevalence of sensitization to spider mite of 16.5% and 12.1% were diagnosed as having occupational asthma.[101] Another cross-sectional study demonstrated that *P. ulmi* and *T. urticae*, the most common apple leaf spider mites, were the most common sensitizing allergens in 725 apple farmers, of whom more than 5% showed isolated allergic skin response to the spider mites.[94] Navarro *et al* found that sensitization to spidermite was more common in atopic greenhouse workers than in non-atopic workers.[95] It was shown that 19% of the sensitized workers had allergic rhinitis symptoms and 7% had asthma symptoms.

Jee *et al* demonstrated that this mite may also be an important allergen in asthmatic non-farmers living around pear orchards.[103] One-third of these asthmatic individuals were sensitised to *T. urticae,* of whom approximately two-thirds exhibited significant bronchoconstriction after inhalation of *T. urticae* extracts. The asthmatic symptoms of the T.urticae-asthmatic individuals were aggravated seasonally, especially in summer and early autumn, at which time the levels of *T.urticae* densities on pear leaves are highest. This suggests that *T.urticae* may be an important causative allergen among asthmatic individuals living around pear farms, who suffer summer-season aggravation of asthmatic symptoms. Cross-sectional studies in children living near citrus farms, have demonstrated that *P. citri* was the second most common sensitising allergen after house dust mites, and that sensitization to *P. citri* was significantly related to bronchial hyperresponsiveness, even in the absence of asthma symptoms.[104]

2.3.3 Cross-reactivity among mites

It is generally accepted that the closer the taxonomic relationship between species, the greater the level of cross-allergenicity. Spider mites belong to the order Acari, the suborder Prostigmata, while house dust mites and storage mites, also of the same order Acari, belong to the suborder Astigmata (Table 2.2). Because of the wide domestic exposure in some populations, many investigators have evaluated the allergenic cross-reactivity between house dust mite and storage mites. Park et al reported marked inhibition of *Tyrophagus putrescentiae*-specific IgE with *D. pteronyssinus* extract but found that *D. pteronyssinus*-specific IgE was not inhibited by *T. putrescentiae* in Korean urban areas.[105] A number of studies have been performed to determine the allergenic cross-reactivity between spider mites and domestic mites. Burches et al reported that specific IgE to *T. urticae* could not be detected in the absence of specific IgE to *D. pteronyssimus*.[93] However, a study by Astarita et al found that *T. urticae*-specific IgE binding was not inhibited by *D. pteronyssinus* in farm workers.[102]

A recent study by Kim et al demonstrated that although *P. ulmi*-specific IgE binding was completely inhibited by *P. citri*, it was only partly inhibited by *T. urticae, T. putrescentiae* and *D. pteronyssinus.* [106] The researchers also demonstrated that *T. urticae*-specific IgE was only partly inhibited by *P. citri* and *P. ulmi, T. putrescentiae* and *D. pteronyssinus*. These findings suggest that some of the spider mite allergens can cross-react with other storage and domestic mite species; however, the majority of allergens appear to be species-specific.

2.3.4 Risk factors for the development of spider-mite allergy

Environmental exposure to allergens has been known to be a potential determinant for sensitization to a causative allergen. Although such sensitization requires exposure to only a small dose, it is nevertheless possible that high exposure may be associated with an increased risk of sensitization. The results from a follow-up study by Sporik et al showed that exposure to high levels of house dust mite allergen increased the risk of sensitization.[107] As for outdoor spider mites, children who had either frequently visited fruit farms, or had been living near them, had enhanced skin responses to spider mites.[108] These findings suggest that environmental exposure and proximity is a major determinant for the risk of sensitization to spider mites, and when combined with the prevalence data for spider-mite allergy, suggest that spider-mite allergy may be a common problem even among non-farming population, especially those living near fruit farms.

Studies focusing on sensitization and allergy to spider mites suggest that sensitization to spider mites is influenced by genetic predisposition to specific IgE responses to common inhalant allergens. Thus, atopic status has been found to be a predisposing factor to *T. urticae* hypersensitivity in numerous studies.[50,95]

It has been demonstrated that exposure to spider mites in greenhouses is associated with an increased risk of developing spider mite allergy.[95] There are several reasons for this: the greenhouse helps the development of this mite due to temperature and humidity conditions. Furthermore, in recent years spider mites have proliferated due to the resistance to common pesticides and the disappearance predators to *T. urticae* resulting in increased allergen loads.

2.4 AGRICHEMICAL USE AND SPIDER MITE ECOLOGY ON WESTERN CAPE FARMS

2.4.1 Use of agrichemicals in grape farms

Agrichemicals may be used to protect crops from unwanted pests, to control weeds or promote healthy crop growth. The range of chemicals includes fungicides, insecticides, herbicides, acaricides (used to control mites), nematicides, plant growth regulators and substances used as metabolic sprays or adjuvants. The frequency and form of their application are determined by a number of factors, chiefly the seasonal variation in the density of the pest populations and the stages of the development of the crop, as well as the mode of action of the chemical. Agrichemical use is widespread in South Africa. The following graph indicates the different pesticides used within the table grape farming sector (Figure 2.4). An increase in use of pesticides has been observed over the years. Fungicides and insecticides are extensively used on vines, comprising 88% by weight of the agrichemicals used in the grape sector; almost half of the fungicides used in the southern region are for vines. This increased use of pesticides has resulted in increasing populations of spider mites, due to failure of chemical control, and high levels of resistance to miticides.[109]

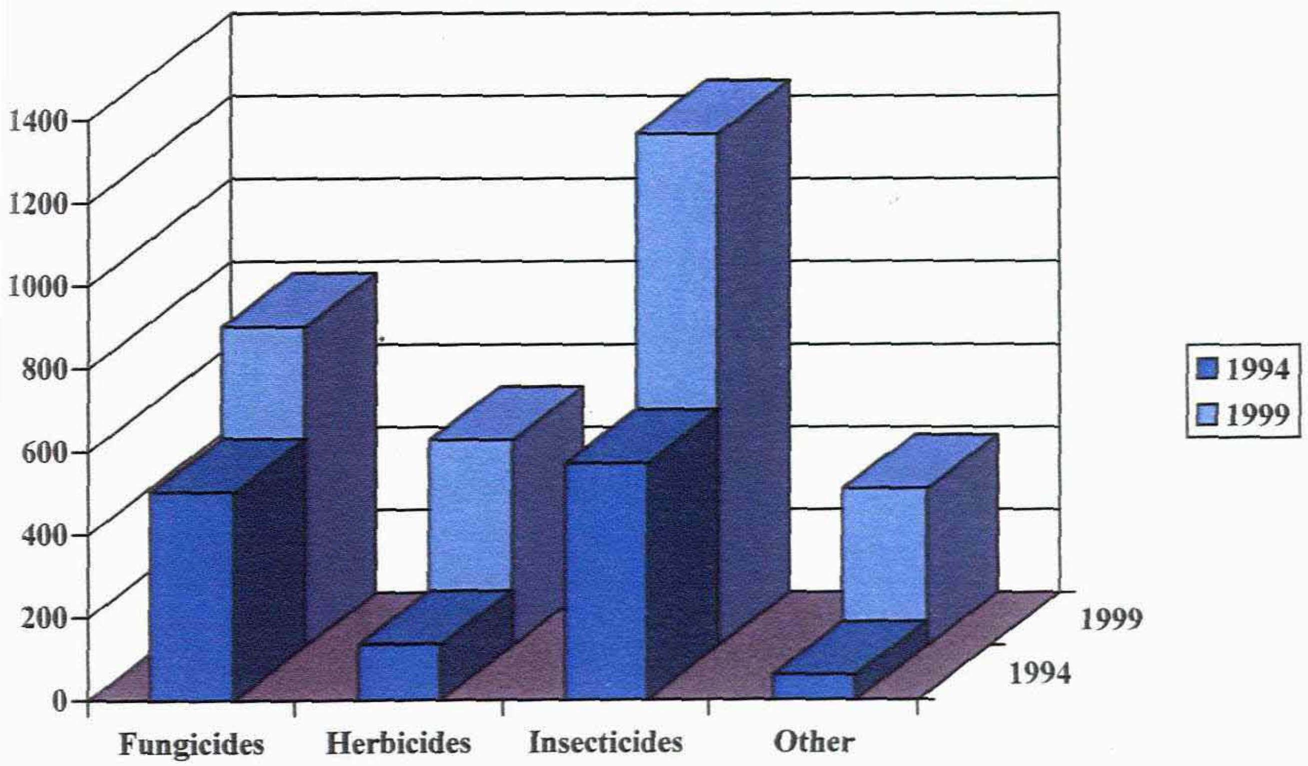

Figure 2.4 Use of agrichemicals in grape farms in the Western Cape from 1994 – 1999

Source: Dalvie MA et al. Audit of agricultural pesticides sales and risks during 1994 & 1999 in South Africa. Workshop on Environmental and Health exposures and effects of pesticide use in the Western Cape: Feedback on Collaborative University of Cape Town/Peninsula Technikon research.

2.4.2 Ecology and distribution of spider mites in the Western Cape

Spider mites (Tetranychidae) are important pests in apple orchards within the Western Cape. Tetranychus urticae Koch and Panonychus ulmi Koch both infest apple trees in the Elgin area, while only T urticae is a problem in the Ceres and Langkloof area[110] (Figure 2.5). In the Elgin area there is seasonal variation in the composition of the spider mite complex. This appears to be related to climate. In years of high rainfall during December and January, which is unusual for this winter-rainfall area Panonychus ulmi often dominates, but when the usual low summer rainfall occurs Tetranychus urticae appears to dominate. Sometimes both species occur simultaneously as was the case in 1994/1995 season.

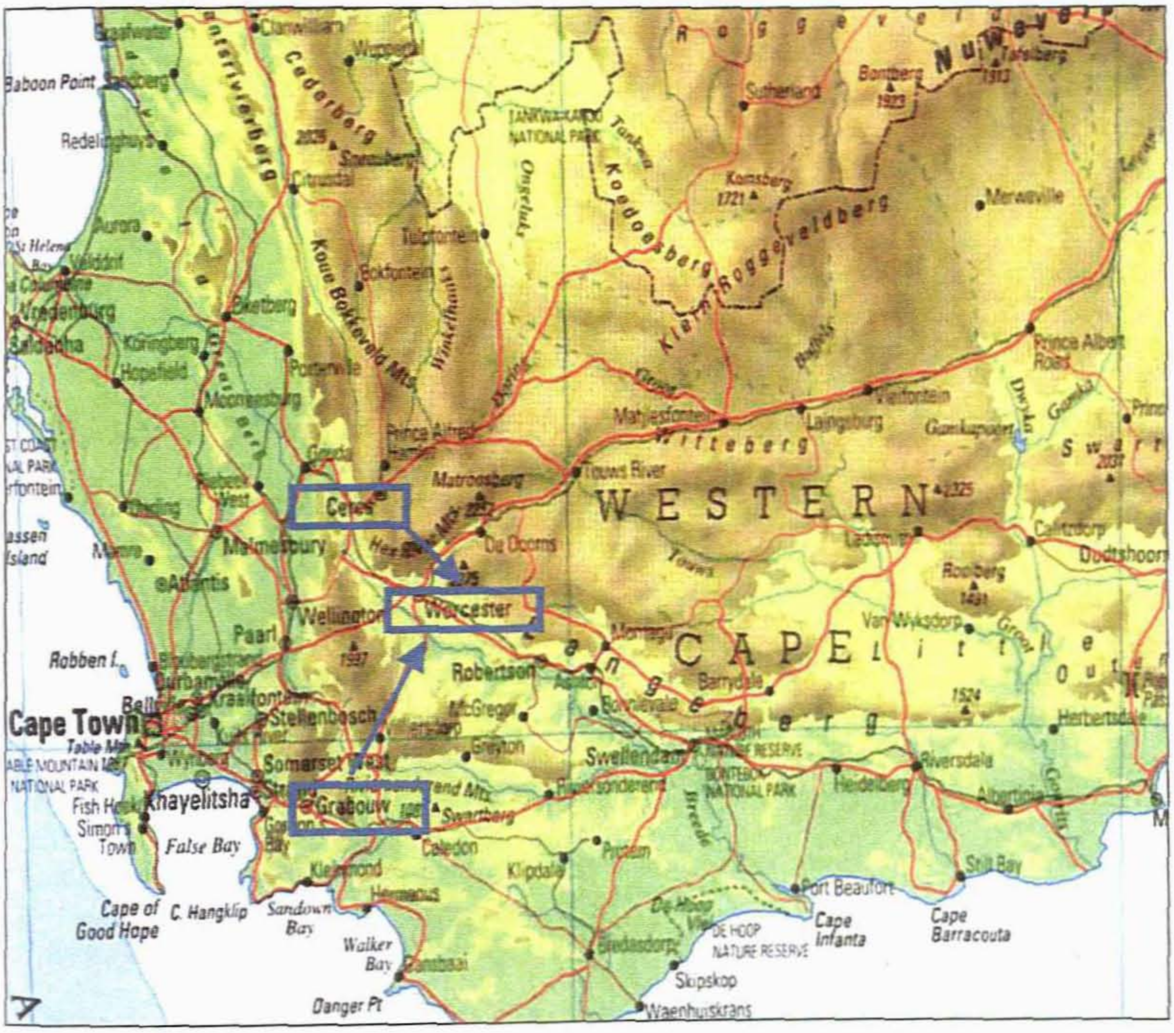

Figure 2.5 Map of the Western Cape indicating areas where excessive spider mite populations are found[111]

Source: NASOU Junior Atlas for Southern Africa. Second Edition. Nov. 1996

Legend:

- Elgin (close to Grabouw): *Tetranychus urticae* Koch and *Panonychus ulmi* Koch both infest apple trees in this area
- Ceres: *T urticae* is a problem in this area
- Worcester: table grape farms in the Hexriver Valley is located in close proximity to this area

In summary, this review has demonstrated that pesticides are important causes of respiratory morbidity among farm workers. However, spider mites have recently emerged as another important allergen among farm workers especially those workers engaged on fruit farms. The introduction of pesticides to eliminate fruit moths in the fruit-cultivation industry, has resulted in an increasing number of spider mite populations that are not well controlled by current predator complexes. Failure of chemical control against these mites is due to high levels of resistance to miticides.[112,109]

The farming of wine and table grapes is one of the biggest source of income in the Western-Cape with about 3000 farms employing over 50,000 workers.[113] Vineyards, in contrast to fruit farms (citrus and apple), have not been previously investigated for occupational allergy and asthma associated with spider mites. Since these farms are located within the same geographical region as apple farms, the ecological distribution of spider mites in these vineyards was considered in all likelihood to be very similar to apple farms. Furthermore, the intensive use of anti-mite pesticides in table grape farms as opposed to wine grape farms made this group of workers the preferred target group of further investigations as described in this study.

CHAPTER 3

THE DATA, THEIR TREATMENT AND THEIR INTERPRETATION

3.1 THE DATA

3.1.1 Data management and analysis

In this study two types of data were used: A) Primary data

B) Secondary data

The nature of each of the two types of data is discussed briefly.

3.1.1.1 Primary data

A standard abbreviated questionnaire was used for interviews based on the European Community Respiratory Health Survey questionnaire, slightly modified for local conditions. The questionnaire concentrated on symptoms most often encountered in an occupational setting. The reliability of the questionnaire had been shown to be acceptable in previous studies on occupational allergy and asthma.

Another source of primary data was collected during the skin prick testing procedures and from immunological tests (mite specific IgE) performed on blood samples of workers.

3.1.1.2 Secondary data

Sources of secondary data included:

1. Specialists in the field of immunology and occupational health and safety in the agricultural setting were also consulted.
2. Demographic data obtained from the Department of Agriculture.
3. Data collected from journal articles of similar studies that were performed. Reference was made to these articles.
4. European Community Respiratory Health Survey questionnaire.

3.2 METHODOLOGY

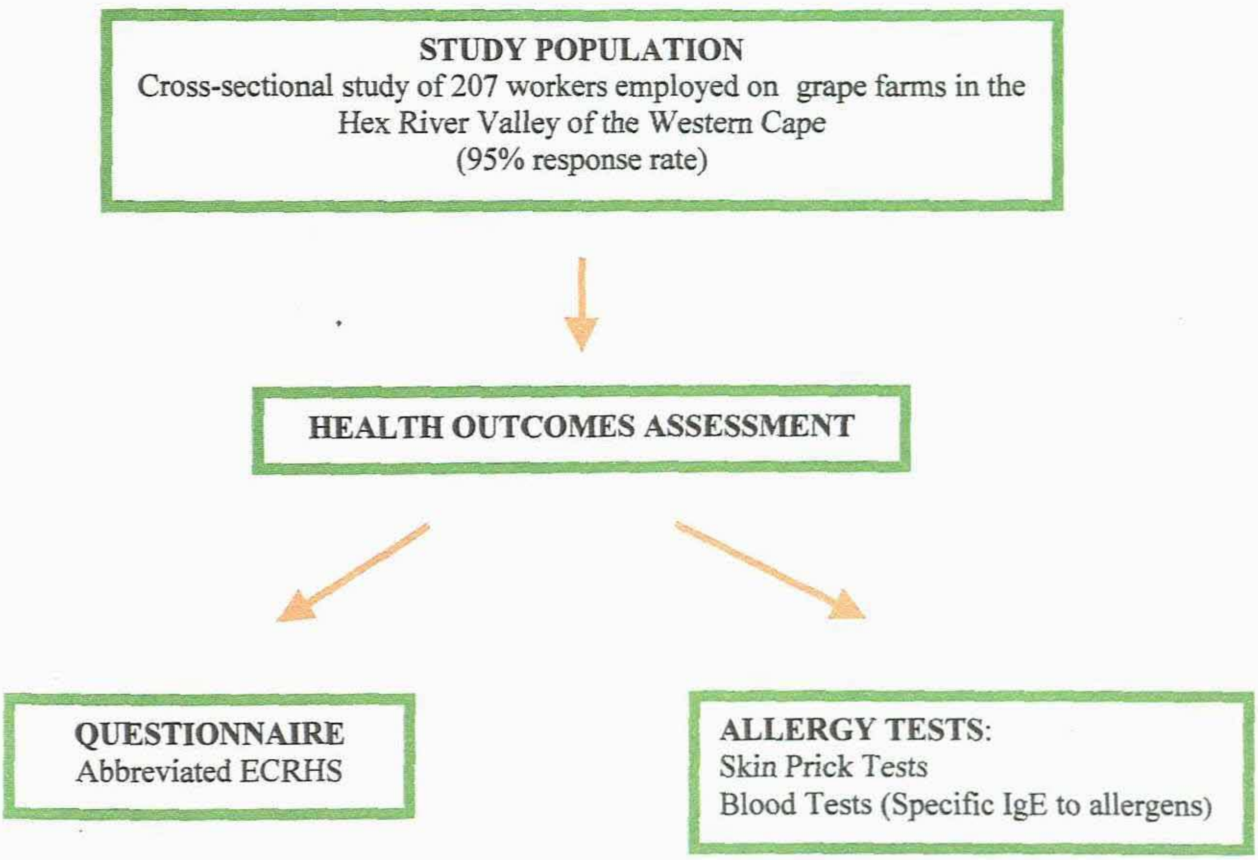

Figure 3.1 Diagrammatic illustration of research process.

3.2.1 Research Design

A cross-sectional analytical study was conducted where the dependent and independent variables were measured simultaneously. In a cross-sectional analytical study, a sample of the study population is investigated and information is collected on risk factors (exposures) and disease (outcome) at a point in time. The study had a descriptive component, which enabled researchers to calculate the prevalence of the risk factors as well as the prevalence of disease. The analytical part of the study consisted of comparing exposure groups with respect to disease presence. The advantages of using this type of study included the fact that it is relatively inexpensive and easy to conduct.

3.2.2 Sampling

A sample of 207 workers was included in the study. These workers were randomly selected from the farms identified for inclusion in this study. Researchers for a study on pesticide usage on these farms had already identified potential table grape vineyards. The workers for this study on occupational allergy were randomly selected from farms identified by the pesticide study. Power calculations were computed for sample size. The power associated with detecting differences in prevalence of allergy parameters among the baseline adult population group relative to the occupationally-exposed group were calculated. This was calculated with $\alpha=0.05$, using the background prevalence of spider mite sensitization in the adult population as 10% (as determined by recent study of bakery workers) and prevalence estimates for sensitization to spider mite of 16% based on Korean studies.[50] Statistical calculations indicated that a sample size of 224 was required for the study to have a power of 80%.

3.2.3 Study instruments

3.2.3.1 Questionnaire

Each worker answered a standard abbreviated questionnaire based on the European Community Respiratory Health Survey questionnaire, slightly modified for local conditions.[114] The questionnaire was translated into Afrikaans and back translated to ensure validity and reliability of responses. (*see Appendix A*)

A trained interviewer administered this questionnaire in the language of the worker. Questions covered included work history, job task, symptoms at work, medical history including medication use (Figure 5). Symptoms were considered to be work-related if they were reported by the workers as being associated with working in the farm orchard or storeroom. Symptoms elicited included wheezing, ocular-nasal symptoms and skin symptoms in the past year. Asthma was defined as a positive answer to the following question: *"Has a doctor ever diagnosed you as having asthma?*[115]

3.2.3.2 Skin prick testing (SPT)

Skin Prick testing was performed on all workers using commercially available extracts of common inhalant allergens (ALK) such as house dust mite (*Dermatophagoides pteronyssinus)*, mouldmix *(Cladosporium herbarum, Alternaria alternata, Fusarium)*, bermuda grass (*Cynodon dactylon),* rye grass *(Lolium perenne)*, cat *(Felis domesticus)* and treemix *(False acacia, Live oak, Olive, White birch, Ash)*, cockroach *(Blatella germanica*) Figure 6. (*See Appendix B & C*)

Potential occupational allergens tested for included grape mould *(Botrytis cinerea)* and an in-house generated extract of spider mite, *Tetranychus urticae*. The latter was provided by Dr Yoon-Keun Kim and Dr Yoon-Seok Chang (Department of Internal Medicine, Seoul National University College of Medicine, Korea). Histamine dihydrochloride was used as a positive control and a diluent of glycerol/sodium chloride as a negative control. Areas of erythema were traced on clear tape that would be stored for later verification. A positive test was regarded as a wheal read 15 minutes after testing that had a diameter of ≥ 3 mm of the negative control. Skin prick test reactivity was expressed as the allergen/histamine wheal ratio (AHWR) – the mean wheal diameter at the allergen site divided by the mean wheal diameter at the histamine site, as described by Aas & Belin.[116] Thus an allergen histamine wheal ratio of ≥0.5 was considered a positive reaction.

The examiner was blinded to the job type of each worker. A subject was considered to be atopic if there was a positive skin reaction to one or more common inhalant allergens.[117] Occupational sensitization to spider mite was defined as positive SPT to *Tetranychus urticae* (TU). Pregnant workers and those with acute asthma symptoms were not eligible for skin prick testing. In this instance blood tests were done instead.

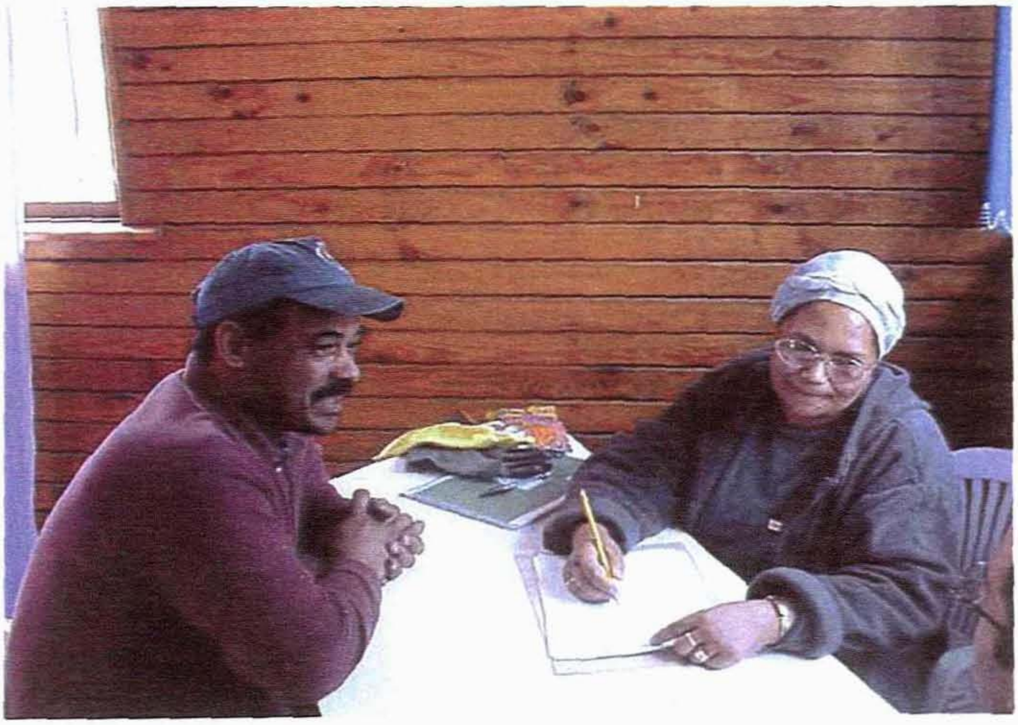

Figure 3.2 Questionnaire interviewing process.

Figure 3.3 Skin prick testing procedure.

3.2.3.3 Specific IgE determinants to mite species

Specific IgE determinants to *Tetranychus urticae*, *Dermatophagoides pteronyssinus* and *Lepidoglyphus destructor* were performed. These tests confirm that the response observed on SPT is due to an IgE mediated mechanism to the specific allergens tested for. They were also used in workers where the skin prick test was contra-indicated.

A blood sample (9-ml) was drawn from each worker using a Becton Dickinson Vacutainer SST tube (with gel medium and clot activator) by a qualified nurse. The blood was allowed to clot for 1-2 hours at room temperature (20-24 degrees Celsius). The sample was then centrifuged at 1350g for 10 minutes at room temperature at the Allergology Unit, Groote Schuur Hospital. The serum was then transferred to another tube and stored at -20 degrees Celsius until assayed for further measurement. The analysis was conducted at the Allergology Unit, Groote Schuur Hospital. A technologist blinded with regard to the exposure history conducted the analysis. While conducting the analysis for one allergy marker, the technologist was blinded with regard to the results of the other markers in that batch.

Aliquots of whole blood obtained for doing the RAST samples was frozen at -80 degrees Celsius. The technologist from the Allergology Unit, Groote Schuur Hospital, used the standard UniCAP assay (Pharmacia & Upjohn Diagnostics, AB, Uppsala, Sweden) procedure for analysing the samples for *Dermatophagoides pteronyssinus* and *Lepidoglyphus destructor*. A positive result was classified as any value more than three times the value of the non-specific binding (RAST ratios >0.35ku/L). Analyses for specific IgE to *Tetranychus urticae* was performed by the Korean laboratory using the

ELISA. A positive result was classified as any value greater and equal to two standard deviations from the mean.

3.2.3.4 Ethics

The Research Ethics Committee of the University of Cape Town approved the study. Informed written consent was sought prior to any investigations being performed on any of the workers. Confidentiality of all results was ensured. Participation was voluntary and withdrawal at any time was permitted, without negative consequences. (*See Appendix D)*

3.3 DATA ANALYSES

The data was encoded by one person. After data capturing the data was analyzed using computer software. Every variable was given a name that identified its "place" in the data set. The statistical package STATA version 6 was used for management and analysis of data and SPSS for graphical presentations.[118,119]

Key associations of interest involved investigating the relationships between independent variables (job type, host factor attributes) and occupational disease outcomes. The dependant variables were respiratory symptoms, skin symptoms, rhinoconjuctivitis and doctor-diagnosed asthma. These variables were dichotomous in nature. The independent variables included age, gender, use of medication, duration of employment, employment status, type of job, skin prick testing results and IgE results. The categorical variables were coded as follows: Yes = "1" and No = "0"

The key disease outcome variables of interest included:

a) Allergic sensitization to:

- spider mite
- house dust mite, and
- storage mite (as measured by positive immediate skin reactivity or antigen-specific circulating IgE antibodies in human serum)

b) Occupational rhinoconjunctivitis to:

- spider mite,
- house dust mite and
- storage mite (work-related specific symptoms and presence of allergic sensitization)

c) Occupational asthma symptoms to:

- spider mite,
- house dust mite and
- storage mite (work-related specific symptoms and presence of allergic sensitization)

The primary measures of exposure that were computed based on the occupational and symptom histories included:

a) employment duration on current farm

b) job type (pesticide crop sprayer or general worker)

Covariates adjusted for in models for **work-related symptoms** included.

- age,
- gender

Covariates adjusted for in models for **allergic outcomes** included.

- age,
- atopy (positive skin reactivity to one or more common aeroallergens).

The general approach involved univariate, bivariate and multivariate analyses of the outcomes of interest in relation to the predictors of interest. Univariate analyses summarized the distribution of each measured variable. Exploratory bivariate analyses were used to assess the nature of the associations between outcomes, exposure and covariates. Both continuous and categorical analyses were considered. Contingency table analysis using the Mantel-Haenszel methods was used in the preliminary analyses. Regression models were developed to assess the exposure effects on the occupational disease outcomes.

Associations between exposure variables (employment duration, job type) and categorical health outcomes (symptoms, immunological measures, occupational disease) were investigated by means of Mantel-Haenszel Chi-Square Test and multiple logistic regression. Spearmans Correlation Coefficient was used for analysis of continuous health outcomes (SPT allergen/histamine ratio) since the data were skewed.

All the statistical tests were performed at a 5% level of significance. Thus an alpha of 0.05 (α= **0.05**) was used as the criteria for determining significance of relationships between variables. The assumptions underlying each of the tests performed were checked.

CHAPTER 4

RESULTS

4.1 Demographic characteristics

A structured questionnaire was administered on all 207 workers from nine farms. Skin prick tests were performed on 197 subjects only (four were pregnant, six complained of tight chest). A further seven subjects were excluded from the data analysis on skin prick tests since one showed demographism, and six did not react to the positive control. None of the subjects developed any severe allergic reactions during or after testing. Due to logistical reasons blood samples were obtained from 201 workers.

The overall proportion of females to males in this study was 1.1:1 (Table 4.1). The mean age of the workers was 36 years with a standard deviation of 11 years. A large proportion were permanent workers (86%). The average duration of employment on these grape farms was 15 years, with 12% of workers involved primarily in pesticide crop spraying (Figure 4.1). A significant correlation (Spearman $r=0.54$, $p<0.001$) existed between employment duration and age. Aside from their current employment, the average duration of employment on other grape farms was 5 years (SD: 5). Only seven percent of the workers reported use of asthma medication.

Table 4.1 Demographic characteristics of table grape farm workers in the Western Cape, 2002

Demographic characteristics (n=207)	
Age (years)	36 ± 11
Gender (F:M)	106 : 101
Employment status (% permanent)	86
Employment duration in current farm (years)	10 ± 8
Employment in current job (years)	9 ± 8
Employment duration in other grape farms (years)	5 ± 5
Crop sprayers (%)	12
Asthma medication usage (%)	7

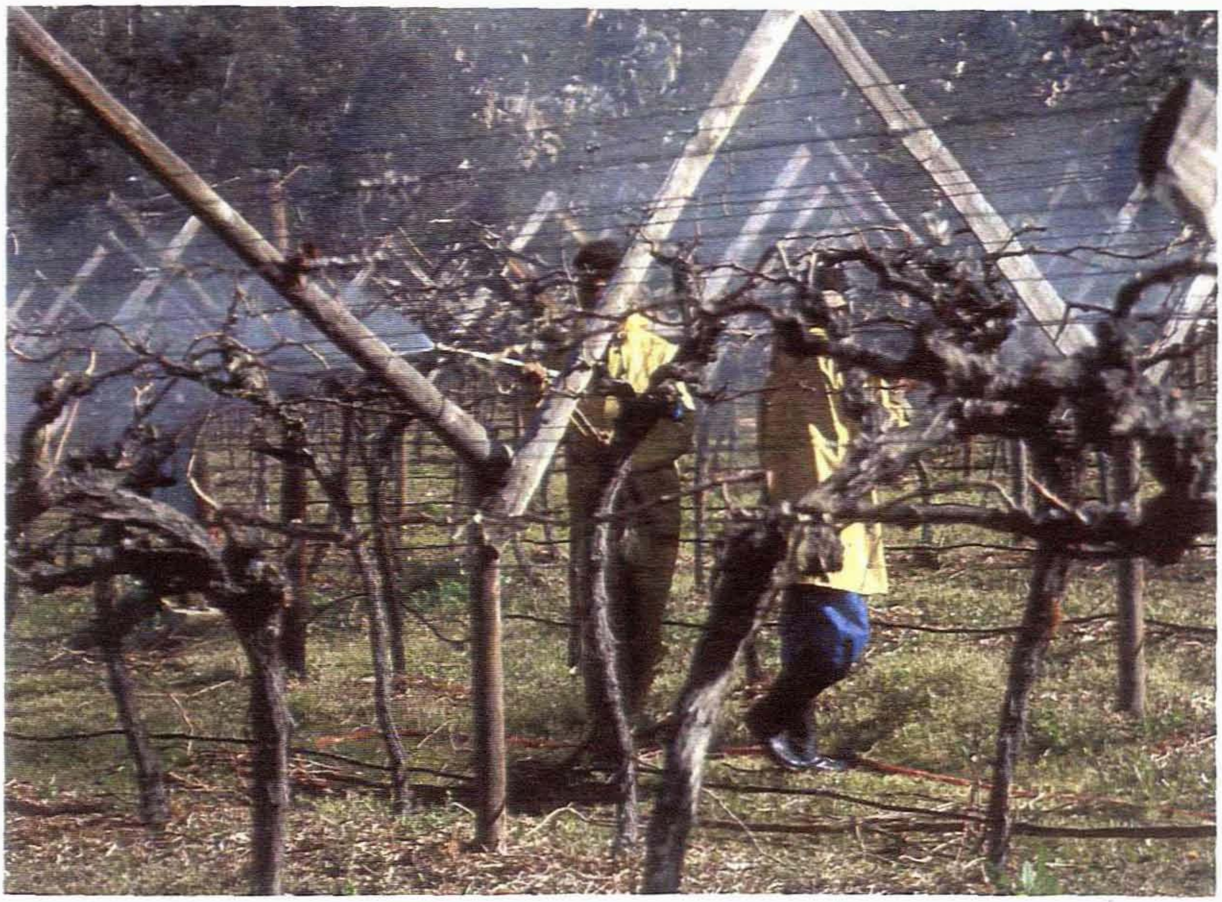

Figure 4.1. Pesticide crop sprayers on a table grape farm
Source: University of Cape Town, Occupational and Environmental Health Research Unit archives)

4.2 Work-related symptoms

The study found a high prevalence of wheezing symptoms in general (30%) and 9% of the workers reported doctor-diagnosed asthma (Table 4.2). The prevalence of work-related wheezing (26%) and ocular-nasal symptoms (24%) was more common than urticaria/skin symptoms (15%). Importantly, work-related symptoms were more prevalent when working in orchards than in the store-rooms ($p<0.001$).

4.3 Allergic sensitization

The prevalence of atopy, as determined by a positive skin prick test to one or more common inhalants, was 25% among these vineyard farm workers (Table 4.3). Surprisingly, skin reactivity to spider mite *T. urticae* (monosensitivity: 7%) was more common (22%) than to house dust mite (16%). However, mite-specific IgE determinations demonstrated the highest prevalence of workers with elevated IgE levels against house dust mite (20%) followed by storage mite (13%) and spider mite (6%). Only 2% of the workers demonstrated sensitization to the grape mould (*Botrytis cinerea*).

Table 4.2 Prevalence of general and work-related allergic symptoms reported by table grape farm workers in the Western Cape in the past year (2002)

Symptom	**General symptoms prevalence (%) (n=207)**	**Work-related symptoms prevalence (%)**	
		Orchard	**Stores**
Urticaria/skin symptoms	41 (20%)	30 (15%)	4 (2%)*
Rhino-conjunctivitis	52 (25%)	47 (24%)	15 (7%)*
Wheezing	63 (30%)	54 (26%)	24 (12%)*
Doctor diagnosed asthma	19 (9%)		

***Chi-square statistic $p<0.001$**

Table 4.3 Patterns of allergic sensitization among table grape farm workers in the Western Cape, 2002

Allergen	Prevalence of sensitization (%)
SPT positive to common inhalant allergens (n=190)	
House dust mite (*D. Pteronyssinus*)	31 (16%)
Cockroach (*B. germanica*)	21 (11%)
Rye grass (*Lolium perenne*)	20 (11%)
Bermuda grass (*Cynodon dactylon*)	10 (5%)
Mouldmix (*Cladosporium herbarum, Alternaria alternata, Fusarium*)	6 (3%)
Treemix (*False acacia, Live oak, Olive, White birch, Ash*)	6 (3%)
Cat (*Felis domesticus*)	3 (2%)
Atopy (positive to >1 allergen)	48 (25%)
SPT positive to occupational allergens (n=190)	
Spider mite (*Tetranychus urticae*)	42 (22%)
Grape mould (*Botrytis cinerea*)	3 (2%)
Elevated mite-specific IgE (n = 201)	
House dust mite (*Dermatophagoides Pteronyssinus*)	40 (20%)
Storage mite (*Lepidoglyphus Destructor*)	27 (13%)
Spider mite (*Tetranychus urticae*)	13 (6%)

Note: SPT positive = AWHR ≥ 0.5

Table 4.4 Determination of the concordance of the skin prick testing results and RAST and ELISA results among table grape farm workers in the Western Cape, 2002

Outcomes	Kappa statistic	p-value
House dust mite SPT vs house dust mite RAST	0.61	<0.001
Spider mite SPT vs spider mite ELISA	0.15	0.005

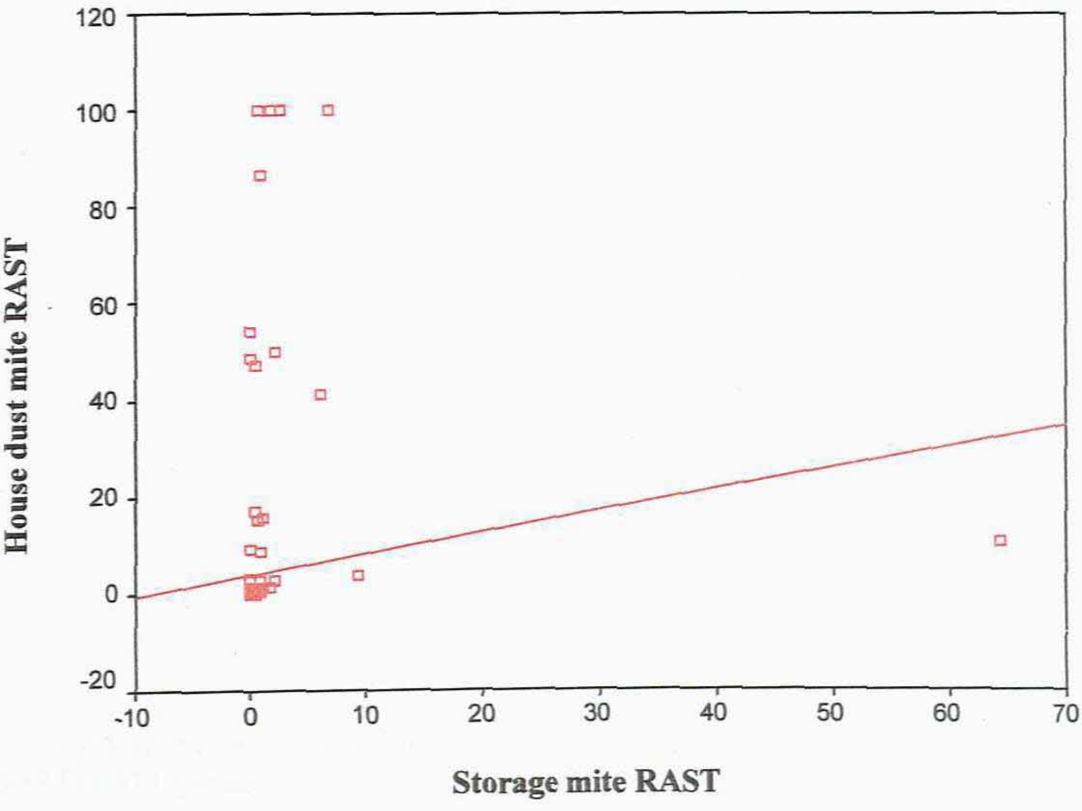

Figure 4.2 Correlation between sensitization to house dust mite (RAST) and storage mite (RAST) (Spearman Rho: 0.71)

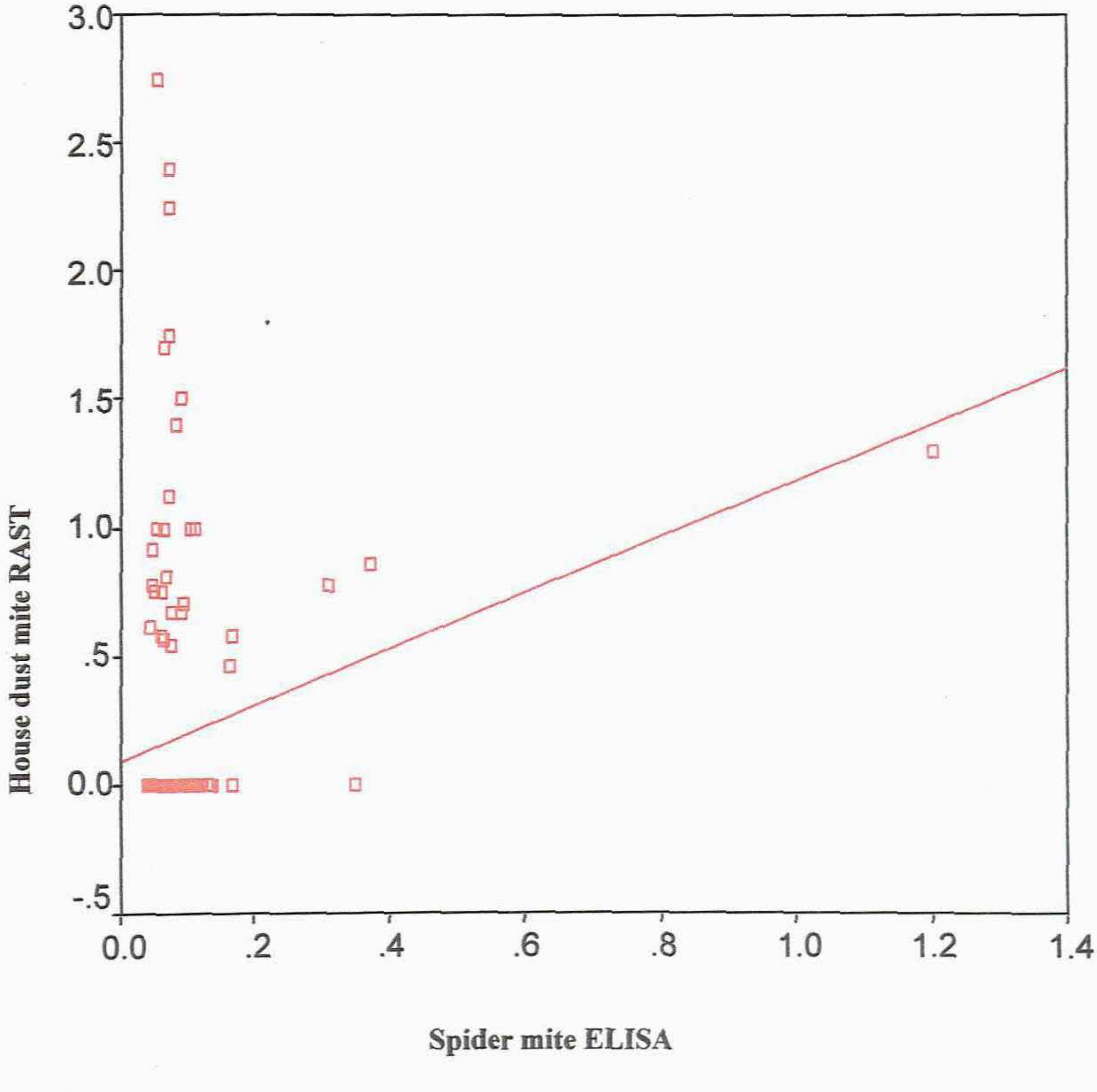

Figure 4.3 Correlation between sensitization to house dust mite (RAST) and spider mite (ELISA) (Spearman Rho: 0.28)

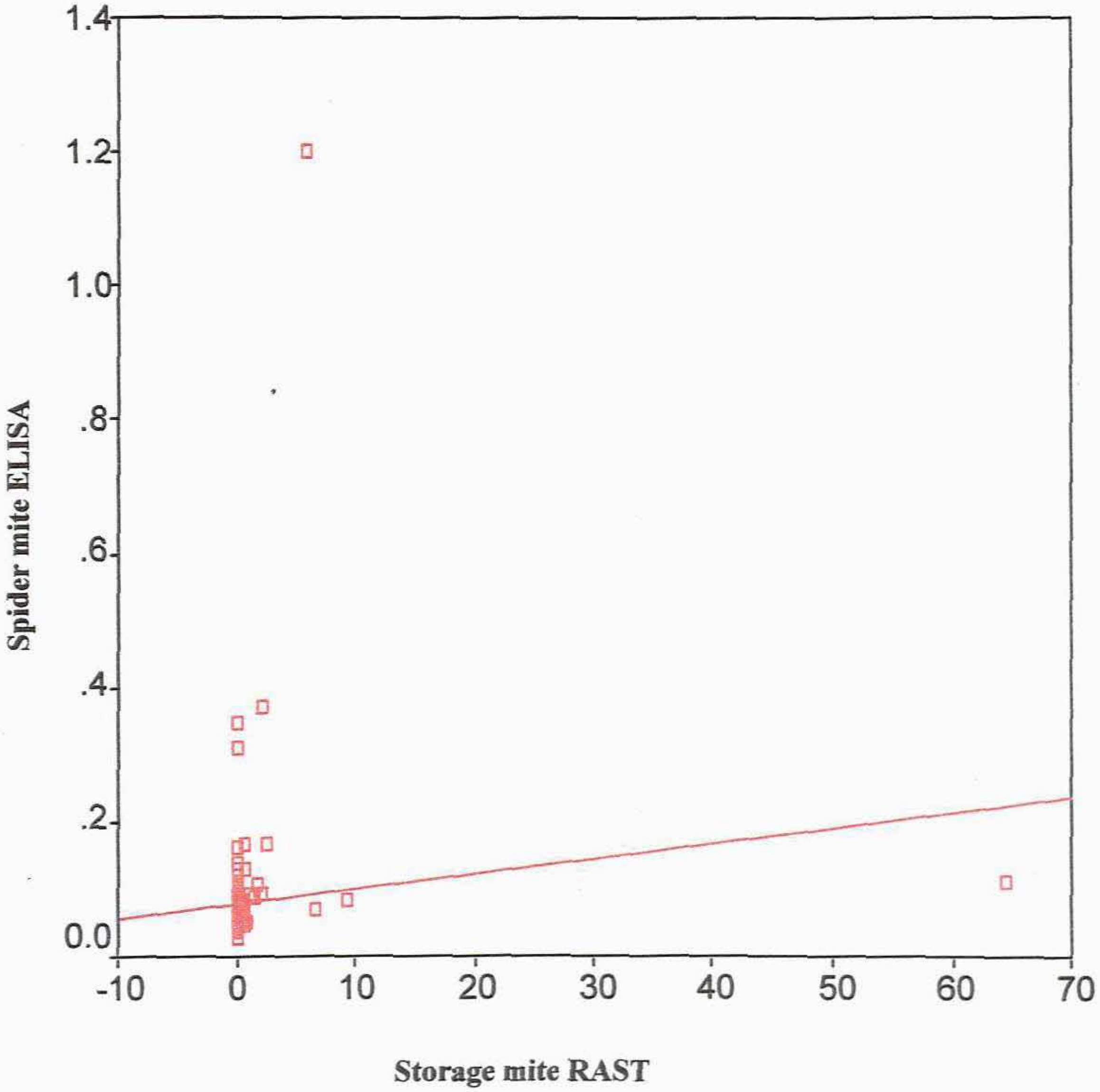

Figure 4.4 Correlation between sensitization to storage (RAST) and spider mite (ELISA) (Spearman Rho: 0.25)

Analysis of the house dust mite skin prick testing and house dust mite RAST results for degree of concordance revealed that there is substantial agreement between house dust mite SPT and RAST test (Kappa statistic 0.61; p-value <0.001) (Table 4.4). However, there was only a slight degree of agreement between spider mite SPT and spider mite ELISA (kappa statistic = 0.15; p-value=0.006).

House dust mite strongly correlated with storage mite. This can be explained by the cross-reactivity between house dust mite and storage mite since both come from the same suborder – Astigmata. Furthermore, while house dust mite RAST was strongly correlated with storage mite RAST (Spearman R = 0.71, p<0.001) it was only modestly correlated with spider mite ELISA (Spearman R = 0.28, p<0.001).

4.4 Mite allergic health outcomes

The overall prevalence of spider mite allergy (work-related allergic symptoms and sensitization to *T. urticae*) was 9.5%, with respiratory allergy (4-6%) more common than skin allergy (1-3%) (Figure 4.5). The prevalence of work-related allergic symptoms almost similar, but slightly higher for house dust mite (2 – 7%) than for storage mite (1 – 6%).

Analysis of the data focusing on symptoms among sensitized workers for house dust mite, storage mite and spider revealed that work-related wheezing seems to be an important factor in sensitized workers (38 - 62%). Workers sensitized to spider mite (RAST) had the highest prevalence of work-related wheezing symptoms (62%) compared to storage mite (44%) followed by house dust mite (38%) (Table 4.5).

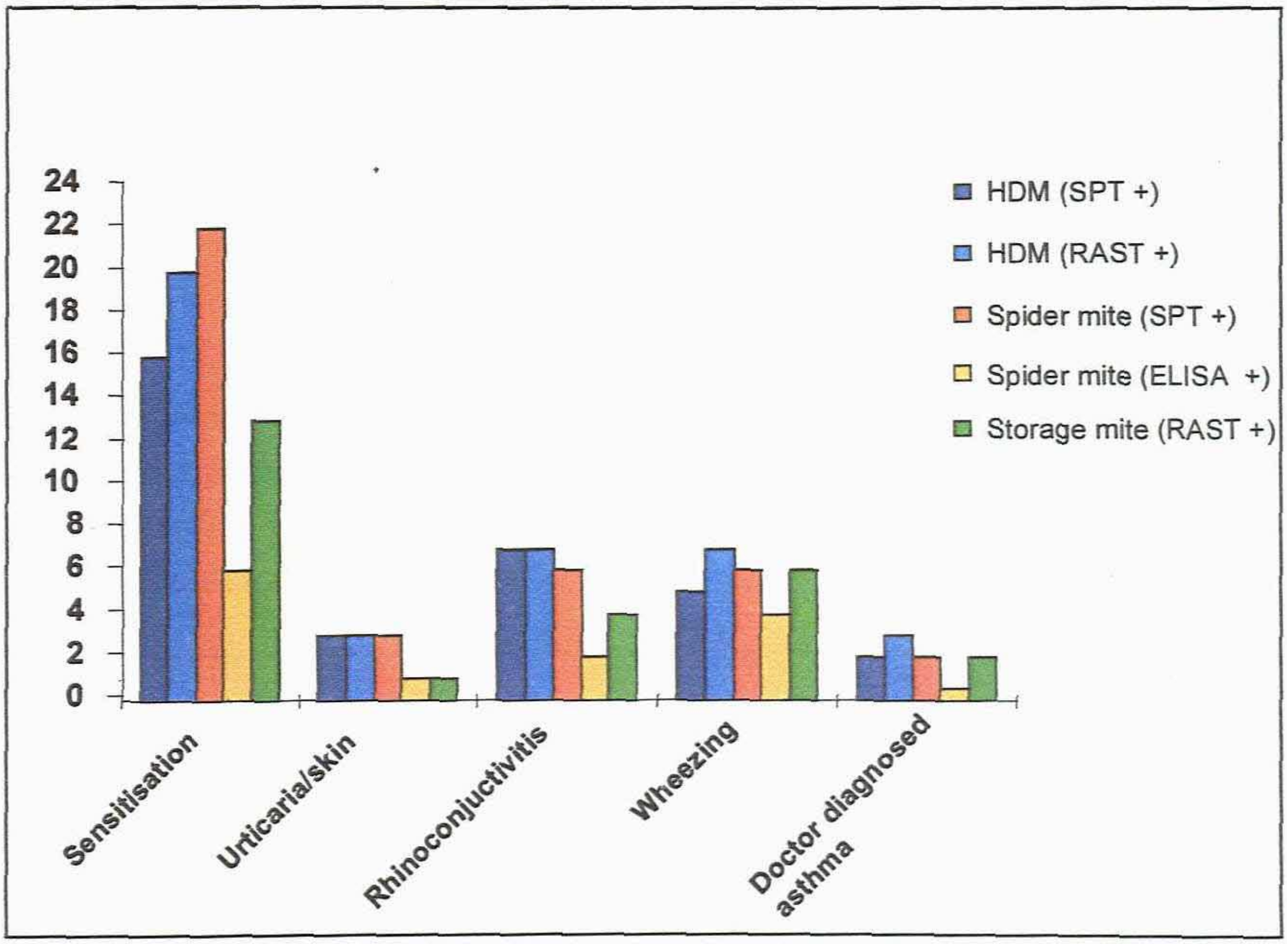

Figure 4.5 Prevalence (%) of mite allergy among table grape farm workers in the Western Cape (n = 207), 2002

Table 4.5 Prevalence of work-related symptoms among mite sensitised table grape farm workers in the Western Cape, 2002

Symptom	Proportion with work-related symptoms				
	House dust mite +		Spidermite +		Storage mite +
	SPT (n=31)	RAST (n=40)	SPT (n=42)	ELISA (n=13)	RAST (n=27)
Urticaria/skin symptoms	6 (19%)	6 (15%)	6 (14%)	2 (15%)	3 (11%)
Rhino-conjunctivitis	13 (42%)	14 (35%)	12 (28%)	4 (31%)	8 (30%)
Wheezing	10 (32%)	15 (38%)	11 (26%)	8 (62%)	12 (44%)
Doctor diagnosed asthma	3 (10%)	6 (15%)	4 (10%)	1 (8%)	5 (19%)

4.5 Environmental and host-associated risk factors associated with work-related symptoms.

4.5.1 Work-related skin symptoms

Having work-related skin symptoms was associated with an increased odds of being a pesticide crop sprayer (OR = 3.42; p = 0.05) and a borderline increased odds of being employed as a permanent worker (OR = 6.40; p = 0.075) (Table 4.6).

4.5.2 Work-related ocular-nasal symptoms

In the unadjusted models significant associations were found between work-related ocular-nasal and gender (OR = 0.52; CI : 0.27 – 0.99); pesticide crop spraying (OR = 4.24; CI : 1.75 – 10.28); and sensitization to house dust mite SPT (OR = 2.87; CI : 1.27 – 6.46) (Table 4.7). After adjusting for age and gender, pesticide crop spraying and sensitization to house dust remained significant predictors of ocular-nasal symptoms among farm workers.

4.5.3 Work-related wheeze

In the unadjusted logistic regression models, age, sensitization to spider mite (ELISA); storage mite (RAST) and house dust mite (RAST) were significantly associated with work-related wheeze symptoms (Table 4.8). After adjusting age and gender, sensitization to spider mite and storage mite remained significant risk factor for work-related wheeze symptoms. Surprisingly, sensitization to spider mite had a higher odds ratio (OR: 5.78; CI : 1.75 – 19.05) associated with work-related wheeze compared to sensitization to storage mite (OR: 2.39; CI : 1.02 – 5.59).

Table 4.6 Environmental and host risk factors associated with work-related skin symptoms among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
Unadjusted bivariate results			
Age	0.97	0.93 – 1.01	0.127
Gender (Male=1, Female=0)	1.29	0.59 – 2.82	0.518
Atopy	1.11	0.43 – 2.82	0.834
Employment status (permanent =1 seasonal=0)	5.68	0.74 – 43.39	0.094
Employment duration in farm	0.98	0.93 – 1.03	0.348
Employment duration in job	0.98	0.93 – 1.03	0.447
Employment duration in other grape farms	0.90	0.80 – 1.03	0.127
Pesticide crop sprayer (1=yes, 0=no)	2.17	0.78 – 6.05	0.137
Sensitization to house dust mite *(D. Pteronyssinus)*			
- Skin prick test (AHWR ≥0.5)	1.67	0.61 – 4.57	0.319
- RAST (≥0.35 ku/L)	1.01	0.38 – 2.66	0.988
Sensitization to spider mite *(T. urticae)*			
- Skin prick test (AHWR ≥0.5)	1.07	0.40 – 2.86	0.898
- ELISA (2 SD of mean)	1.04	0.22 – 4.94	0.962
Sensitization to storage mite *(L.Destructor)*			
- (RAST (≥0.35 ku/L)	0.68	0.19 – 2.42	0.552
Adjusted for age & gender			
Employment status (permanent =1 seasonal=0)	6.40	0.83 – 49.40	0.075
Employment duration in farm	0.99	0.93 – 1.06	0.908
Employment duration in job	1.00	0.94 – 1.07	0.970
Employment duration in other grape farms	0.95	0.82 – 1.10	0.502
Pesticide crop sprayer (1=yes, 0=no)	3.42	1.00 – 11.66	0.050
Sensitization to house dust mite *(D. Pteronyssinus)*			
- Skin prick test (AHWR ≥0.5)	1.64	0.59 – 4.56	0.342
- RAST (≥0.35 ku/L)	1.02	0.38 – 2.73	0.976
Sensitization to spider mite *(T. urticae)*			
- Skin prick test (AHWR ≥0.5)	1.02	0.38 – 2.77	0.965
- ELISA (2 SD of mean)	0.94	0.19 – 4.51	0.934
Sensitization to storage mite *(L. Destructor)*			
- (RAST (≥0.35 ku/L)	0.71	0.20 – 2.54	0.595

Table 4.7 Environmental and host risk factors associated with work-related ocular-nasal symptoms among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
<u>Unadjusted bivariate results</u>			
Age	1.02	0.99 – 1.06	0.115
Gender (Male=1, Female=0)	0.52	0.27 – 0.99	0.048
Atopy	1.70	0.82 – 3.53	0.156
Employment status (permanent =1 seasonal=0)	1.28	0.49 – 3.35	0.610
Employment duration in farm	1.04	0.99 – 1.08	0.060
Employment duration in job	1.04	0.99 – 1.08	0.063
Employment duration in other grape farms	0.99	0.90 – 1.07	0.702
Pesticide crop sprayer (1=yes, 0=no)	4.24	1.75 – 10.28	0.001
Sensitization to house dust mite *(D. Pteronyssinus)*			
- Skin prick test (AHWR≥0.5)	2.87	1.27 – 6.46	0.011
- RAST (≥0.35 ku/L)	2.09	0.98 – 4.44	0.056
Sensitization to spider mite *(T. urticae)*			
- Skin prick test (AHWR≥0.5)	1.39	0.64 – 3.02	0.400
- ELISA (2 SD of mean)	1.50	0.44 – 5.11	0.518
Sensitization to storage mite *(L. Destructor)*			
- (RAST(≥0.35 ku/L)	1.46	0.59 – 3.58	0.412
<u>Adjusted for age & gender</u>			
Employment status (permanent =1 seasonal=0)	1.16	0.44 – 3.09	0.762
Employment duration in farm	1.03	0.99 – 1.08	0.151
Employment duration in job	1.04	0.99 – 1.09	0.138
Employment duration in other grape farms	0.97	0.88 – 1.07	0.544
Pesticide crop sprayer (1=yes, 0=no)	3.49	1.31 – 9.31	0.012
Sensitization to house dust mite *(D. Pteronyssinus)*			
- Skin prick test (AHWR ≥0.5)	3.17	1.37 – 7.33	0.007
- RAST (≥0.35 ku/L)	2.42	1.10 – 5.32	0.029
Sensitization to spider mite *(T. urticae)*			
- Skin prick test (AHWR ≥0.5)	1.54	070 – 3.39	0.288
- ELISA (2 SD of mean)	1.71	0.49 – 5.99	0.400
Sensitization to storage mite *(L. Destructor)*			
- (RAST (≥0.35 ku/L)	1.39	0.55 – 3.48	0.485

Table 4.8 Environmental and host risk factors associated with work-related wheeze among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
Unadjusted bivariate results			
Age	1.03	1.00 – 1.06	0.031
Gender (Male=1, Female=0)	1.14	0.62 – 2.13	0.670
Atopy	1.50	0.73 – 3.10	0.271
Employment status (permanent =1 seasonal=0)	2.56	0.85 – 7.71	0.095
Employment duration in farm	1.02	0.99 – 1.06	0.189
Employment duration in job	1.03	0.96 – 1.07	0.089
Employment duration in other grape farms	0.98	0.91 – 1.06	0.576
Pesticide crop sprayer (1=yes, 0=no)	1.71	0.70 – 4.17	0.241
Sensitization to house dust mite (*D. Pteronyssinus*)			
- Skin prick test (AHWR≥0.5)	1.51	0.66 – 3.50	0.329
- RAST (≥0.35 ku/L)	1.88	0.90 – 3.91	0.093
Sensitization to spider mite (*T. urticae*)			
- Skin prick test (AHWR≥0.5)	1.06	0.49 – 2.33	0.875
- ELISA (2 SD of mean)	4.94	1.54 – 15.85	0.007
Sensitization to storage mite (*L. Destructor)*			
- (RAST(≥0.35 ku/L)	2.51	1.09 – 5.79	0.030
Adjusted for age & gender			
Employment status (permanent =1 seasonal=0)	2.66	0.87 – 8.15	0.087
Employment duration in farm	1.00	0.96 – 1.05	0.921
Employment duration in job	1.01	0.97 – 1.06	0.516
Employment duration in other grape farms	0.942	0.86 – 1.03	0.193
Pesticide crop sprayer (1=yes, 0=no)	2.06	0.75 – 5.70	0.162
Sensitization to house dust mite (*D. Pteronyssinus*)			
- Skin prick test (AWHR ≥0.5)	1.46	0.625 – 3.40	0.383
- RAST (≥0.35 ku/L)	1.82	0.86 – 3.86	0.121
Sensitization to spider mite (*T. urticae)*			
- Skin prick test (AWHR≥0.5)	1.02	0.46 – 2.26	0.963
- ELISA (2 SD of mean)	5.78	1.75 – 19.05	0.004
Sensitization to storage mite (*L.Destructor)*			
- (RAST (≥0.35 ku/L)	2.39	1.02 – 5.59	0.044

4.6 Environmental and host factors associated with spider mite allergy

Analyses of work-related ocular-nasal symptoms (positive response to question on work-related symptoms + sensitization to spider mite on SPT) found atopy to be *significantly associated with allergic symptoms (Table 4.9.1). Pesticide crop spraying* was associated with allergic symptoms but this association was only of borderline significance. However, using an alternative definition to that used RAST positivity instead of skin prick test did not demonstrate any significant associations (Table 4.9.2).

Work-related wheeze due to spider mite was defined as a positive response to a question on wheezing when working in either the stores or orchards, as well as a positive skin prick test to spider mite (Allergen/histamine wheal ratio ≥ 0.5). In the unadjusted models atopy was significantly associated with work-related wheeze due to spider mite (OR = 9.27) (Table 4.9.3). Multivariate analyses adjusting for age and atopy demonstrated that work-related wheeze due to spider mite had a borderline association with pesticide crop spraying. A similar finding was demonstrated using an alternative definition for spider mite related wheeze (ELISA ≥ 2 SD of the mean) in the unadjusted models (Table 4.9.4).

Table 4.9.1 Environmental and host risk factors associated with work-related ocular-nasal symptoms due to spider mite (SPT) among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
Unadjusted bivariate results			
Age	1.00	0.95 – 1.06	0.951
Gender (Male=1, Female=0)	1.50	0.46 – 4.90	0.504
Atopy	4.68	1.41 – 15.52	0.012
Employment status (permanent =1 seasonal=0)	1.97	0.24 – 15.87	0.525
Employment duration in farm	1.01	0.95 – 1.08	0.701
Employment duration in job	1.00	0.93 – 1.06	0.993
Employment duration in other grape farms	1.00	0.86 – 1.17	0.972
Pesticide crop sprayer (1=yes, 0=no)	3.24	0.77 – 13.53	0.108
Adjusted for age & atopy			
Employment status (permanent =1 seasonal=0)	1.83	0.22 – 15.43	0.576
Employment duration in farm	1.01	0.93 – 1.11	0.791
Employment duration in job	0.99	0.91 – 1.08	0.822
Employment duration in other grape farms	1.00	0.83 – 1.22	0.963
Pesticide crop sprayer (1=yes, 0=no)	4.32	0.93 – 20.04	0.062

Table 4.9.2 Environmental and host risk factors associated with work-related ocular-nasal symptoms due to spider mite (ELISA) among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
Unadjusted bivariate results			
Age	1.00	0.92 – 1.10	0.939
Gender (Male=1, Female=0)	0.30	0.03 – 2.92	0.298
Atopy	3.18	0.44 – 23.30	0.254
Employment status (permanent =1 seasonal=0)	-	-	-
Employment duration in farm	0.97	0.84 – 1.12	0.687
Employment duration in job	0.98	0.85 – 1.13	0.794
Employment duration in other grape farms	1.03	0.82 – 1.29	0.807
Pesticide crop sprayer (1=yes, 0=no)	-	-	-
Adjusted for age & atopy			
Employment status (permanent =1 seasonal=0)	-	-	-
Employment duration in farm	0.95	0.81 – 1.12	0.555
Employment duration in job	0.97	0.82 – 1.14	0.683
Employment duration in other grape farms	1.02	0.76 – 1.38	0.882
Pesticide crop sprayer (1=yes, 0=no)	-	-	-

Table 4.9.3 Environmental and host risk factors associated with work-related wheeze due to spider mite (SPT) among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
<u>**Unadjusted bivariate results**</u>			
Age	0.99	0.94 – 1.06	0.996
Gender (Male=1, Female=0)	2.95	0.76 – 11.48	0.119
Atopy	9.27	2.35 – 36.57	0.001
Employment status (permanent =1 seasonal=0)	1.78	0.22 – 14.45	0.591
Employment duration in farm	0.96	0.88 – 1.05	0.396
Employment duration in job	0.97	0.89 – 1.06	0.538
Employment duration in other grape farms	0.97	0.82 – 1.14	0.683
Pesticide crop sprayer (1=yes, 0=no)	2.81	0.69 – 11.48	0.150
<u>**Adjusted for age & atopy**</u>			
Employment status (permanent =1 seasonal=0)	1.62	0.18 – 14.38	0.666
Employment duration in farm	0.93	0.84 – 1.03	0.181
Employment duration in job	0.95	0.85 – 1.05	0.298
Employment duration in other grape farms	0.93	0.75 – 1.14	0.471
Pesticide crop sprayer (1=yes, 0=no)	4.47	0.91 – 22.00	0.066

Table 4.9.4 Environmental and host risk factors associated with work-related wheeze due to spider mite (ELISA) among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
<u>**Unadjusted bivariate results**</u>			
Age	0.98	0.92 – 1.06	0.664
Gender (Male=1, Female=0)	1.55	0.36 – 6.67	0.556
Atopy	8.56	1.60 – 45.8	0.012
Employment status (permanent =1 seasonal=0)	-	-	-
Employment duration in farm	0.98	0.88 – 1.08	0.628
Employment duration in job	0.99	0.89 – 1.09	0.781
Employment duration in other grape farms	0.98	0.79 – 1.20	0.824
Pesticide crop sprayer (1=yes, 0=no)	1.06	0.12 – 9.02	0.959
<u>**Adjusted for age & atopy**</u>			
Employment status (permanent =1 seasonal=0)	-	-	-
Employment duration in farm	1.00	0.88 – 1.15	0.962
Employment duration in job	1.02	0.90 – 1.16	0.779
Employment duration in other grape farms	0.97	0.72 – 1.31	0.839
Pesticide crop sprayer (1=yes, 0=no)	1.78	0.18 – 17.22	0.620

4.7 Environmental and host factors associated with storage mite allergy

The analyses of ocular-nasal symptoms due to storage mite, demonstrated that age may be an important risk factor for the development of allergic ocular-nasal symptoms. However, this association was borderline in the unadjusted models (Table 4.10.1).

In this study, age (OR: 1.05) and atopy (OR: 29.84) were significant predictors of allergy to storage mites in the unadjusted models. In the adjusted models none of the exposure variables were significantly associated with ocular-nasal symptoms due to storage mite (Table 4.10.2).

Table 4.10.1 Environmental and host risk factors associated with work-related ocular-nasal symptoms due to storage mite (RAST) among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
<u>**Unadjusted bivariate results**</u>			
Age	1.05	0.99 – 1.12	0.083
Gender (Male=1, Female=0)	0.54	0.12 – 2.30	0.401
Atopy	-	-	-
Employment status (permanent =1 seasonal=0)	1.24	0.15 – 10.44	0.845
Employment duration in farm	1.02	0.94 – 1.11	0.699
Employment duration in job	1.03	0.95 – 1.12	0.535
Employment duration in other grape farms	1.02	0.87 – 1.19	0.825
Pesticide crop sprayer (1=yes, 0=no)	-	-	-
<u>**Adjusted for age & atopy**</u>			
Employment status (permanent =1 seasonal=0)	0.53	0.04 – 6.59	0.623
Employment duration in farm	0.95	0.82 – 1.09	0.477
Employment duration in job	0.98	0.85 – 1.12	0.758
Employment duration in other grape farms	0.99	0.78 – 1.26	0.950
Pesticide crop sprayer (1=yes, 0=no)	-	-	-

Table 4.10.2. Environmental and host risk factors associated with work-related wheeze symptoms due to storage mite (RAST) among table grape farm workers in the Western Cape, 2002

Risk factor	Prevalence Odds Ratio	Confidence Interval	p-value
Unadjusted bivariate results			
Age	1.05	1.04 – 1.11	0.034
Gender (Male=1, Female=0)	0.91	0.28 – 2.92	0.873
Atopy	29.84	3.62 – 246.18	0.002
Employment status (permanent =1 seasonal=0)	1.99	0.25 – 16.04	0517
Employment duration in farm	1.03	0.967– 1.10	0.363
Employment duration in job	1.04	0.98 – 1.11	0.228
Employment duration in other grape farms	0.97	0.84 – 1.12	0.708
Pesticide crop sprayer (1=yes, 0=no)	0.66	0.08 – 5.34	0.694
Adjusted for age & atopy			
Employment status (permanent =1 seasonal=0)	0.83	0.08 – 8.21	0.872
Employment duration in farm	1.01	0.91 – 1.13	0.800
Employment duration in job	1.04	0.93 – 1.15	0.486
Employment duration in other grape farms	0.86	0.69 – 1.08	0.194
Pesticide crop sprayer (1=yes, 0=no)	2.05	0.19 – 22.11	0.555

4.8 Summary of significant risk factors for work-related symptoms

The most important risk factors associated with work-related symptoms and allergic health outcomes are presented in Table 4.11 & 4.12.

This study found that having work-related skin symptoms was significantly associated with pesticide crop spraying (OR = 3.5). Sensitization to house dust mite (OR=3.2) and being a pesticide crop sprayer (OR=3.5) were significantly associated with work-related ocular-nasal symptoms. On the other hand, workers with work-related wheeze were more likely to have elevated specific IgE levels to spider mite (OR=5.8) and to a lesser extent to storage mite (OR=2.4).

Atopic status was significantly associated with both spider mite (OR = 9.27) and storage mite (OR = 29.84) respiratory allergy. Borderline associations were found between pesticide crop sprayers and spider mite allergic rhinoconjunctivits (OR = 4.32) and probable asthma (OR = 4.47). House dust mite allergic rhinoconjuctivititis and respiratory allergy was significantly associated with atopic status (OR = 19.57).

Table 4.11 Summary of significant risk factors for work-related symptoms among table grape farm workers in the Western Cape, 2002

Outcome	Prevalence *Odds Ratio*	Confidence *Interval*	p-value
Skin/urticaria			
Pesticide crop sprayer*	3.42	1.00 – 11.66	0.050
Ocular-nasal symptoms			
Male	1.93	1.01 – 3.72	0.048
Pesticide crop sprayer*	3.49	1.31 – 9.31	0.012
House dust mite (SPT)*	3.17	1.37 – 7.33	0.007
House dust mite (RAST)*	2.42	1.10 – 5.32	0.029
Wheeze symptoms			
Age	1.03	1.00 – 1.06	0.031
Permanent employment*	2.66	0.87 – 8.15	0.087
Spider mite (ELISA)*	5.78	1.75 – 19.05	0.004
Storage mite (RAST)*	2.39	1.02 – 5.59	0.044

*Adjusted for age and gender

Table 4.12 Summary of significant risk factors for work-related mite allergy among table grape farm workers in the Western Cape, 2002

Outcome	Prevalence Odds Ratio	Confidence Interval	p-value
Spider mite allergy (SPT)			
- **Ocular-nasal**			
Atopy	4.68	1.41 – 15.52	0.012
Pesticide crop sprayer*	4.32	0.93 – 20.04	0.062
- **Wheeze**			
Atopy	9.27	2.35 – 36.57	0.001
Pesticide crop sprayer*	4.47	0.91 – 22.00	0.066
Spider mite allergy (ELISA)			
- **Wheeze**			
Atopy	8.56	1.60 – 45.81	0.012
Storage mite allergy (RAST)			
- **Ocular-nasal**			
Age	1.05	0.99 – 1.12	0.083
- **Wheeze**			
Age	1.05	1.04 – 1.11	0.034
Atopy	29.84	3.62 – 246.18	0.002
House dust mite allergy (RAST)			
- **Ocular-nasal**			
Atopy	19.57	4.101 – 93.40	<0.001
- **Wheeze**			
Atopy	19.57	4.101 – 93.40	<0.001

*Adjusted for age and atopy

CHAPTER 5

5.1 DISCUSSION

Table grape farm workers in the Western Cape reported a higher prevalence (26%) of work-related wheezing in the past year compared to the 19% prevalence recently reported by pesticide applicators in the USA.[7] Work-related symptoms were more prevalent when working in orchards than in the store-rooms ($p<0.001$) (Table 5). The significant difference in the prevalence of symptoms between the stores and orchards can be explained by the possible link with outdoor exposures such as the spider mites compared to indoor exposures of house dust mite and storage mite.

Physician-diagnosed asthma was reported by 9% of workers, which is similar to current estimated prevalence of 5-10% for adult asthma. Definitions of asthma often include clinical and/or physiological features such as reversible airways narrowing, hyperresponsiveness and inflammation. Since these tests require major logistical arrangements especially when studying farming activities where workers are widely dispersed, questionnaires used in epidemiological settings can produce equally valid results.[120] Questionnaires usually ask for "physician diagnosed asthma" - the definition which was adopted in our study. The validity of self-reported asthma in questionnaires has been estimated by Toren *et al.*[115] The sensitivity varies between 48% and 100%, but the specificity is high, especially for the question on "physician diagnosed asthma" (specificity $\geq$ 99%).

The overall prevalence of spider mite allergy (work-related allergic symptoms and sensitization to *T. urticae*) was 9.5%, with respiratory allergy (4-6%) more common than skin allergy (1-3%) (Figure 8). The prevalence of work-related allergic symptoms almost similar, but slightly higher for house dust mite (2 – 7%) than for storage mite (1 – 6%). Storage mites have been established as a cause of symptoms in the upper and lower airways. The significance of these species as an important occupational hazard is becoming more and more apparent. These mites have been reported to provoke asthma and rhinoconjunctivitis. An epidemiological study found that 6,2% suffer allergy to storage mites.[66] The prevalence of allergy due to storage mite was similar in our study.

The prevalence of atopy was relatively lower (25%) among these vineyard farm workers compared to other working populations in the Western Cape (36% among seafood processing workers and 45% among grain mill workers).[121,122] This lower prevalence of atopy may be indicative of the "hygiene hypothesis" (Figure 4.6). The so-called 'hygiene hypothesis' postulates that limited exposure to bacterial and viral pathogens during early childhood results in an insufficient stimulation of T helper type 1 cells, which in turn cannot counterbalance the expansion of T helper type 2 cells and results in a predisposition to allergy.[123]

Since the late 1990s, a series of epidemiological studies consistently showed a reduced risk of hay fever and the expression of atopy in children from farming families compared with their peers from non-farming families, a protective effect on asthma was not observed in all of these studies.[124,125,126,127] Two studies investigated whether the protective effect of a farm childhood would persist into adulthood. Common atopy, respiratory symptoms and bronchial hyper-responsiveness were measured in a cohort of

Danish farming students and compared with conscripts from the same rural area as controls.[128]

Both being a farmer and having lived on a farm in childhood contributed independently to a lower risk of sensitization to common allergens. A farm childhood was also inversely associated with total IgE, respiratory symptoms and bronchial hyper-responsiveness. Similarly, a farm childhood in Finnish first-year university students was found to protect against adult asthma and sensitization, especially to pollen and cat allergen.[129]

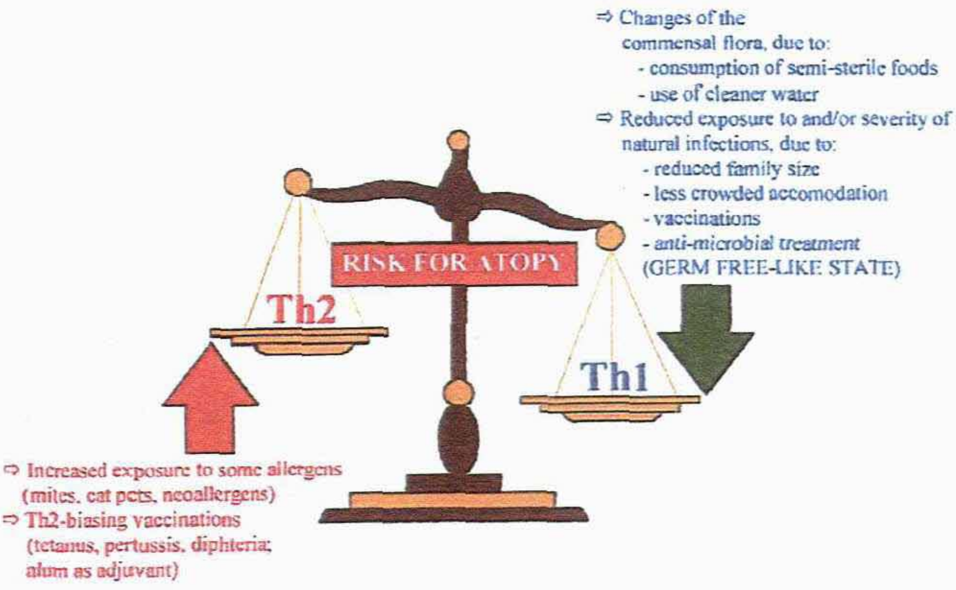

Figure 5.1 Factors that have contributed to change infectious environment during childhood, thus favouring the alteration of balance between T_H1 and T_H2 responses to innocuous antigens (allergens) in favour of T_H2 responses
Source: Romagnani S. J Allergy Clin Immunol 2000; 105: 399 - 408

In this study among table grape farmers, a high prevalence of sensitization to *Tetranychus urticae* (22%) was found, with 7% of workers demonstrating isolated positive skin responses to spider mite (Table 6). This is much higher than studies among citrus farmers (16.5%) but comparable to apple farmers (5%) in Korea.[94,101] Considering the existence of other sources of allergens on farms, sensitization to *T. urticae* among table grape farm workers was found to be higher than to allergens such as the common house dust mite (HDM). This could be due to the nature of work involved, in that outdoor farming promotes the development of increasing spider mite populations due to optimal temperature and humidity conditions. This mite has become one of the most important fruit-cultivating pests since pesticides were introduced ~40 years ago to eliminate other fruit pests. Furthermore, in recent years *T. urticae* has proliferated extraordinarily in the South African farm environment probably due to its resistance to common pesticides and the disappearance of natural predators.[91,95,112] Only 2% of the workers demonstrated sensitization to the grape mould (*Botrytis cinerea).* The prevalence of sensitization to grape mould in this study was much lower compared to previous studies, with 13.8% of the workers showing positive skin response to this mould.[73] Popp et al first described an agricultural disease associated with vineyards is winegrower's lung - an alveolitis of exogenous allergic origin triggered by *Botrytis cinerea* spores.[72]

Analysis of the house dust mite skin prick testing and house dust mite RAST results for degree of concordance revealed that there was substantial agreement between house dust mite SPT and RAST test (Kappa statistic 0.61; p-value <0.001). This confirms that sensitivity to house dust mite is detected to a large extent with both assays. However, there was much lower levels of agreement between spider mite SPT and spider mite

ELISA (kappa statistic = 0.15; p-value=0.006). Thus, sensitivity to spider mite is not easy detected with one or the other assay. The reason for this could be that the spider mite allergens in the SPT-solution and in the ELISA behave differently. Although the extract is derived from the same laboratory and the same spider mite cultures, the antigens might show different stabilities when in solution or bound on the ELISA plates. Another possibility is that these novel allergens change some of their confirmation when bound on the ELISA plate and select for a different IgE binding as compared to the same ,allergens in the (unbound) solution. Basically resulting in different workers having positive results in one or the other test. The findings of this study point to the need to better define the predictive value of *T. urticae* specific IgE on symptom occurrence as suggested by Gargano et al.[130]

It is generally agreed that the level of cross-allergenicity is greater if the taxonomic relationship between mites is closer.[131,132] Correlation analysis demonstrated that house dust mite strongly correlated with storage mite. This can be explained by the cross-reactivity between house dust mite and storage mite since both come from the same suborder – Astigmata. Furthermore, while house dust mite RAST was strongly correlated with storage mite RAST (Spearman R = 0.71, p<0.001) it was only modestly correlated with spider mite ELISA (Spearman R = 0.28, p<0.001). Regarding allergenic relationships of spider mite with house dust mite, there has only been one study suggesting the presence of significant cross-reactivity with D. pteronyssinus. However, they used only one kind of farmers' sera sensitized to both spider mite and house dust mite. The results of this study is similar to the findings of Park et al suggesting no evidence of cross-reactivity of spider mite with house dust mite.[133] These findings indicate that spider mite-derived extracts contain species-specific allergens, in addition to those allergens that are shared with domestic mites.

Work-related skin symptoms was associated with an increased odds of being a pesticide crop sprayer (OR = 3.24; p=0.05) and a borderline increased odds of being employed as a permanent worker (OR = 6.40; p=0.075) (Table 8). In this study sensitization was however not significantly associated with skin symptoms. Astarita et al demonstrated that *T. urticae* was direçtly responsible for recurrent dermatitis, caused by different immune-mediated mechanism in farm workers. However, this finding was not demonstrated in this study. It is likely that the skin symptoms were on an irritant basis. Sensitization to house dust mite (OR=3.2) and being a pesticide crop sprayer (OR=3.5) were significantly associated with work-related ocular-nasal symptoms. While, workers with work-related wheeze were more likely to have elevated specific IgE levels to spider mite (OR=5.8) and to a lesser extent to storage mite (OR=2.4) (Table 13). This finding suggests that spider mite sensitization may be more important than sensitization to storage mite and house dust mite in causing lower respiratory symptoms among table grape farm workers. The contribution of vine pollen sensitization to allergic symptoms is another factor to consider in explaining the allergic symptoms reported.[71] This, however was not assessed since no commercial extracts were available for use at the time of the study.

In this study, at least 59% (26/44) of the workers with a positive SPT to *T. urticae* were asymptomatic. The clinical significance of asymptomatic positivity on skin prick test is unknown, but this may identify a group at risk of becoming symptomatic in the future. Furthermore, since the study was conducted in winter, when the environmental exposure to spider mite is known to be low, this may have also contributed to this finding. As with most cross-sectional studies this may also be indicative of a healthy worker effect in operation, in that symptomatic workers may have left the job and sought alternative employment. The delineation of health effects due to some exposures may be made more complicated by workers' departure from the industry through either self-selection or forced retirement. There is evidence that such departures, a major component of what has been termed the "healthy worker effect," do occur and are related to some agricultural exposures. Thelin and Hoglund found in a retrospective cohort study of Swedish farmers and farm workers that farmers (i.e. farm owner-operators) changed their jobs less often than men in other occupations, but farm workers (i.e., employees) changed jobs more often than control subjects. [134] Allergic disease was one of the common explanations given in this study for farm workers' changing their jobs.

Atopic status was significantly associated with both spider mite (OR = 9.27) and storage mite (OR = 29.84) respiratory allergy. Borderline associations were found between pesticide crop sprayers and spider mite allergic rhinoconjunctivitis (OR = 4.32) and probable asthma (OR = 4.47). House dust mite allergic rhinoconjunctivitis and respiratory allergy was significantly associated with atopic status (OR = 19.57). In this study, atopy was therefore significantly associated with being allergic to *T. urticae*. This confirms previous studies demonstrating atopy as a predisposing factor to *T. urticae* hypersensitivity.[94]

This study showed that sensitization to spider mite was positively correlated with work-related asthmatic symptoms. These findings are consistent with the results from previous studies that skin responses and serum specific IgE responses to citrus mites were associated with work-related symptoms. These results suggest that specific IgE responses to outdoor mites, particularly spider mites, may be important in the development of occupational asthma in table grape farm workers. The association demonstrated between spider mite sensitization and symptoms suggests a possible association with pesticide use on table grape farms. There have been reports of the failure of pesticides to control the spider mite populations and thus the consequent increase of the mite populations on table grape farms (Figure 5.2). Previous studies have demonstrated an association between pesticide use and decreased lung function.[19] However, this association between symptoms and pesticide use was not clearly demonstrated in this study suggesting that spider mite sensitization seems to be the more important risk factor for work-related asthma symptoms among table grape farm workers.

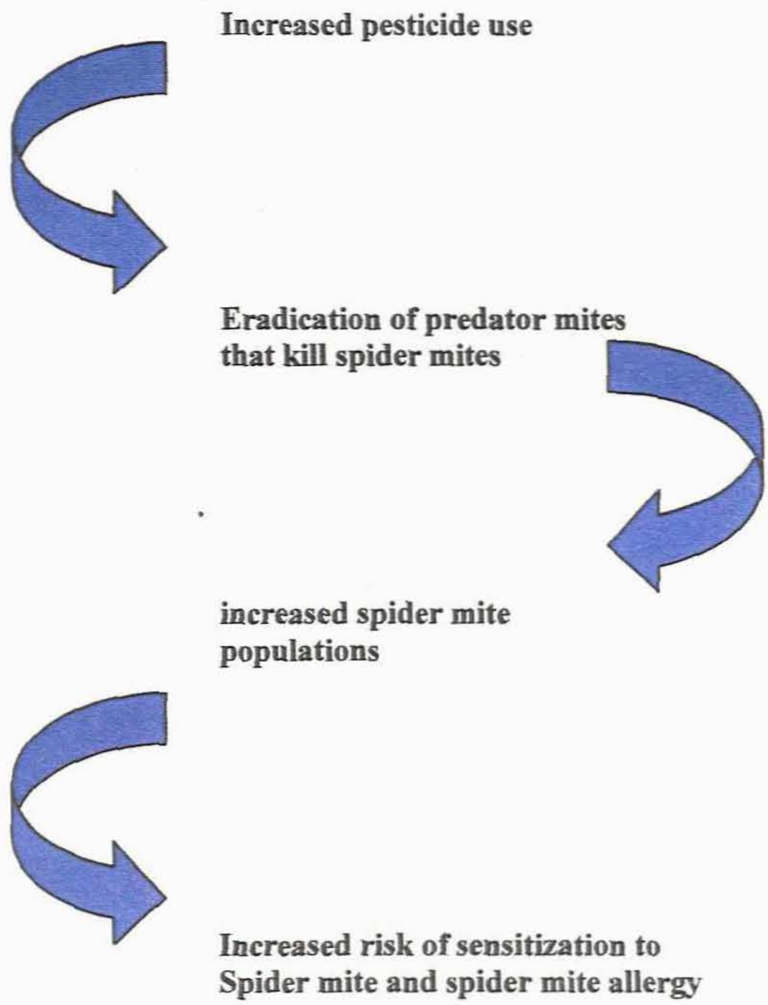

Figure 5.2 Possible link between pesticide use and spider mite allergy

5.2 Limitations of the study

The limitations of the study include the cross-sectional design of the study. In occupational epidemiological studies there is by definition, a very important selection bias called the "healthy worker effect" as discussed. This type of bias may lead to an underestimation of the prevalence of allergy among the workers studied.

Another limitation include the refinement of exposure and exposure classification. In light of this dose-response relationships need further refinement which includes:

- characterizing individual job exposures to spider mite antigens
- characterizing job exposures to pesticide usage

The following issues also needs to be addressed:

- attenuation by concomitant exposures or independent effect of pesticide exposure
- association of smoking status and symptoms

The *potential confounding* effect of smoking status was not assessed in this study. This was another limitation of this study. The effect this might have on the associations demonstrated in this study is unclear. However, studies have demonstrated that in general, farmers do smoke less than persons in most other occupations.[74] Thus, it is thought that the effect of smoking on the associations found might be modest, and the possibility of an even stronger effect should not be ignored. This should however be taken into account in future studies.

CHAPTER 6

6.1 CONCLUSION

Spider mites are outdoor phytophagous mites that incur a severe economic effect on agriculture and have been found to be distributed worldwide. Epidemiological studies have demonstrated that, spider mites are important allergens in the development of work-related asthma and rhinitis in fruit-cultivating farmers, after several case reports of occupational allergy to spider mites. The present study revealed that *Tetranychus urticae* was the most common sensitising allergen and may be an important outdoor allergen among table grape farm workers in the Western Cape of South Africa. This conclusion is based on the following:

- A high skin reactivity to spider mite was demonstrated on skin prick tests compared to house dust mite and other allergens
- Workers with work-related wheeze symptoms had an almost 6-fold increased odds of being sensitized to spider mite. (OR = 5.78)
- Overall a 9.5% prevalence of *T. urticae* allergy was found with respiratory allergy being most common manifestation (4 – 6%)

The association demonstrated between spider mite senisitization and symptoms suggests a possible association with pesticide use on table grape farms. This conclusion is based on the following:

- Work-related symptoms were more prevalent when working in orchards than in store rooms ($p < 0.001$)
- Workers with ocular-nasal symptoms were more likely to be pesticide crop sprayers (OR = 3.5)
- A borderline association was found between pesticide crop spraying and spider mite allergic rhinoconjunctivits (OR = 4.3) and probable asthma symptoms (OR = 4.5).

These findings suggest that many cases of asthma thought to be intrinsic in nature might in fact be occupational in origin because of allergens derived from outdoor phytophagous mites.

6.2 RECOMMENDATIONS

Farming is associated with a variety of respiratory hazards. This study has illustrated that spider mites are important outdoor allergens on table grape farms. Spider mite extracts should therefore be included in the skin prick test panel for evaluating patients living close to fruit farms or farm workers on fruit farms presenting with allergic symptoms. This will enable occupational health services to detect unrecognised cases of occupational allergy using more sensitive immunological markers for early diagnosis and treatment.

Careful investigation of work-related symptoms among table grape farm workers is necessary to establish a correct diagnosis, since respiratory conditions exhibit similar non-specific symptoms. Improving knowledge among farm workers and raising diagnostic awareness in hospital physicians and general practitioners in rural areas are key components in addressing the problem of respiratory disease in table grape farm workers. In this manner the pattern of occupational mite allergy on fruit farms in the Western Cape will be better characterised thereby spurring the development of preventative measures to protect the health of workers.

Areas for further exploration:

- General background population prevalence of sensitization to spider mite
- routes of sensitization and symptom manifestation
- environmental aeroallergen concentrations of mites, and vine pollen

- cross-reactivity between various mites - the contribution of storage and possibly house dust mite towards work-related asthma symptoms needs to be investigated further for probable cross-reactivity to spider mite.
- The relationship between sensitization to spider mite and excessive pesticide use as a mechanism for work-related asthma symptoms independent of the direct irritant effect of pesticides in relation to skin and ocular-nasal symptoms observed in this study needs further investigation.

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PENINSULA TECHNIKON AND UNVIVERSITY OF CAPE TOWN OCCUPATIONAL ALLERGY STUDY AMONG VINEYARD WORKERS IN THE WESTERN CAPE - 2003

APPENDIX A

Survey Number ☐☐☐ 1-3

A. IDENTIFICATION DATA

1. Surname ____________________________

2. First name/s ____________________________

3. Address ____________________________

____

____

____

4. Work number ________________________ ☐☐☐☐☐☐ 4-9

5. Date of birth: Day____Month______Year______ ☐☐☐☐☐☐ 10-15

6. Gender: ☐ 16

Male	(1)
Female	(2)

7. Home language : ☐ 17

English	(1)
Afrikaans	(2)
Xhosa	(3)
Other	(4)

8. Interviewer's initials:________________________ ☐ 18

9. Date of interview:
Day___Month_______Year_____ ☐☐☐☐☐☐ 19-24

10. Farm: ________________________________ ☐ 25

11. Are you a casual, seasonal or permanent worker? ☐ 26

Casual	(1)
Seasonal	(2)
Permanent	(3)

B. ALLERGIC HEALTH PROBLEMS

12. 1 Have you had wheezing or whistling in your chest at any time in the last **12 months (1 year)?**

	Yes	(1)	☐ 27
	No	(2)	

12.2 Do you get a tight chest or wheeze when you work in the:

12.2.1 orchard	Yes	(1)	☐ 28
	No	(2)	
12.2.2 packing room	Yes	(1)	☐ 29
	No	(2)	
12.2.3 other:	Yes	(1)	☐ 30
	No	(2)	

Specify:________________________________

12.3 Has the doctor ever told you that you have asthma?

	Yes	(1)	☐ 31
	No	(2)	

12.4 Are you currently taking any medicine (including inhalers, pumps or tablets) for asthma?

	Yes	(1)	☐ 32
	No	(2)	

13.1 Have you had any nasal allergies including hay fever or itchy and watery eyes/nose in the last **12 months (1year)?**

	Yes	(1)	☐ 33
	No	(2)	

13.2 Do you get itchy/watery eyes or nose when you work in the:

13.2.1 orchard	Yes	(1)	☐ 34
	No	(2)	
13.2.2 packing room	Yes	(1)	☐ 35
	No	(2)	

13.2.3 Other Yes (1) No (2) 36

Specify:________________________________

14.1 Have you had any skin problems in the last **12 months (1 year)?**

Yes (1)
No (2) 37

14.2 Do you get red, itchy pimples when you work in the:

14.2.1 orchard Yes (1) No (2) 38

14.2.2 packing room Yes (1) No (2) 39

14.2.3 Other Yes (1) No (2) 40

Specify:________________________________

C. WORK HISTORY

15.1 How long have you been working at this farm? 41-44

Years_______Months________

15.2 What job do you do here? 45

____

15.3 How long have you been doing this job? 46-49

Years_______Months________

15.4 Were you employed either as a seasonal or permanent worker in this farm or any other grape farm previously?

Yes (1)
No (2) 50

15.4.1 If yes, for how long did you work?

Years_______Months________ 51-54

THANK YOU FOR ANSWERING THE QUESTIONNAIRE

PENINSULA TECHNIKON AND UCT OCCUPATIONAL ALLERGY STUDY AMONG VINEYARD WORKERS IN THE WESTERN CAPE - 2003

APPENDIX A

Survey Number ☐☐☐ 1-3

A. IDENTIFIKASIE DATA

1. Van ______________________________

2. Eerste name ______________________________

3. Adres ______________________________
____
____
____

4. Werk nommer ______________________________ ☐☐☐☐☐☐ 4-9

5. Geboorte datum: Dag____Maand______Jaar______ ☐☐☐☐☐☐ 10-15

6. Geslag: ☐ 16

Manlik	(1)
Vroulik	(2)

7. Huistaal: ☐ 17

Engels	(1)
Afrikaans	(2)
Xhosa	(3)
Ander	(4)

8. Onderhoud voerder se voorletters:_______________ ☐ 18

9. Datum van die onderhoud:
Dag___Maand_______Jaar_____ ☐☐☐☐☐☐ 19-24

10. Plaas: ______________________________ ☐ 25

11. Is jy 'n deeltydse, seisoenwerker of voltydes werker? ☐ 26

Tydelik	(1)
Seisoen	(2)
Voltyds	(3)

B. GESONDHEIDS PROBLEME

12.1 Het jy 'n fluitende bors, gedurende die **laaste 12 maande (1 jaar)** gehad?

	Ja	(1)	☐ 27
	Nee	(2)	

12.2 Raak jou bors styf of fluit jou bors ooit gedurende werk in die:

12.2.1 Wingerd	Ja	(1)	☐ 28
	Nee	(2)	
12.2.2 Stoor Kamer	Ja .	(1)	☐ 29
	Nee	(2)	
12.2.3 Ander	Ja	(1)	☐ 30
	Nee	(2)	

Spesifiseer:________________________________

12.3 Het 'n dokter ooit vir jou vertel dat jy asma het?

	Ja	(1)	☐ 31
	Nee	(2)	

12.4 Gebruik jy op die oomblik, enige medikasie (soos pompe of tablette) vir asma?

	Ja	(1)	☐ 32
	Nee	(2)	

13.1 Het jy enige allergiese probleme met die neus of oë soos hooikoors of jeukerige neus en waterige oë in die **laaste 12 maande (1 jaar)** gehad?

	Ja	(1)	☐ 33
	Nee	(2)	

13.2 Ondervind jy enige probleme met jeukergie/ waterige oë gedurende u werk in die:

13.2.1 Wingerd	Ja	(1)	☐ 34
	Nee	(2)	
13.2.2 Stoor Kamer	Ja	(1)	☐ 35
	Nee	(2)	

13.2.3 Ander Ja (1) 36
Nee (2)

Spesifiseer:______________________________

14.1 Het jy enige vel probleme in die **laaste 12 maande** (1 jaar) gehad?

Ja (1) 37
Nee (2)

14.2 Ondervind jy rooi, jeukerige puisies/bommels gedurende jou werk in die:

14.2.1 Wingerd Ja . (1) 38
Nee (2)

14.2.2 Stoor Kamer Ja (1) 39
Nee (2)

14.2.3 Ander Ja (1) 40
Nee (2)

Spesifiseer:______________________________

C. WERK GESKIEDENIS

15.1 Hoe lank werk jy al by hierdie plaas? 41-44
Jare_______Maande________

15.2 Watter soort werk doen jy hier? 45

____

15.3 Hoe lank doen jy al hierdie soort werk? 46-49
Jare_______Maande________

15.4 Was jy ooit aangestel as 'n seisoen of voltydse werker in hierdie plaas of enige ander druiwe plaas in die verlede?

Ja (1) 50
Nee (2)

15.4.1 Indien Ja, vir hoe lank het jy gewerk? 51-54
Jare_______Maande________

DANKIE DAT U DIE VRAELYS BEANTWOORD HET

APPENDIX B: SKIN PRICK TEST DATA COLLECTION SHEET

Record Number [ ][ ][ ] 1-3

Work number [ ][ ][ ][ ][ ][ ] 4-9

Date [ ][ ] [ ][ ] [ ][ ] 10-15
DAY MONTH YEAR

Time started: ___________

Read at (20 minutes after time started): ___________

VOLAR LEFT LOWER ARM:

TOP (elbow)

Bermuda gr.	**H/dust mite**
Cockroach	**Rye gr.**
Cat	**Mouldmix**
Storage mite	**Treemix 5**
Spidermite	**Grape mould**
- Control	**+ Control**

BOTTOM (wrist)

BERMUDA GRASS *(Cynodon dactylon)*
[ ][ ] 1st diam [ ][ ] 2nd diam 16-19

HOUSE DUST MITE *(D. Pteronyssinus)*
[ ][ ] 1st diam [ ][ ] 2nd diam 20-23

COCKROACH *(Blatella germanica)*
[ ][ ] 1st diam [ ][ ] 2nd diam 24-27

RYE GRASS *(Lolium perenne)*
[ ][ ] 1st diam [ ][ ] 2nd diam 28-31

CAT *(Felis domesticus)*
[ ][ ] 1st diam [ ][ ] 2nd diam 32-35

MOULDMIX *(Cladosporium herbarum, Alternaria alternata, Fusarium)*
[ ][ ] 1st diam [ ][ ] 2nd diam 36-39

STORAGE MITE *(Lepid. destructor)*
[ ][ ] 1st diam [ ][ ] 2nd diam 40-43

TREEMIX 5 *(False acacia, Live oak, Olive, White birch, Ash)*
[ ][ ] 1st diam [ ][ ] 2nd diam 44-47

SPIDERMITE *(Tetranychus urticae)*
[ ][ ] 1st diam [ ][ ] 2nd diam 48-51

GRAPE MOULD *(Botrytis cinerea)*
[ ][ ] 1st diam [ ][ ] 2nd diam 52-55

- NEGATIVE CONTROL (saline)
[ ][ ] 1st diam [ ][ ] 2nd diam 56-59

+ POSITIVE CONTROL (histamine)
[ ][ ] 1st diam [ ][ ] 2nd diam 60-63

1. Other allergic symptoms/reactions during skin prick tests of left arm? (ring answer) Yes/No [ ] 64

[ ] 65

If yes, specify? ______________________________

2. General comment: (eg. reason test not done/ stopped, reaction to tape, dermographism) [ ] 66

______________________________ [ ] 67

3. Blood sample taken? (ring answer) Yes/No: ___________ [ ] 68

If No, specify reason? ______________________________

4. FIELDWORKER INITIALS: ___________ [ ] 69

APPENDIX C: SPT PRETEST DATA COLLECTION SHEET

		Card
Record Number	[ ][ ][ ]	1-3
Work number	[ ][ ][ ][ ][ ][ ]	4-9
Date	[ ][ ] DAY [ ][ ] MONTH [ ][ ] YEAR	10-15

Do you have any allergies that you know of? YES [1] NO [2] [ ] 16

1.1 ***If Yes,*** what are you allérgic to? (Examples: cats, dogs, dust, grasses or trees, etc.) Please list.

__________________________________ [ ] 17

__________________________________ [ ] 18

__________________________________ [ ] 19

1.2 Have you ever had a severe allergic reaction to any of these (collapse, chest tightness, wheeze)?

YES [1] NO [2] [ ] 20

> If YES, indicate to the person that the skin prick tests will not be done.
> Explain that a blood test will be done instead.

Have you ever had a severe allergic reaction to seafood (collapse, chest tightness, wheeze)?

YES (1) NO (2) [ ] 21

> If YES, indicate to the person that the skin prick tests will not be done.
> Explain that a blood test will be done instead.

Do you currently have an active skin problem such as eczema?

YES (1) NO (2) [ ] 22

If present, indicate to the person that the skin prick tests will not be done.
Explain that a blood test will be done instead.

ave you used any medicines or skin creams for allergies or flu in the past **3 days**?

1. YES 2.NO ☐ 23

4.1 ***If yes,*** which medicines?

______________________________ ☐ 24

______________________________ ☐ 25

______________________________ ☐ 26

If medicine contains antihistamines, indicate to the person that the skin prick tests will not be done.
Reschedule another appointment in **one** week's time and counsel accordingly.
Explain that a blood test will only be done today.

or **Women**:

Are you Pregnant? 1. YES 2.NO ☐ 27

Are you Breastfeeding? 1. YES 2.NO ☐ 28

regnant, indicate to the person that the Skin-Prick Test will not be done today. Explain t a blood test will be done instead.
reastfeeding, proceed with Skin-Prick Testing.

Are you wheezing or having a tight chest today? 1. YES 2.NO ☐ 29

If YES, indicate to the person that the skin prick tests will not be done.
Explain that a blood test will be done instead.

If answers to any of the above are NO, proceed with skin prick testing.

APPENDIX C: SPT PRETEST DATA COLLECTION SHEET

		Card
Record Number	☐☐☐	1-3
Work number	☐☐☐☐☐☐	4-9
Date	☐☐ ☐☐ ☐☐ (DAY MONTH YEAR)	10-15

1. Het jy enige allergieë waarvan jy weet? JA (1) NEE (2) ☐ 16

1.1 ***Indien JA,*** waarvoor is jŷ allergies? (Voorbeelde: katte, honde, stof, grasse of bome, ens.) Lys asseblief.

________________________________ ☐ 17

________________________________ ☐ 18

________________________________ ☐ 19

________________________________ ☐ 20

2. Het jy al ooit 'n ernstige reaksie teenoor hierdie dinge gehad (flou geval, stywe bors, fluitende bors)?

JA (1) NEE (2) ☐ 21

> If YES, indicate to the person that the skin prick tests will NOT be done.
> Explain that a blood test will be done instead.

3. Het jy tans 'n aktiewe vel probleem soos ekseem?

JA (1) NEE (2) ☐ 22

> If present, indicate to the person that the skin prick tests will NOT be done.
> Explain that a blood test will be done instead.

APPENDIX C: SPT PRETEST DATA COLLECTION SHEET

Card

Record Number ☐☐☐ 1-3

Work number ☐☐☐☐☐☐ 4-9

Date ☐☐ ☐☐ ☐☐ 10-15

DAY MONTH YEAR

..et jy enige allergieë waarvan jy weet? JA (1) NEE (2) ☐ 16

1.1 ***Indien JA,*** waarvoor is jy allergies? (Voorbeelde: katte, honde, stof, grasse of bome, ens.) Lys asseblief.

______________________ ☐ 17

______________________ ☐ 18

______________________ ☐ 19

______________________ ☐ 20

Het jy al ooit 'n ernstige reaksie teenoor hierdie dinge gehad (flou geval, stywe bors, ..tende bors)?

JA (1) NEE (2) ☐ 21

> If YES, indicate to the person that the skin prick tests will NOT be done.
> Explain that a blood test will be done instead.

Het jy tans 'n aktiewe vel probleem soos ekseem?

JA (1) NEE (2) ☐ 22

> If present, indicate to the person that the skin prick tests will NOT be done.
> Explain that a blood test will be done instead.

Het jy in die laaste **3 dae** enige medikasie of vel rome vir griep of allergieë gebruik?

1. JA 2.NEE ☐23

4.1 ***Indien JA,*** watter medikasie?

____________________________________ ☐24

____________________________________ ☐25

____________________________________ ☐26

If medicine contains antihistamines, indicate to the person that the skin prick tests will NOT be done.
Explain that a blood test will only be done today.

Vir **Vroue**:

Is jy swanger? 1. JA 2.NEE ☐27

Borsvoed jy? 1. JA 2.NEE ☐28

regnant, indicate to the person that the Skin-Prick Test will NOT be done today. Explain at a blood test will be done instead.
reastfeeding, proceed with Skin-Prick Testing.

Huig jy of is jou bors styf vandag? 1. JA 2.NEE ☐29

If YES, indicate to the person that the skin prick tests will NOT be done.
Explain that a blood test will be done instead.

If answers to any of the above are NO, proceed with skin prick testing.

PENINSULA TECHNIKON / UNIVERSITY OF CAPE TOWN OCCUPATIONAL ALLERGY STUDY AMONG VINEYARD WORKERS IN THE WESTERN-CAPE - 2003

APPENDIX D: CONSENT FORM

1. **Title of research project**

Occupational Allergy and asthma caused by spider-mites among workers on vineyards in the Western-Cape and cross-reactivity of mite allergens to related insect allergens.

2. **Purpose of the research**

The Peninsula Technikon and University of Cape Town is conducting this important study of the allergic effects of spidermites. This study is going to be done by researchers who are independent of the company. We will be studying a group of workers who have been working on the farms.

3. **Description of the research project**

If you agree to participate you will be asked to complete the following tests during working time:

a) **Complete a questionnaire**. A member of our study team will interview you in privacy to complete the questionnaire. You will be asked questions about any breathing or chest problems and current and previous employment history.

b) **Skin tests**

Skin tests would be done to see whether you are allergic to any of the spidermites or other insects that cause allergy or any other substance that commonly causes allergy in the Western Cape. A nurse will place a drop of liquid containing each type of allergen on your forearm and then use a lancet to scratch the skin in that area.

c) **Blood test**
You will also be asked to undergo a blood test to check for allergies to spidermites.

4. **Confidentiality of information collected**

Your name will not appear in any reports on this study. The records of questionnaires, skin tests and blood tests will be kept completely confidential and will be seen only by members of the study team.

5. **Risks and discomforts of the research**

a) **From the blood test**. You will feel a single needle stick when the blood is taken. Sometimes a small bruise may occur from the needle stick, but this is minor and will heal quickly. The total amount of blood taken is quite small and your body will quickly replace it.

b) **From the questionnaire.** There are no risks from completing the questionnaire.

c) **From the skin tests.** Itchiness can occur in some instances. Very rarely severe allergic reactions to skin tests (difficulty breathing or feeling faint and collapsing) may occur in people that are highly allergic. You will be asked questions before receiving the tests to help make sure you are not at any risk for such a problem. In addition, a nurse will be available to check you for any possible problems, for several hours after the test and have medications on hand to treat any such reaction. A doctor is also located nearby ready to help if necessary.

6. **Expected benefits to you and to others**

You will be given a written copy of all your test results along with an explanation of what they mean, unless you tell us that you do not wish to receive this. You may wish to show these to your doctor if you are having any problems. These tests will help determine if you have an allergy to spidermite or other substances used in the skin tests. What we learn from this study will help to protect you, and other farmworkers on vineyards in South Africa and other parts of the world. We will learn how best to monitor worker's health and how to reduce workers' exposure to these mites.

7. **Costs to you resulting from participation in the study**

The study is offered at no cost to you. In the event a problem is discovered and you wish to be seen by a doctor for it, we can recommend to you whom to see. However, the study cannot pay for these additional medical visits or treatments.

8. **Contact person.**

You may contact one of the following persons for answers to further questions about the research, your rights, or any injury you may feel is related to the study.

Peninsula Technikon Researchers: Ms Roslynn Baatjies (Telephone No. 083 527 8053)
Mr Emmanuel Rusford (Telephone No. 021-959-6366)

University of Cape Town Researchers: Dr Andreas Lopata (Telephone No. 021- 404-2395)
Dr Mohamed Jeebhay (Telephone No. 021- 406-6309)

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9. **Consent of the participant**

I have read the information given above, or it has been read to me. I understand the meaning of this information, Dr./Mr./Ms. ______________________________
has offered to answer any questions concerning the study. By signing this form, I hereby consent to participate in the study. I also understand that I am free to withdraw from the study at any time without penalty.

10. **Documentation of the consent**

One copy of this signed document will be kept together with our research records for this study. A copy of the information sheet about the study will be given to you to keep.

______________________________ ______________________________

Printed name of participant | Signature, Mark, or Thumb Print

______________________________ ______________________________

Interviewer's name (Print) | Signature

DATE: ____________________

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TOESTEMMING VIR DEELNAME AAN STUDIE

1. Titel van navorsings projek

Beroeps allergie en asma wat verband hou met spinnekop miete onder werkers op druiweplase in die Wes-Kaap en kruis-reaktiwitiet van miete met ander insekt allergiee.

2. Doel van die navorsing

Die Skiereilandse Technikon en Universiteit van Kaapstad lei hierdie belangrike studie oor die allergiese effekte van spinnekop miete. Die studie gaan gedoen word deur navorsers wat onafhanklik van die maatskappy is. Ons gaan 'n groep werkers betrokke met werk op wynplase bestudeer.

3. Beskrywing van die navorsings projek

Indien jy instem om deel te neem, sal jy gevra word om die volgende toetse gedurende jou werkstyd te ondergaan:

a) **Voltooi 'n vraelys:** 'n Lid van ons studie span sal 'n private onderhoud met jou voer om die vraelys te voltooi. Jy sal vrae gestel word oor enige asemhalings of bors probleme; en huidige en vorige werk geskiedenis.

b) **Vel krap toets:** Toetse sal op jou vel gedoen word om vas te stel of jy allergies is vir enige van die spinnekop miete of enige ander insekte wat oor die algemeen allergiese probleme in die Wes-Kaap veroorsaak. 'n Verpleegster sal 'n druppel vloeistof wat elke soort allergiee bevat op jou voorarm plaas, en dan 'n naald (lancet) gebruik om die area liggies te krap.

c) **Bloed toets:** U sal gevra word om 'n bloedtoets te ondergaan om te kyk of jy vir spinnekop miete allergies is.

4. Vertroulikheid van inligting wat versamel word

Jou naam sal nie op enige van die verslae van die studie voor kom nie. Die verslae van veltoetse, bloed toetse en vraelyste word heeltemal apart gehou, is uiters vertroulik en sal slegs deur lede van die navorsingspan gesien word.

5. Risiko en ongemaklikheid van die navorsing

a) **Van die bloed toetse:** Jy sal slegs 'n enkele naald prikkie voel wanneer die bloed geneem word. Die totale hoeveelheid bloed wat geneem sal word is baie min, en jou liggaam sal dit gou weer vervang.

b) **Van die vraelys:** Daar is geen risiko ten opsigte van die vraelys nie

c) **Van die veltoetse:** Jeukerigheid kan in sommige gevalle voor kom. Dit is baie seldsaam dat ernstige allergiese vel reaksies voorkom in vel krap toetse (moeilike asemhaling of 'n flou gevoel) in mense met 'n ernstige allergie. Jy sal voor die toets vrae gestel word om seker te maak dat jy nie risiko's vir sulke probleme loop nie. Boonop sal jy op die plaas wees, waar verpleegsters beskikbaar sal wees om uit te kyk vir sulke probleme vir 'n paar ure na die toets. Sy sal ook medikasie gereed hê om enige sulke reaksies te behandel. 'n Dokter sal beskikbaar wees om te help op enige tyd wanneer dit nodig is.

6. Verwagte voordele vir jou en ander werkers

Jy sal 'n geskrewe afskrif van al jou toets resultate, met 'n verduideliking waarvan dit beteken ontvang, tensy jy vir ons sê dat u dit nie wil ontvang nie. Jy mag dalk hierdie toets resultate vir jou dokter wil wys as jy wel enige probleme ervaar. Wat ons leer van hierdie studie, sal ons help om ander werkers op druiweplase in Suid Afrika werk te help, asook werkers in ander dele van die wêreld. Ons sal leer wat die beste manier is om 'n werker se gesondheid te monitor en hoe om die werker se ontblooting aan spinnekop miete te verlaag.

7. Onkoste aan jou as gevolg van deelname aan die studie

Die studie word aangebied teen geen koste aan jou nie. In 'n geval waar ons 'n probleem ontdek en jy deur 'n dokter daarvoor gesien wil word, kan ons iemand voorstel, maar die studie kan nie vir hierdie addisionele mediese besoeke of behandeling betaal nie.

8. Kontak persoon

Jy mag een van die volgende persone kontak vir antwoorde tot verdere vrae in verband met die navorsing, u regte, of enige besering wat jy voel met die studie verband hou.

Skiereilandse Technikon Navorsers: Me. Roslynn Baatjies (Telefoon Nr. 083 527 8053)
Mnr Emmanuel Rusford (Telefoon Nr. 021-959 6366)

Universiteit van Kaapstad Navorsers: Dr. Andreas Lopata (Telefoon Nr. 021-404-2395)
Dr. Mohamed Jeebhay (Telefoon Nr. 021-406-6309)

9. Toestemming van deelnemer

Ek het die bogaande inligting gelees. Ek verstaan die betekenis van die inligting.
Dr/Mnr/Me.____
het aangebied om enige vrae oor die studie te beantwoord. Deur hierdie toestemmings vorm te teken, stem ek in om deel te neem aan die studie.

10. Dokumentasie van die toestemming

Een afskrif van die dokument sal saam met ons navorsings rekords oor die studie gehou word. Die tweede afskrif sal aan jou gegee word om te hou.

_________________________ Naam van deelnemmer (drukskrif)

_________________________ Handtekening, Merk, Duim afdruk

_________________________ Onderhoud voerder se naam (drukskrif)

_________________________ Handtekening

DATUM:______________________