Agrichemical safety practices on farms in the western Cape

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Abstract **In order to study agrichemical safety practices in a rural farming area in the western Cape, an audit of 45 randomly sampled farms was performed over 3 months in 1992. A response rate of 87% was achieved, and the survey results suggest that approximately 9% of permanent and 14% of seasonal farm workers are employed in jobs with potential exposure to agrichemicals. While protective equipment was widely available, gloves and masks were seldom used, with little enforcement or commercial support from the suppliers of the equipment. Farm workers receive little training on pesticide safety, but interest in the possibility of further training for workers was high. In the absence of a system of pesticide disposal, the presence of residual, unwanted and outdated stocks of pesticides in farmers' stores, and to a lesser extent the presence of empty containers, are identified as important problems. Current pesticide storage practices require improvement by simple industrial hygiene measures. Health facilities available to workers on most farms are extremely limited, particularly in the light of statutory requirements for occupational safety and health under the Machinery and Occupational Safety Act. It is argued that collective solutions to problems of pesticide safety are possible within the ambit of a public health response, particularly given the willingness of the farming community to identify and address potential health problems. As a result, initiatives to meet these needs are currently under way in the region.**

S Afr Med J 1994; **84:** 273-278.

Despite their role in protecting crops and maintaining food production,[1,2] pesticides pose considerable health risks to people exposed through their work, the environment and intentional misuse.[1,3-5] Little information is available in South Africa on the extent of the problems related to pesticides and other agrichemicals[6] and on their usage and control on farms. Surveillance is imperfect[7] and considerable undernotification of incidents of pesticide poisoning in the country is evident.[6-9]

Control and safe handling of agrichemicals is a key aspect of the prevention of pesticide morbidity and mortality[10,11] and is the subject of substantial legislation with regard to the labelling, distribution and storage of pesticides.[6] However, among cases notified to the Department of National Health and Population Development, the most frequent source of the pesticide has been a farm pesticide store, and the majority of cases involve farmers, farm workers or their families.[12] This suggests that unauthorised access to pesticides is an important problem not addressed by existing legislation.

Safety training is a key aspect of prevention but appears to be poorly co-ordinated and unevenly distributed.[9,13] Two safety initiatives in the western Cape include the National Productivity Institute (NPI) Deciduous Fruit Division, who provide audiovisual self-help materials to fruit farmers for training on the safe application of agrichemicals, and the Rural Foundation (RF), whose field worker provides a basic industrial hygiene assessment to member farms of the RF on request. However, the extent to which these (and other) safety initiatives have been applied locally is unknown.

In order to identify some of the key needs for agrichemical safety in the farming community, an audit of pesticide safety and control conditions was conducted on a random sample of farms in a rural district of the western Cape over 3 months in 1992. The survey was aimed at providing information to the local authority health service on which to plan a public health response to the question of agrichemical safety.

The objectives of the study were to: (*i*) describe the size and workforce profile of farms in the region and identify the numbers and job types of farm workers potentially exposed to agrichemicals during the course of their work; (*ii*) describe the sources of agrichemical supplies, as well as attitudes towards their storage, control and disposal and practices in this regard; (*iii*) describe the prevalence of safety practices; (*iv*) describe the extent of health services available on farms and levels of safety training in relation to agrichemicals; and (*v*) assess the extent of record keeping for agrichemical use on farms and document any previous poisoning events on the farms surveyed in relation to notifications.

Methods

A random sample of 75 farms and smallholdings was drawn from a sampling frame of 884 rural holdings available from the health inspectorate at the local Regional Services Council Health Department. After non-agricultural holdings had been excluded, 45 farms and smallholdings were left in the sample. Measurement consisted of a semi-structured interview conducted with the farmer, farm manager or supervisor directly involved in production processes on the farms and an inspection of the farm's pesticide store. The questionnaire was piloted on a subsample of farms in the region early in 1992. All participants were assured of the anonymity of their individual responses.

Results

The response rate in the sample was 87%, with 6 farms declining to participate in the survey. No difference between participants and non-participants was noted regarding incidents of previous poisoning episodes recorded with the local authority.

Farm profile

The majority of farms surveyed were involved in production of grapes for wine (72%). Other common activities were fruit (46%) and vegetable farming (18%). Multiple crop production activities involving more than one product were common (56%). Eleven farms out of 35 who gave unequivocal answers (31%) reported being members of the RF. The distribution of farm size and workforce size is shown in Figs 1 and 2.

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Accepted 15 Nov 1993.

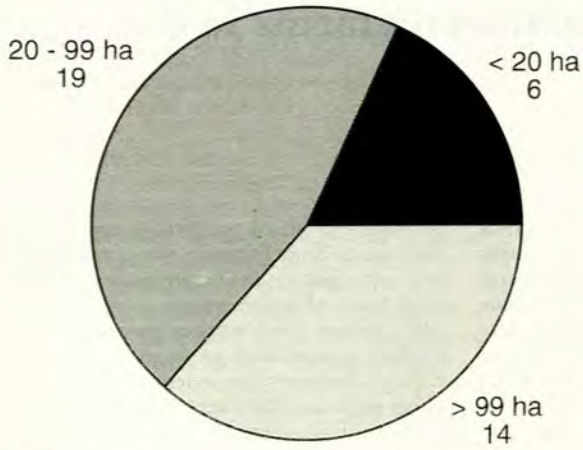

FIG. 1.
Distribution of farm size (in hectares) (39 farms).

FIG. 2.
Average workforce by farm size, employment status and gender (39 farms).

Workforce size varied widely from 1 or 2 workers on smallholdings to over 100 on farms that were part of groups of holdings or agribusinesses. Seasonal labour was widely used, except for vegetable farming, and constituted roughly half of the total workforce (Fig. 2).

Contract migrant labour was used on only 3 farms. Continuity of re-employment of seasonal workers from one year to the next varied from 0% (i.e. total turnover from one season to next) to 100% (usually when the seasonal workforce consisted of the family of the same or a neighbouring farm's permanent workforce). Average return of seasonal labour over all farms using seasonal labour was 36%.

Agrichemical sources and storage, control and disposal attitudes and practices

The majority of farmers (72%) reported receiving the bulk of their agrichemicals directly from agrichemical companies rather than from a co-operative. Seventy-four per cent reported having a separate pesticide store that was usually locked, and Fig. 3 shows the numbers and type of personnel with access to the store.

The usual situation on most farms (82%) was that keys to the store were kept by the farmer, his manager or the foreman. On only 15 farms (38%) was it reported that more than one person had authorised access to the store.

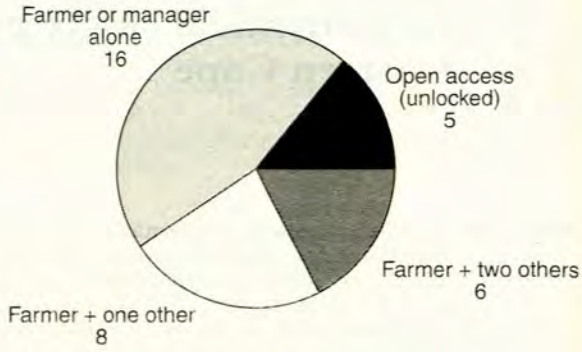

FIG. 3.
Access to pesticide stores (35 farms — 4 farms reported no formal store for pesticides).

Fig. 4 shows the results of a brief industrial hygiene inspection of the stores conducted at the time of interview. In most cases (56%) the store was found to be unlocked at the time of visiting. Another important finding was that a large number of farms (49%) kept material unrelated to pesticides (such as tools and diesel fuel) in the pesticide store. Empty containers outside the store (including containers for pesticides such as mancozeb, glyphosate, paraquat and diquat) and unlabelled containers in the store were also found, but less commonly.

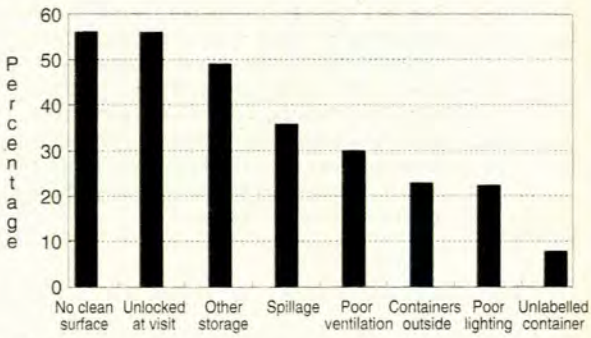

FIG. 4.
Industrial hygiene assessment based on inspection of stores.

Eleven farms reported having unwanted empty pesticide containers and 18 farms (46%) having residual pesticides in their stores of which they had not been able to dispose. The types of pesticide container and residual pesticide are listed in Table I.

Farmers most frequently reported disposing of empty pesticide containers by a combination of puncturing, burning and burying the containers in a specific site on their farms (89%). Thirty-one per cent of respondents experienced problems with getting rid of empty containers, and a similar proportion stated that they had to store up containers inside their store until there were enough to destroy. Two respondents reported disposing of empty containers at the municipal dump. None of the farms that washed out containers before destroying them had any plan to deal with the effluent water used to clean the containers. Only 1 farm was currently making use of a disposal service for empty containers, and 2 farmers expressed knowledge of a local container disposal service that had started recently.

While only 6 farmers reported re-using empty containers for purposes of storage of other chemicals, 19 out of 25 thought it possible to re-use containers of pesticides they thought were 'not dangerous'. Two-thirds

TABLE I.
Residual pesticides and containers (39 farms)

Empty pesticide containers	Residual pesticides
Azodrin	Azodrin
Bravo	Amitrole
Capsine	Bladex
Chlorpyrifos	Buctril
Dithane	Basaman
Dieldrin	Bayleton
Folimat	DDT
Folidol	Dieldrin
Glyphosate	Ethylene dibromide
Karathane	Eptam
Parathion	Folidol
Phosdrin	Folin
Sting	Gusathion
	Karathane
	Lead arsenate
	Maneb
	MCPA
	Planovin
	Shell-B-Amine
	Stomp
	Tedion
	Toxaphene
	Triadimenol
	Rogor
	Fruitop

expressed an interest in participating in a service that could recycle or dispose of empty pesticide containers.

Potentially exposed workforce

Thirty-two farms (82%) reported that the main route of pesticide application was by tractor spraying. Backpack spraying was the major method of application on 5 farms, including the nurseries and smallholdings, while a number of farms used backpack spraying as a supplementary form of pesticide application. The number of workers involved in spraying ranged from 1 to 12 per farm and was dependent on the size of the farm. The median number of tractor drivers involved in spraying was 2 per farm. In addition, 20% of the farms had supervisory staff who came into regular contact with pesticides by storing, mixing or handing pesticides to the sprayers. None of the farms had workers solely responsible for the maintenance of the pesticide store. Out of a total of 1 060 permanent workers in the sample, 8,5% were involved in work that brought them into direct contact with pesticides (mixing, packing, spraying or handling). In addition, a further group of workers (constituting about 14% of the seasonal workforce) were involved in other agricultural activities in the field, such as pruning or shaping vines, which brought them into indirect contact with pesticides that had been sprayed onto the vine, tree or crop.

Farmers or farm managers were involved in activities exposing them to pesticides on 28 farms (72%). In most cases (77%) farmers, managers or supervisory employees were responsible for packing and storage. In contrast, pesticides were frequently mixed by those workers involved in their application (71%), usually the tractor drivers. While there was some overlap in responsibilities for mixing, it appeared that application was usually the sole responsibility of drivers or labourers, while control of storage was usually the sole responsibility of the farmer or manager. The frequency with which different categories of personnel were involved in different aspects of pesticide handling is indicated in Fig. 5.

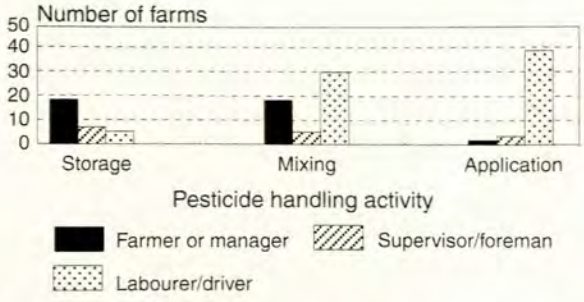

FIG. 5.
Responsibility for pesticides (39 farms) — category of personnel involved in storage, mixing and application. Responsibilities for different job activities may overlap (see text).

Farms on which workers were responsible for packing and mixing pesticides included 4 (13%) where the workers were reported to be illiterate.

Safety precautions in handling agrichemicals

Issuing of personal protective equipment (PPE) (including gloves, masks and overalls) for mixing and applying pesticides was widely reported. However, many farmers doubted that PPE was used regularly (Fig. 6). More than one farmer commented that it was difficult to get workers to wear protective equipment and only 2 claimed to enforce use of PPE by workers.

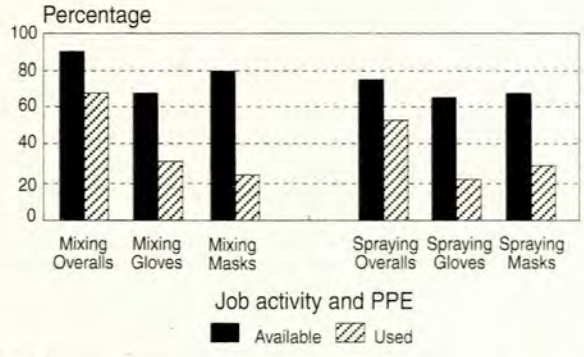

FIG. 6.
Personal protective equipment (39 farms) — availability and usage by type of PPE and by pesticide activity.

None of the farmers who provided masks reported receiving any follow-up from the co-operative from which the mask was purchased. Reporting of replacement of filters on the masks was very variable, ranging from once a week to once a month.

Health services

With the exception of 1 farm, the owner of which was a doctor, the only form of health service available on the farms was a first-aid box or boxes (62%). Twelve respondents (31%) reported that they had no form of first aid or health service on the farm. On farms that provided a first-aid box, the source of first aid was most commonly the wife (or mother) of the farmer or manager (36%), followed by the farmer or manager himself (31%) or other clerical staff on the farm (8%). On 2 farms workers had received specific first-aid training.

Sixteen out of 26 farmers indicated that they thought they would be able to recognise the signs and symptoms

if a worker were to be poisoned. Most said that in such a case they would take the worker to the nearest general practitioner or hospital, both of which were in all cases less than 20 km away.

Safety training

Training of the workforce on pesticide safety was low (Fig. 7). Most farms (60%) reported that they did not have any specific training other than that provided by the farmer or manager as part of the worker's general training. Only 4 farms (11%) had arranged for specific training on pesticide safety and handling for their workers and the remaining 29% reported no training of workers on pesticide safety at all.

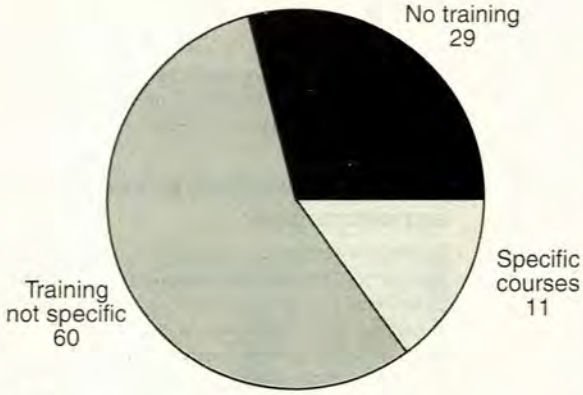

FIG. 7.
Training in pesticide safety (% of sample).

In terms of known educational initiatives in the region, only 3 of 35 farms (9%) had been exposed to the NPI video on pesticide application and 4 of the RF's 11 members in the survey had previously been audited as part of the RF's safety programme. Two farmers had been on special courses on pesticide handling and safety.

Concern about training on pesticide safety for the workforce was high, 31 out of 38 farmers (84%) indicating an interest in sending their workers on a training course on safe handling of pesticides.

Record keeping and previous morbidity

The extent of record keeping in relation to agrichemical application is set out in Table II.

TABLE II.
Record keeping of agrichemical applications (39 farms)

Records for	No. of farms	%
What was sprayed	33	85
When applied	31	80
Where applied	31	80
Quantity applied	26	67
Who applied*	15	58

*Data not available for 13 farms.

More than half of the farms only kept records for 2 years or less, the range for keeping of records being 1-13 years. Quality and duration of record keeping appeared to have no relationship to farm size or to whether there had ever previously been a case of poisoning on the farm. Frequently the records took the form of spray programmes, which usually (but not always) give information on the timing, nature, amount and site of application, but do not give data on which workers were exposed.

Seven farms (18%) reported that there had been incidents of poisoning in the past. The nature of these incidents was very diverse, and was not tightly defined. They included a parasuicide, an accident on duty (leading to a Workmen's Compensation claim) and 2 cases of symptoms which it was thought had been caused by pesticides but which were unconfirmed. For 3 cases notification could be traced at the local health authority. Three farmers or farm managers reported that they themselves had been poisoned by pesticides in the past.

Discussion

The random sample of farms included in this study appears to be a representative range of farm types in the area. In following up the 6 farms that failed to participate in the survey, little difference was found between their safety records or production activities and those of the rest of the sample. Moreover, with a response rate well in excess of 80%, the research should have good generalisability to the local region. Inasmuch as this area is regarded as a relatively 'enlightened' farming community, the survey results probably reflect one of the best-case scenarios in relation to farming practices in the western Cape more broadly and in South Africa as a whole.

In assessing occupational exposure to hazardous agrichemicals, it appears that most potentially exposed workers are tractor drivers and backpack sprayers primarily involved in pesticide application and, to a lesser extent, mixing activities. However, a significant number of supervisory staff or farmers themselves are exposed through their responsibility for the pesticide stores. These assessments of exposure require further qualitative elaboration in epidemiological studies.[14]

Farm-based records appear to be adequate for assessing short-term exposures on farms for the immediate past season, but are generally not available for assessing long-term exposure, especially where chronic health outcomes are under investigation. Exposure records are also not generally linked to individual workers, and further measures would need to be instituted to investigate health risks in individual subjects. Mixed production is a common feature of agriculture in the area and is probably likely to increase as farmers diversify their crop output,[15] which will add to the heterogeneity of chemical exposures among workers. Agrichemical exposures experienced by seasonal workers would be difficult to assess in the presence of high turnover from one season to another, so they would be a difficult population in which to perform any epidemiological study. Similarly, contract (migrant) labour is not substantially used in the area.

Availability of protective equipment in this study appears to be reasonably high, in contrast to actual use — less than a third of workers were reported to use gloves or masks in the course of performing hazardous activities. These are probably substantial overestimates of the true rates, given that the study chose to use data obtained from interviews with the farmers and managers, and was not designed to validate use in the field. These results are consistent with studies in underdeveloped countries around the world where use of protective equipment is low.[16,17]

Further investigation into the reasons for low use as well as training for appropriate use of PPE are indicated. A further deficit identified was the lack of follow-up provided by the retailers supplying masks for protective use, and there appears to be sound motivation for co-operatives to provide follow-up to individual farmers on how to use, maintain and replace their protective equipment.

Disposal, both of empty containers and of residual pesticides, is a significant problem.Current methods of disposal of empty containers on farms appear to meet minimum legal standards[18] but do not address the environmental problem of water effluent produced from rinsing containers. Moreover, re-use of containers does occur. Even though this re-use is reported as being specifically to transport other chemicals, there is a perception that containers of 'less hazardous' agrichemicals are safe to re-use. This might suggest that re-use of containers is more widespread than reported.

A more important hazard, from both an environmental and a personal health perspective, is the presence of substantial amounts of unwanted agrichemicals in pesticide stores on farms in the region (Table I). These include some extremely hazardous chemicals, of which a number are no longer registered for use. Many of these residual pesticides were inherited with the farms, and in 3 cases the containers were so rusted that removal was likely to result in breakage and spillage. On two other farms, containers present were so old that it was no longer possible to identify what was inside them because the labels were totally illegible.

Part of the explanation for this phenomenon may be the prohibitive costs and logistic difficulties of commercial waste disposal, as well as the reluctance of agrichemical companies to take responsibility for outdated chemicals. Only 1 farm reported that the agrichemical supplier had removed excess unwanted pesticide.

Given the considerable concern expressed by farmers, it is hardly surprising that the majority of the farms surveyed identified a need for a system for agrichemical disposal. These findings are remarkably similar to an unpublished study of pesticide hazards on farms in the Hex River region, where 51% of farmers reported having problems with unwanted containers or chemicals and identified a need for a disposal service (A. Reid — personal communication). These findings have formed the basis for a current pilot programme, located in the western Cape, to assess the viability of instituting a pesticide disposal service through the facilitation of the local Regional Services Council health authority.[19]

Storage and security of control of pesticides on farms need to be improved, particularly in light of the frequency of cases of notified poisonings in which unauthorised access to pesticides plays a role.[12] Simple measures such as keeping all non-chemical materials in a separate store would minimise the need to open the store and reduce the time during which access to dangerous chemicals is possible. Provision of clean working surfaces, adequate lighting and ventilation and the clearing of all spillage are simply applied measures that should be incorporated in training and support provided to farmers, managers and supervisors.

Health services on farms in the area appear to be limited, and the usual providers of first aid have little training, particularly in the recognition and treatment of pesticide poisoning. If poisoning occurs, it is the responsibility of the farmer alone to recognise the seriousness of the condition and get the worker to a doctor — this may be an impossible expectation if he has received no training. While the farms in the study area are relatively fortunate in being in close proximity to the local hospital or local general practitioners, there is definitely a need for an emergency service on farms. Moreover, this situation fails to meet the requirements of the Machinery and Occupational Safety Act, which governs workplace safety in South Africa at present.

Reported morbidity on the farms surveyed is difficult to assess given the lack of definition of a previous episode of poisoning. However, the fact that only 3 out of 7 cases could be traced in notifications appears to support findings in other studies that pesticide poisoning is substantially underreported.[9-10] Surveillance for disease caused by pesticides needs to be critically re-evaluated. Active surveillance, in the form of a regular monitoring programme for exposed workers, should be seriously considered as a public health intervention.

Levels of safety training are disturbingly low. Current safety initiatives investigated in this study (NPI video and safety audit by RF field worker) appear to have achieved very limited coverage. Few farmers had made use of any specific training courses for their workers (Fig. 7) or for their own education, in spite of frequently being exposed to pesticides in the course of their own work, and illiteracy of some of the workers involved in handling potentially hazardous chemicals (13% of farms) is a major obstacle to further training. However, there is strong interest in potential training on most farms, and local developments are likely to produce some response to this need.[19] Interestingly, during interviews farmers suggested that agrichemical companies could play an important role in this regard.

Conclusion

Deficiencies in a number of areas of pesticide safety have been identified. These include inadequate training and usage of protective equipment, shortcomings in storage practices, the absence of a disposal system for empty containers and residual pesticides, insufficient and inappropriate provisions for medical care on farms, undernotification and a lack of effective surveillance. However, many of these can be solved within the ambit of a public health approach, and three aspects (surveillance, training and disposal) are currently the subject of three major regional initiatives.

Moreover, many of the farmers in the study were willing to address the potential problems identified in the study. Given this attitude, and a growing concern for a healthy environment, there is ample reason to believe that a co-ordinated response to pesticide safety is possible. A strategy involving collaboration of all the parties concerned, including farmers, workers, agrichemical companies, development organisations, research institutions and health authorities, should bring about a considerable reduction in the acute and long-term risks arising from agrichemical usage in the farming community.

Part of this research was carried out while the author was the recipient of the Guy Elliot Fellowship at the University of Cape Town in 1991/92. The author wishes to thank Mr B. Slon and Mr T. Pollock for their assistance with data collection and the Western Cape Regional Services Council Health Department staff for their full co-operation. The co-operation, time and insights given to the author by the farmers, workers and managers who participated in the interviews, and the support of the International Development Research Centre in the development of this research, are also acknowledged.

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