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Evaluation of toxicity risks in farmers exposed to pesticides in an agricultural community in Concórdia, Santa Catarina State, Brazil

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ABSTRACT. There has been an increase during recent years in the use of pesticides in agricultural activities to improve productivity, reduce labor costs and increase profits. On the other hand, the use of pesticides in excess or without adequate biosafety practices could lead to serious harm to human health. Current research evaluated toxicity risks in the case of 50 agricultural workers from the São Paulo Rural Community in the municipality of Concórdia, Santa Catarina State, Brazil, who were exposed to pesticides. The questionnaire with open- and closed-ended questions revealed that there are several situations and procedures that expose most farm workers to toxicity risks since they do not have a clear understanding of biosafety measures or suitable knowledge on the products they use. Since a lack of information on pesticides exists, there is strong evidence for measures to inform and raise consciousness so that agricultural workers may exercise self-care in handling pesticides.

Keywords: pesticides, environmental risks, poisoning.

Avaliação do risco de toxicidade em agricultores expostos a agrotóxicos em uma comunidade agrícola de Concórdia, Estado de Santa Catarina, Brasil

RESUMO. A utilização de agrotóxicos nas atividades rurais tem crescido ao longo dos anos com o intuito de aumentar a produtividade das lavouras e reduzir a mão-de-obra empregada. Em contrapartida, o uso excessivo ou sem medidas adequadas de biossegurança podem causar sérios danos à saúde humana. Este trabalho tem por objetivo avaliar o risco de toxicidade de 50 agricultores da comunidade da Linha São Paulo, município de Concórdia, Estado de Santa Catarina, expostos a produtos agrotóxicos pela aplicação de questionário com perguntas abertas e fechadas. Foi possível observar que estão presentes várias situações e procedimentos que expõem boa parte dos agricultores envolvidos nesta pesquisa a riscos de intoxicação, pois não possuem uma ideia clara a respeito das medidas de biossegurança, como também não há entendimento adequado sobre os produtos que utilizam, sugerindo carência na veiculação de informações acerca dos produtos. Estes dados corroboram para o aumento do risco à saúde dos agricultores entrevistados em sua rotina de trabalho. Dessa forma, fica fortemente destacada a necessidade de medidas voltadas à informação e sensibilização, que conscientizem e conduzam ao autocuidado no manejo de agrotóxicos.

Palavras-chave: agrotóxicos, risco ambiental, intoxicação.

Introduction

According to Government Decree 4,074 of the 4th January 2002, pesticides are chemical compounds or a mixture of chemical compounds to prevent, destroy and repel, directly and indirectly, any type of pathogenic agent from the animal or vegetal world that is harmful to plants and animals within the production chain, its products and sub-products, and to humans (BRASIL, 2002).

According to the National Trade Union of Industries of Agricultural Defense Products (SINDAG, 2008), the use of pesticides in Brazil is on

the increase and accounted for the commercialization of 82 tons in 2006. Up to July 2008, farmers in Brazil bought 311 times as much as the amount in 2006 (SINDAG, 2008). The risks that agricultural defensives bring to human health basically depend on the toxicological profile of each pesticide and on the duration and intensity of exposure by each rural worker, with certain cases leading to death (DELGADO; PAUMGARTTEN, 2004).

Notice and investigation of poisoning by pesticides in Brazil are highly unreliable. According to the World Health Organization (WHO), each notified poisoning case hides other

50 not notified ones. In most Brazilian states, poisoning by pesticides is not even the object of the epidemiological and health vigilance system. The absence of a more efficient registration and classification by the public health organization and the unreliability of the outpatient system contribute towards the under-registration of all poisoning cases (OPAS/OMS, 1996). Moreover, corroborating the above data, 6,260 cases of poisoning by pesticides (linked to agricultural use) were registered in Brazil in 2007, mostly involving young people and adults within the 20-49 year bracket, or 3,820 cases (61%). Further, 1,749 notified cases, with 47 deaths, occurred in the southern region of Brazil, or rather, 22% of pesticide poisoning cases registered in the country for that year in the exercise of the farming profession (SINITOX, 2007).

According to the 2000 Census prepared by the Brazilian Institute of Statistics and Geography (IBGE, 2007), 21.3% or 1,138,429 inhabitants in the state of Santa Catarina live in the rural area. Since there is a constant migration of rural workers to the towns and cities, the occurrence produces a direct impact on agricultural labor and a decrease in the number of workers proportionate to the rise of pesticide use in the cultivars. This is due to the small agribusiness run by the family which is so characteristic of the state of Santa Catarina (PERES; MOREIRA, 2007).

Poisoning by pesticides may occur through inhaling by mouth and skin, either voluntarily or not. The three type of poisoning, either separately or synergically, may occur in the case of farm workers (OGA et al., 2008; PIRES et al., 2005). However, in Santa Catarina, due to the lack of conscience-raising programs for farm workers, there is an increase in poisoning cases through the incorrect management of these substances. Current research evaluated the poisoning risk of a sample of farm workers in a district in the municipality of Concórdia, Santa Catarina State, Brazil with regard to exposure to pesticides.

Material and methods

Current research was carried out in 2009 by applying a questionnaire to rural workers of the district São Paulo in the municipality of Concórdia, Santa Catarina State, Brazil, to evaluate the poisoning risk (toxicity) for workers exposed (passive or active) to pesticides.

Methodological design was based on research by Peres et al. (2004) and Silva et al. (2005), with modifications.

Research under the form of a scientific project was submitted to and approved by the Committee

for Ethics in Research of the Universidade do Contestado, Concórdia, Santa Catarina State, Brazil (506/2008). During the research all ethical procedures in the Resolution 196/96 of the National Health Council – Ministry of Health, were complied with.

A preliminary survey was undertaken for the selection of the area among the rural communities of the municipality and the number of interviewed people that would be researched. The area had to be characterized by high demographic concentration and a large area cultivated. The São Paulo community was thus selected and since the researcher who applied the questionnaire had acquaintance with the community, the workers readily accepted to participate in the research. In fact, a friendly atmosphere was installed which guaranteed the legitimacy of the data collected.

Three farmers were not interested in current research and thus 50 out of the 53 farm workers, males and females, members of the community, were interviewed. They all had handled pesticides one to three times a year within the 2007-2009 period. Exclusion criteria from the research were people less than 18 years old and those who had not handled pesticides for more than two years or had never handled pesticide anytime.

Data were collected by half-structured interviews at the home of the farmers and based on a previously defined list of questions, although they could be altered according to the situation. Field work was thus characterized by a descriptive analysis of data in the context of a transversal study. The questions for the analysis of exposure risks to pesticide included information on social, economical and demographical factors, such as age, schooling, civil status, labor functions and residence. Information was also obtained on exposure and on pesticide risks, such as the time spent in this type of work, use of pesticide within the production process (past and current), perception of poisoning risks, use and acceptance of Individual Protective Equipments (IPE), the motives for the use or non-use of the equipment, type of sprayer used, frequency and duration of the toxic applications, types of pesticides used, the concomitant use of two or more pesticides, knowledge on the products applied, understanding of the information and symbols on the labels related to the products' toxicology classification. Morbidity was also referred to through surveys comprising poisoning events and the identification of signs and symptoms of poisoning. The level and the existence of information by technical personnel on buying the toxic products were also investigated.

Results and discussion

The buying power of the small Brazilian rural farmer has been decreasing since the 1994 currency stabilization. This is a consequence of the pairing of agricultural products to the US dollar and to the policy of cheaper food on the retail market. Coupled to other factors, the situation has led to easily observed migrations to the towns and cities (PERES et al., 2004).

The above situation is heightened due to the small size of rural properties and the family labor employed. In fact, this is typical of the community under analysis contrasting to the industrialization and mechanization of production, as reported by Silva et al. (2005). Owing to low buying power and to the decrease in the number of inhabitants on small-sized rural properties where the interviews took place (it is a common feature that the offspring of farm owners go to school in the town and shun working anymore on the farm), the even smaller numbers of remaining laborers start using pesticides. This fact exposes them to toxic risks and to probable establishment of poisoning events.

Moreover, agricultural labor and its use of pesticides greatly reflect the political and economical guidelines determined for this specific population. A historical discourse is thus reinforced on the need of using pesticides to warrant agricultural production for consumption and for the exporting market, foregrounded on the idea of a mono-culture production model (PERES et al., 2005b). The model thus incorporates the risk inherent to the use of pesticides.

It is highly important to define what are risks and risk factors which current research tries to detect and analyze since most data obtained and discussed are related to the risks of exposure and intoxication. Silva et al. (2005) state that risk factors may be understood as the expression of employed technologies, of labor division and organization, of workers' intervention in their place of work, of technical and institutional activities related to problems that involve their legality.

Within this context, age or age bracket of rural workers is highly important since it constitutes common information to indicate the active portion of workers within a determined community, the potential time of exposure or the earliness of such exposure.

The population sample under analysis showed that more than 50% of farm laborers participants in current research were over 35 years old and 32% were within the 36-50 year-old bracket. In fact, it is the most active age bracket in this type of labor. Data

also showed that 72 and 28% of participants in the research had respectively more and less than 35 years of farm labor, demonstrating the long period of possible exposure to pesticides.

Moreover 54% of farm workers under analysis had lower junior schooling, 22% had higher junior schooling, 2% had began secondary schooling and 16% complete high school. Only 6% of the farmers had completed their undergraduate course. In a study on farm laborers in the interior of the state of São Paulo, Brazil, Schmidt and Godinho (2006) reported on the farmers' low schooling level, very similar to most of the people interviewed in current research. Actually 76% of participants had only had primary schooling. Farm workers in other Brazilian states have a similar profile characterized by low schooling which causes a decrease in understanding the risks inherent to pesticides (ARAÚJO et al., 2000; MOREIRA et al., 2002).

Duration of pesticide use on farms also showed great variations among the interviewed population. In fact, 24% used pesticides for less than 5 years; 20% between 5 and 10 years; 32% between 11 and 20 years and 24% for more than 20 years (Figure 1A), most of whom (62%) were males. With regard to the frequency of pesticide used by farm workers in the space of one year, the questionnaire revealed that 40% used them for 3 months; 48% for 6 months and only 12% used them once (Figure 1B).

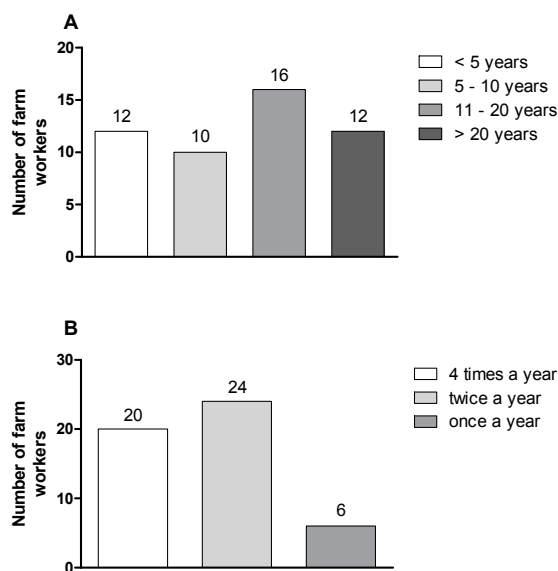


Figure 1. Time during which pesticides were employed (A) and Interval between pesticide applications during the year (B) by farm workers in current study.

The above data show the dependence on pesticides in agricultural management, their subsequent contribution in environment toxic

accumulation and the degree of exposure experienced by agricultural workers (BRITO et al., 2009).

Pesticide application methods are highly diversified although 50% of farmers use knapsack sprayers. Low price in their acquisition and maintenance justify their use although this type of application increases poisoning risk if adequate personal protective equipments are not used. Contact with the pesticide is direct and exposes the applicators to the poison through skin, mouth and inhalation. Moreover, 40% of farm workers apply pesticides by means of sprayers mounted on tractors, a practice generally associated with extensive agricultural areas. However, the method also sprays great amounts of pesticides which establish poisonous conditions if these particles are disseminated by the wind. Approximately 10% of farmers merely prepare the dilution as described on the label of each pesticide. In this case, since the people who prepare the product are not the same as the sprayers, the former are not concerned in using the personal protective equipments. A statement by one of the female farm workers interviewed revealed a highly critical situation. Mentioning the preparation of the solution, she stated: "I prepare the mixture by hand". In other words, gloves were not used.

Acute and chronic signs and symptoms of poisoning by pesticides in humans are extremely relevant data for therapy against the toxic substances and for the elucidation of the etiology for secondary diseases related to poisoning. Investigating the process of casual identification and decision and attitude taking, Levigard e Rosemberg (2004) provided signs and symptoms of pesticide poisoning which are characteristics of pesticide-caused diseases. These may be abundant sweating, intense salivation, tears, body weakness, giddiness, abdominal pain and aches, dizziness, contracted pupils, vomiting, difficulties in breathing, body collapse, muscular trembling and convulsions.

If the pesticide application methods are coupled to the frequency with which the farmers applied the pesticides, the existence of potential poisoning risks in the population interviewed becomes clear. In fact, when the farmers were asked whether they had felt any reaction after handling the pesticides, 72% answered affirmatively. Headaches were prevalent (31.91%) among the signs and symptoms mentioned by the farmers, followed by general discomfort (12.55%); nausea, dizziness and a feeling of burning in the nose (11.11% each); facial erythema (6.67%);

itching on the lips, feeling of burning in the eyes, coughing (4.44% each); allergies (2.22%) (Table 1).

The monitoring of pesticide exposure may reduce the number of poisoned individuals, prevent new cases and minimize the seriousness of intoxication illnesses already diagnosed. Further, it provides better therapeutic results during the patients' recovery (PERES et al., 2005a).

However, although monitoring pesticide exposure may be a crucial attitude for the well-being of rural workers, it does not seem to be properly faced by health policies in the municipality of Concordia. Poisoning diagnosis, when adequately detected, and treatment for specific cases are the activities observed. However, there are no programs or activities which establish educational planning for the prevention of pesticide poisoning so that exposure risks would be reduced on the farms.

Table 1. Percentage of the distribution of signs and symptoms previous to the interview which were perceived by farm workers when in contact with pesticides.

Signs and symptoms reported	Occurrences(%)
Headaches	31.91
Discomfort	12.55
Nauseas	11.11
Dizziness	11.11
Burning in the nose	11.11
Facial Erythema	6.67
Lip itching	4.44
Burning in the eyes	4.44
Coughing	4.44
Allergies	2.22

Changes are not easily made since they denote conscience-raising of needs, logistic support (which includes the clinical and laboratory support), technical cooperation with government organizations for an improvement in the transit and the quality of information and strategies for changes in planting practices (decrease or even total abandon or slow reduction of the use of pesticides), technical support and strategies for the export of produce.

The problem may be heightened through the concomitant use of more than one pesticide according to the need of the particular cash crop and the presence of weeds or pests. Table 2 shows the use of several types and brands of pesticides. Pesticides represent approximately 85% of products used by farmers interviewed, although not all of them remembered all the names of the pesticides employed. Most may have mentioned either those which they handled recently or those which they thought were the most relevant. If this actually occurred, the existence of poisoning risk may be taken as proportional.

Table 2. Identification, toxicological classification and percentage of pesticides used by farmers and mentioned in the interview. Toxicological classification according to WHO (2009).

Active substance	Toxicological class	Use (%)
Glyphosate	III	35.71
Mesotrione	NL	20.54
Lambda-cyhalothrin	II	15.18
Fluroxypyr	U	8.93
Parathion	Ia	5.36
Metsulfuron-methyl	U	5.36
Paraquat + Diuron	II	2.68
Atrazine + simazine	III	1.78
Nicosulfuron	U	1.25
Others	II and III	3.21

I – Extremely hazardous; II – Moderately hazardous; III – Slightly hazardous; U – Unlikely to present acute hazard in normal use; NL – Not listed.

Table 2 shows that the herbicide glyphosate is highly used by the farmers. The fact coincides with the trend according to which use of pesticide expands according to geographical limits since among the toxic products glyphosate is first in sales and use (VESTENA et al., 2009).

Toxic risk for the sample of farmers under analysis increases according to their lack or scanty knowledge level on the products used and on the aggregate toxic effects in their use (Figures 2A and 2B). The interviews demonstrated that only 6% (7) of the farmers involved in current research said they were totally aware of the pesticides employed. However, 80% (40) of the total replied they had scanty knowledge and, more worrying still, 14% answered they had no information on the pesticide used. These data corroborate other studies conducted in Brazil. In fact, it constitutes a serious threat not only to the farmers' health but also to consumers of the final products (ARAÚJO et al., 2007; MOREIRA et al., 2002; SOARES et al., 2003).

So that one may understand the type of knowledge and perception of farmers on the pesticides used, which is closely linked to their exposure to these pesticides, the farmers were asked whether they could identify the signs and symptoms on their organisms which manifest themselves through the handling and exposure of the pesticides. Results showed that a high percentage (76%; 38) of the farmers could detect the signs and symptoms of intoxication in contrast to a very low percentage (9%; 12) that replied ignorance of the fact (Figure 2C). Although farmers replied positively that they were aware of symptoms related to poisoning by pesticides, research only revealed knowledge on nausea, dizziness and headaches. It may be possible that they lacked the knowledge on the wide spectrum of information and that this knowledge was only due to observations on themselves and on others. In fact, these signs were the most frequent. If this actually occurred, the appearance of other

symptoms would not be identified as a consequence of the use of pesticides, which may increase risks in exposure and toxicity.

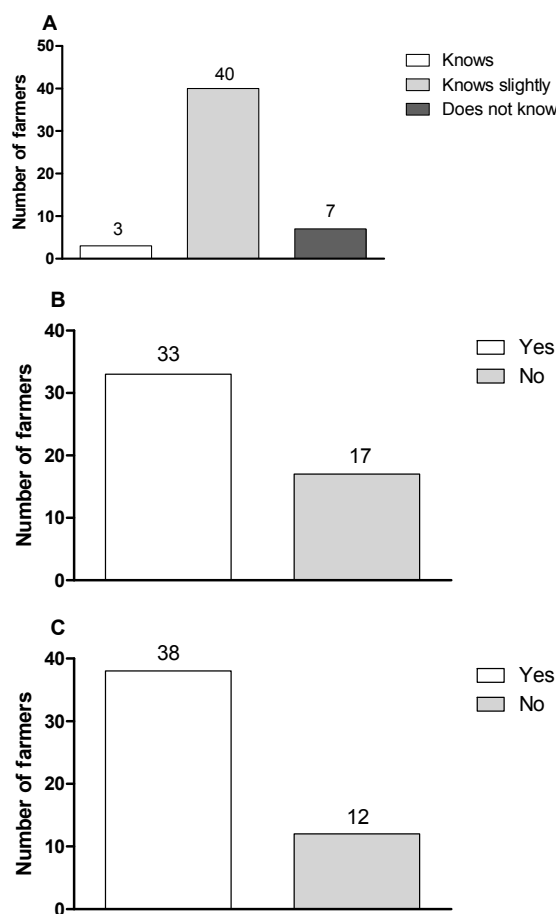


Figure 2. Knowledge of farmers interviewed on the pesticides used (A), on risks in their use (B) and on the perception of signs or symptoms of poisoning (C).

Another relevant item within the toxicity risks is the information with regard to the indications and health care when handling or applying these toxic products, which makes mandatory the presence and orientation of an agricultural technician or an agronomy engineer. However, only 18% of the participants had received any technical orientation, in contrast to the other 52% who did not receive any professional monitoring. There were even other farmers (30%) who received orientation from non-professional people. Such information is highly disturbing since more than half of the farm workers are simply left to fend for themselves or on their capacity to understand the technical information provided on the labels or the accompanying information sheet of the toxic products. Another relevant item is the unsafe information given by non-professional personnel since instructions may

be conflicting and cause a higher exposure to the workers that handle or apply the pesticides.

It is important to note that even when most farmers said they were aware of the risks involved when handling pesticides and they were conscious of the signs and symptoms characteristic of pesticide poisoning, only 38 replied that they use PPE to protect themselves adequately. This evidence may be related either to the irresponsibility of the farmers who know the risks in handling pesticides without PPEs, or to lack of knowledge and information or even to a distorted perception of facts on exposure risks. They thus become victims of the entire process which leads them to mistakes and involuntary careless actions.

Nevertheless, the lack of the use of PPEs was justified by the same farmers under three headings: PPEs are expensive for many workers since they live on what they plant (information given by those with low buying power); PPEs are uncomfortable and terrible to use in the heat of the day (information given by those who could buy the equipments); decreasing farms hands with no time to waste. Frequently some farmers use PPEs only partially which do not guarantee total protection.

According to Fonseca et al. (2007), some studies show that the proper use of PPRs is related to the knowledge of risks inherent to the management of pesticides that makes the workers responsible for their perception of the accumulated risks when handling or applying pesticides. Moreover, according to Peres et al. (2005a), other studies suggest that the most important thing is not the risk in itself but the perception of risks that bring out interpretations, evaluations and criteria at the subjective and intersubjective levels of the agents involved. In this case, behavior is associated with representations measured by the cultural aspects of the individuals who determine the way they produce actions, either by ignoring or not the probability of occurrences of damage and harm to health.

Another important factor for the safety of farm workers is bath-taking after the application of pesticides. When asked on this item, it became clear that a high percentage (94%) of rural workers took a bath after handling or applying pesticides, in contrast to 6% who failed to do so.

Information is highly relevant to assure the farmers' health and the correct preparation and handling of the toxic products. The farmers were asked if they read the label on each batch of pesticides prior to use. Only 38% (19) were accustomed to do so even though they mentioned reading only the information on pests and doses necessary.

Further, 48% (24) of the farmers interviewed reported difficulties in understanding the information provided on the labels whereas 18% (9) failed to understand anything on the label read. The other 34% (17) of the interviewed farmers reported easy understanding of the information on the labels (Figure 3A). However, all said that the size of the letters was extremely small and difficult to read and an excess of information was provided. It may be asked whether those rural workers who said they understood all the information on the label actually did so with regard to required and important information on the products.

These data enhance the fragility to access information, which makes the workers susceptible to the installation of toxic diseases due to the intoxication risks and lack of assistance.

A strategy to minimize the occurrence of accidents by pesticides is the differentiation of colors on the labels to identify the toxicological class they belong to. As a rule, this strategy may facilitate the farmers' perception and make them take greater care in the handling and application of pesticides. However, not all the interviewed farmers were aware of the meaning of the symbols employed as Figure 3B shows. In fact, 48% (24) knew the meaning of the color bands in contrast to 28% (14) who did not know their meaning and even 24% (12) who only had scanty knowledge on this classification.

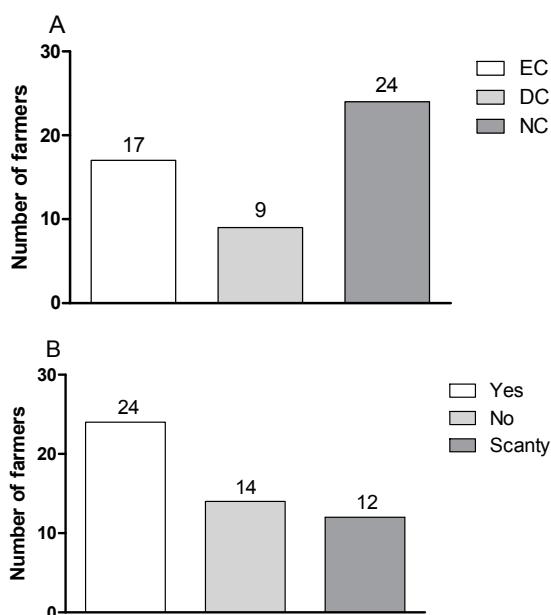


Figure 3. Comprehension by interviewed farm workers on the contents of labels on pesticides (A); Comprehension of color bands on the labels by farm workers (B).

EC = easy comprehension, DC = difficulties in comprehension, NC = no comprehension.

Facts on exposure and poisoning risks of the rural workers in the community under analysis cause great concern and stimulate the establishment of strategies on efficacious and sufficient information to the rural workers in the handling and application of pesticides. This fact requires a commitment of all people involved in the process on the use and consumption of the products, with a lessening of the intrinsic risks involved.

On the other hand, positive experiences, alternatives to the use of pesticides, are on the market which, contrary to what is published, are established deeply in common sense and are able to maintain the commercial equilibrium, feed great populations with great prodigality and remove or at least decrease the toxicity risks of rural workers (PERES et al., 2005a).

These facts may be accomplished entirely within the community under analysis since it does not comprise large estate farmers. On the contrary, they have small farms run by family cooperation. In principle, it seems to be easy to adopt an alternative for the use of pesticides, when the area, aggregated value in organic products and decrease in poisoning risks are taken into account. Certain impairments, such as the propaganda for the use of pesticides which has been present for many years, should be overcome. By the age brackets given in the interviews, one may surmise that most farmers grew up convinced that pesticides were fundamental compounds for the success of agricultural production.

Conclusion

Current research emphasized the evident lack of technical information on the use and acre in the handling and application of pesticides by the farmers interviewed. Their perception of health risks is at odds with the actual fact of exposure to pesticides brought about by lack of information. When a state of health risk is perceived, help is generally not the best available. All data corroborate towards an increase in health risks of the interviewed farmers in their daily work. Measures of sensitiveness that would raise their perception to self-care in the handling and application of pesticides should be enhanced.

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