

Knowledge and Practice of Farmers on Pesticide Pre-Harvest Interval and Pre-Entry Period and Personal Protective Equipment Use in Vegetable Growing Area of South Gondar, Ethiopia

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Abstract

This study aimed to assess the personal protective equipment use, understanding of farmers on pre-harvest interval, and pre-entry period for pesticides on different vegetables after pesticide application in south Gondar, Ethiopia. Sixty-three farmers were randomly selected and interviewed using a questionnaire. The majority of the farmers were not aware of the negative effects of pesticides on their health and the environment if not well handled. The farmers did not have awareness about the pesticide pre-harvest interval period and they did not read the instruction. Similarly, none of the respondents, followed the instruction of the manufacturer (reentry time specified on pesticide label) to reenter the sprayed field. Furthermore, farmers in the study area do have not enough awareness or they are careless regarding PPE use. Unavailability, inconvenience PPE wearing (e.g. mask affect breath properly), misperception about pesticide long term health effect and cost of personal protective equipment were raised as major causes for different farmers as factors behind their pesticide handling without personal protective equipment. It is recommended that If farmers can not to read the period of reentry on the pesticide container label, it is advised to wait at least 72 hours after the last application.

Keywords: pesticide Pre-harvest interval period, re-entry time, personal protective equipment

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Introduction

Farmers can be influenced by pesticides during transport of pesticides and preparation of spray solution as well as before, during or after pesticide application (Andrade-Rivas and Rother, 2015)

In particular, farmers can be affected by pesticides in three different ways during pesticide use. These mainly include oral exposure, dermal exposure, and exposure via inhalation. Especially during spraying with fog (10-30 mm) or aerosol (30-50 mm) small droplets, which are suspended in the air, farmers have to use a mask (Matthews, 2006). If farmers do not use mask, pesticide droplets about 1e 5 mm in diameter are accumulated in the lungs and the breathing tube. Furthermore, small droplets (<1 mm) are spread in the lower part of the lungs (Lindquöst et al., 1993).

According to studies performed in Italy, approximately 30% of foods showed residues below MRLs, and the main products that provide residues to a person's diet were fruits and wine, comprising 77 and 15% of intake residues, respectively (Pasarella *et al.*, 2009).

Pesticides are the only toxic substances released intentionally into our environment to kill living things (Sarwar, 2015). In the most cases, they are designed to kill pests; however, many pesticides can also pose risks to the peoples (Sarwar, 2015). Chemical pesticides contaminate surface water and as a result, affect fish population, livestock, poultry and human health. To regain the lost status of safe food, it is high time to start agriculture with judicious use of agricultural inputs without further delay. The health effects of pesticides depend on the type of pesticide, some chemicals such as the organophosphates and carbamates; affect the nervous system, while others may irritate the skin or eyes (Sarwar, 2015). There are several classes of pesticide including insecticides (control insect infestations), fungicides (control the spread of fungal diseases), herbicides (control the competing effects of weeds), molluscicides (control the destructive effects of slugs and snails) and rodenticides (control the activities of rats and mice) (Aktar et al., 2009; Agrawal et al., 2010). Inappropriate use of pesticides can have negative effects on human health and agro-ecosystems, damage wildlife habitats, create pesticide resistance of insects and diseases, and pollute ground and surface water resources (Shormar et al., 2014). Every pesticide has a withholding period or pre-harvest interval (PHI), which is defined as the number of days required to lapse, between the date of final pesticide application and harvest, for residues to fall below the tolerance level established for that crop or for a similar food type (Prodhan *et al.*, 2018). The PHI differs from pesticide to pesticide and crop to crop. But very little or limited research work has so far been done to determine how long time the farmer wait for vegetable harvesting after spraying of pesticide. Therefore, the current research work was undertaken to assess the farmers understanding on pre-harvest interval and pre-entry period and personal protective equipment use for pesticides.

Material and Methods

Study area

The assessment was conducted in three districts, Fogera, Dera and Libokemkem of South Gondar and these districts were selected because the majority of farmers use their irrigated land for vegetables production. The survey carried out from October 2020 and March 2021. The questionnaire was first prepared and pretested to improve it and there after translated to local language for convenience communication between farmers and interviewers. The multi-stage sampling technique was used to select the respondents for the study. A total of 63 irrigated vegetable growers who have more than one year vegetable production and pest management experience, were interviewed.

Data analysis

The statistical package for social sciences (SPSS) software version 20.0 was used for data analysis.

Result and discussion

The majority pesticide sprayer in the study area is males, regarding to their age 18-36 years old farmers account 56%. Around half percent (48%) of respondents aged above 36 years, the remained respondents (18%) were younger than 16years. Farmers who had more than 49 years of age only 9.32%. Byrness and Byrness, 1978, reported that education enhances one's ability to receive, decode and understand information. The current result showed that 55% of the participants were didn't receive any formal education at all, whereas 38% of respondents had primary school education. The remaining 9% of respondents were secondary school graduates, while only one respondent attained a college diploma.

Table1 showed that the socio-economic characteristics of the farmers.

Variables	Respondents (%) (N=63)
Work force in pesticide application (sex)	
Male	99
Female	1
Work force for pesticide spray (age)	
12-16	18
18-36	56
>36	48
Level of education	
Illiterate (unable to read and write)	55
Elementary (Grade 1-8)	38
Secondary (Grade 9-12)	9
College or University graduated	1

Use of personal protective equipment (PPE) by small holder farmers

PPE is categorized in five groups. These are head protection, eye and face protection, body protection, respiratory protection, as well as hand and foot protection.

Table 2 showed that use of personal protective equipment, fate of empty pesticide container and storage practice. Studies indicate that PPE and behaviors are effective in reducing farmers' exposure to pesticides (Damalas and Hashemi, 2010). According to Payán, 2012 lack of personal protective equipment (PPE) is the cause of potential exposure through dermal absorption and inhalation, accordingly that increase the risk of a long-term health effect. In this regard most of (94.81%) vegetable growers in our study area did not use personal protective equipment during pesticide application; they wear normal clothes (Table2). Furthermore, the farmers in this survey experienced pesticide spraying with bare feet were 29%. In the other aspect, only 15.58% of participants used hats at the time of pesticide application (Table 2). Using overalls and boots are the other recommended PPE during pesticide application, but only 2.6% and 10.39% of our participants used overalls and boots respectively. The current survey revealed that only 12.99 % of farmers wear a mask during pesticide application (Table 2). Additionally, our survey showed that only one and two of the farmers wear eyeglass and closed boots, respectively (Table 2). Overall, our study found that almost all farmers did not use full PPE during pesticide mixing and spray, which relates to a previous study conducted in some part of Ethiopia, by Mequanint et al. (2019) which revealed that 90.2% of farmers did not use PPE during pesticide mixing and application and only in 10% farmers use PPE (Negatu et al. 2016). These previous and current study similarities implied that there is no progressive change from year to year (2016 to 2021) in using of PPE. Hence, Ethiopian government should give attention and sensitise farmers about the risks associated with the use of pesticides and PPE.

The current study situation is similar with other African some low-income countries, such as Ghana, is even worse: Okoffo et al. (2016) show that about one-fifth of the farmers in that country do not wear any PPE, while the most of the others protect themselves only partially. Similarly dy Samuel et al., 2015 reported that farmers in Nigeria did not use PPE during herbicide applications.

Ethiopian farmers use adequate PPE only in 10% of cases, and 62% of them do not take a shower after

applying pesticides, even when using scarce protections (Negatu et al. 2016).

This implied that farmers in different part of developing country, particularly in Ethiopia have no enough awareness or they are careless regarding PPE using. Unavailability, inconvenience PPE wearing (e.g. mask affect breath properly), misperception about pesticide long term health effect and cost of personal protective equipment were raised as major cause for different farmers as factors behind their pesticide handling without personal protective equipment. The current study, farmers' point of view regarding not use of PPE, in line with Nicol and Kennedy, 2008 report which showed that discomfort, high expense and loss of time as farmers' reasons for not wearing PPE. Research suggests that farmers who had a higher income used significantly higher pesticide safety practices (Moradhaseli et al., 2017, Khan, 2009). They also have greater access to information that explains the need for PPE and how best to use it (Sapbamrer et al., 2020). On smaller operations, farmers more often do not follow manufacturers' safety recommendations for handling and applying pesticides and cannot afford or do not use adequate protective clothes or equipment.

Our study suggests that manufacturers' rethink and produce comfortable, affordable and adequate protective clothes for developing country small holder farmers. They also consider the size of protective equipment for different country people. Furthermore, awareness creation about importance wearing PPE expected from government and non government organization. Researchers also should contribute regarding PPE by verifying it, is really unsuitable or not. If it is unsuitable, the researcher should design and redesign how and which PPE should be effective and suitable for those developing country small holder farmers.

Table 2 represents the places where pesticides purchase, and storage carried out and fate of empty pesticide container (multiple answers possible).

Variables	Respondents (%) (N=63)
Protective equipment used bay farmers	
Wearing normal clothes	94.81
Hat	15.58
Spraying with bare feet	22.08
Boots	10.39
Face mask	12.99
Eye glass	1.3

Re-entry period to treated farms

None of the respondents followed the instruction of manufacturer (reentry time specified on pesticide label) to reenter to the sprayed field. Half of the interview participants (52.38%) reentered their pesticide treated field after 24 h, while 33.33% of the respondents reentered the sprayed fields just after finishing the spray work. Furthermore, about 30.16%, and 15.87%, of the respondents reentered after seven and >10 days, respectively. Farmers also asked who and why they entered to their pesticide treated farm, they said that, the purpose of entering into the farm was, to collect grass for their livestock, for weeding purpose, and to irrigate the farm, all the family members (including women, children) have possibility to enter to the farm without any PPE. The current result showed, farmers did have no awareness and knowledge with the concept of safe re-entry times for treated fields.

The respondents families members, including children and women exposed to pesticide risk, associated to disrespect of the product labels of periods of re- entry.

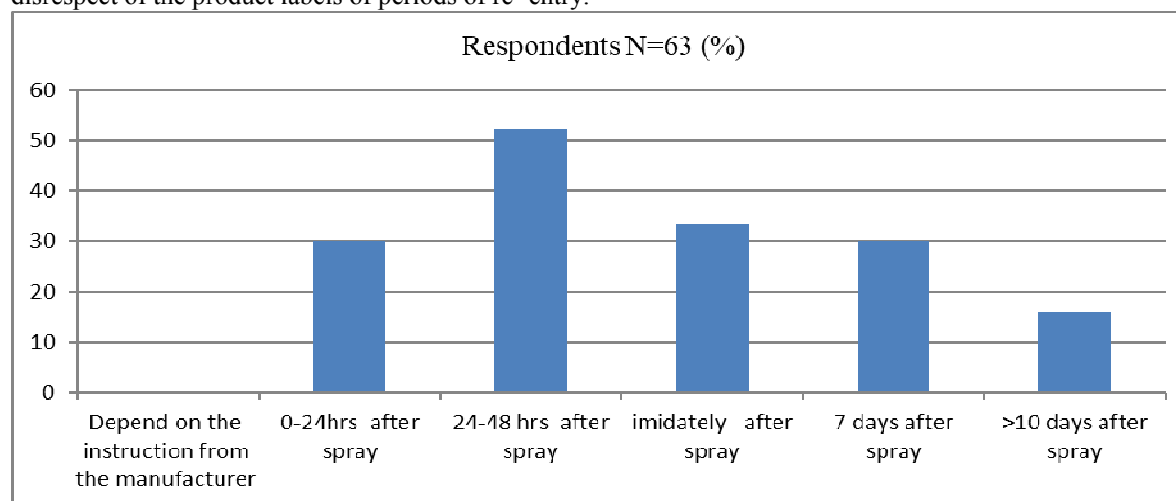


Figure 2 represent the farmers Re-entry period to their farm Residues on food crops and pre-harvest intervals

The current findings revealed that 2% farmers harvested the product within 24 hrs of the pesticide application, 9% of them harvest after 2 days. Majority of farmers 39% of farmers harvested the vegetable after 10 days pesticide spray and 17% of the farmers who had harvest the products after 5 days pesticide application. Around 33% of them harvested after two weeks. The current research found that none of farmers read manufacturer instruction (pre-harvest interval) in pesticides label prior to harvest of vegetables (Fig 3). Pre-harvest interval is also not fully understood. Thus farmers in the current study area violate the Environmental Protection Agency (EPA) of USA recommendation, which states that farmers should allow 1-3 weeks period to reduce the residual effects of pesticides before harvesting the crop and it's depending on the type of pesticides (Sharaniya and Loganathan, 2016). The maximum residual limit (MRL) of pesticides in the vegetables for human is 0.1-0.3 mg/kg (depending on the type of pesticides and vegetables) that is only possible to get within one week after spraying of pesticides (Prodhan et al., 2018). It indicates that maximum vegetables in Ethiopia may carry more than the MRL. In all study area highly toxic (II class pesticide) vegetables were harvested by the farmer. The results of this survey, farmers in the current study didn't consider about residual toxicity of pesticides and their health impacts and they considered only their income.

The PHIs for a given product will not be the same for all vegetables.

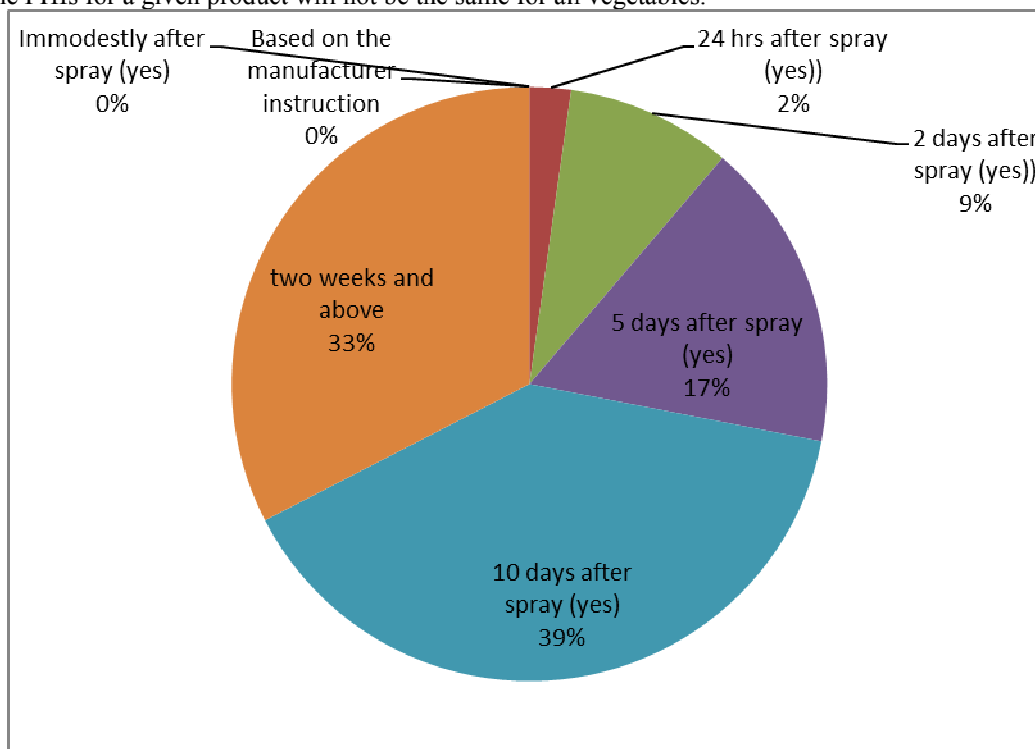


Figure 3 showed that the percentage of farmer among the vegetable based on the PHI of pesticide.

Do farmers understand the Maximum Residue Limits ?

All most all farmers did not have awareness about MRLs which are the most implemented standards when it comes to food safety, as they represent the maximum concentration of the pesticide residue in commodities. MRLs set by different countries/ or organizations legislation are good indication for consumers in aspect of human health prospective.

Table 1 represents farmers understanding on Maximum residue limits (MRL)

Maximum residue limits (MRL)	Respondents (%) (N=63)
Do you Know MRL (yes)	1.2

Time of pesticide application (within the day)

Many insects are most active early in the morning and around dusk, making very early morning and early evening the most effective times for insecticide application. According to the Just as plants absorb water best early in the morning, they will absorb chemicals most effectively between 3 a.m. and 8 a.m., and again around dusk. Majority of farmers (73%) farmers spray pesticide between 7:00 to 10:00 am morning and 41.3% respondents' sprayed pesticide from 10:00 to 12:00 am. Quarter of respondents (30.2%) applied pesticide at the wrong time (12:00 am to 9:00 pm). Insecticides can have undesirable consequences if they are applied at the wrong time.

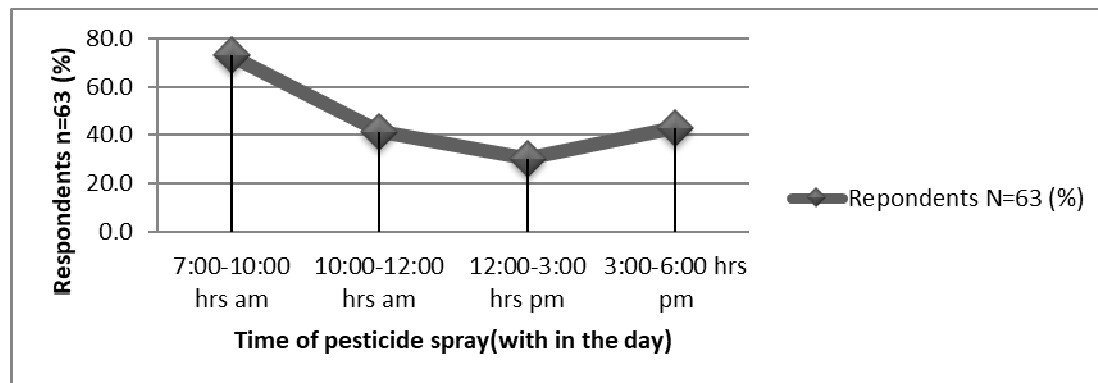


Figure 1 showed that pesticide spray time by the farmers

Conclusion

Most of the farmers had no clear understanding about pesticide pre-entry and pre-harvest period same farmers harvested the product same day of the pesticide application, and they reentered to the treated farm. Thus farmers in the current study area violate the Environmental Protection Agency (EPA) of USA recommendation regarding pesticide pre-entry and pre-harvest period, which states that farmers should allow 1-3 weeks period to reduce the residual effects of pesticides before harvesting the crop and it's depending on the type of pesticides (Sharaniya and Loganathan, 2016). The maximum residual limit (MRL) of pesticides in the vegetables for human is 0.1-0.3 mg/kg (depending on the type of pesticides and vegetables) that is only possible to get within one week after spraying of pesticides (Prodhan et al., 2018). It indicates that maximum vegetables in Ethiopia may carry more than the MRL. In all study area highly toxic (II class pesticide) vegetables were harvested by the farmer. Farmers in Ethiopia have no enough awareness or they are careless regarding PPE using. Unavailability, inconvenience PPE wearing (e.g. mask affect breath properly), misperception about pesticide long term health effect and cost of personal protective equipment were raised as major cause for different farmers as factors behind their pesticide handling without personal protective equipment.

It is recommended that if farmers can not to read the period of reentry period on the pesticide container label, it is advised to wait at least 72 hours after the last application. Furthermore, to minimize pesticide effects on human health, farmers have to use appropriate personal protective equipment (PPE) in all stages of pesticide handling.

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