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Interventions in Handling of Pesticides in Agriculture: A Review

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Abstract

Pesticides are widely used to reduce the incidence of crop destruction due to attack by insect –pests and thereby help to improve crop yield. But despite these benefits, they also contribute to the destruction of environment as well as human health, if not used as per the recommended guidelines. Hence, there is a need to educate the farmers and their families about the appropriate usage of pesticides to improve yield as well as quality of crops without harming themselves and the environment. This paper presents a review of various studies undertaken with the farming community to reduce pesticide exposure and change in their behaviour regarding handling pesticides through the means of educational intervention programmes. For this, eighteen researches published in various esteemed journals were selected on the basis of criteria like farmer's handling the pesticides and analysed through systematic approach. As an outcome of the review, it was found that the farming community showed improvement in safe pesticides handling practices as a result of educational interventions in the intervention areas (experimental) as compared to the non-intervention (controlled) areas. Hence, further provides scope for these kinds of researches and reviews in order to make people aware about these facts.

Keywords: Behavioural change, Intervention, Knowledge acquisition, Personal Protective Equipment, Pesticides.

1. Introduction

Agriculture supports the livelihood of nearly two- thirds of the Indian population and has been considered as the lifeline of Indian economy for many years. It also signifies as the largest private enterprise contributing over 17% to the National Gross Domestic Product; accounts for more than 10% of the national exports besides engaging 52% of the national workforce and forms the backbone of Agri-based industry (Kumar and Pradhan, 2011; ICAR, 2014).

India, over the years with the application of modern agricultural technologies has moved from the era of chronic food shortages and 'begging bowl' status during the 1960s with annual food import around 8-10 MT to a level of self – sufficiency and buffer stocks since 1990s. The period of transformation has not only paved for the achievement of self-sufficiency in food grain production but also became a food grain exporting base to many countries (ICAR, 2014). As an outcome of the Green Revolution, application of modern agricultural tools and techniques have become widespread and been helping the agricultural sector in India to achieve goals of food production over the years. The development and infusion of agricultural production technologies in recent decades have made a visible impact on the national food and nutritional security (ICAR, 2014). This can be inferred from the growth of increased farm production in recent years.

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The food grain production of India in recent year (264 MT in 2013-14) is approximately 7 MT higher than the previous year's (257 MT in 2012-13) food grain production (IBEF, 2015).The introduction of modern agricultural technology i.e., high yielding varieties, off-season cultivation, hybrid seeds, and high external inputs contributed to the increased agricultural productivity as well as improvement in the economy with welfare of the people.

However, the economic implications of the crop damage and crop loss due to the pest incidences have compelled many Indian farmers to resort to frequent pesticide applications. Pesticides are positioned as one of the chief inputs of agrarian growth of the country. Because of the benefits associated with pesticides like improved crop yields, reduced civil unrest etc., the extensive use of pesticides has taken place in the last few years (Government of Puducherry, 2015).

But the excessive and uncontrolled use of pesticides in order to gain higher yields over the years resulted in dramatic changes in insect pest outbreaks vis a vis crop production. The escalating quest for higher profit and superfluous pesticide usage triggered several ecological and environmental consequences as well as, the unsafe practices in farming sector. In India, 51% of the food commodities have been detected with pesticide residues (Gupta, 2004). A study conducted by Charan *et al*. in 2010, to determine the pesticide contamination levels in farmgate vegetables of the Central Aravalli Region, revealed that 40.11% of total analyzed samples were contaminated with different pesticide residues. It was also reported that 35.62% of total contaminated samples exceeded the maximum residual limit (MRL) values recommended by the Food and Agriculture Organization (FAO)/ World Health Organization (WHO). Another study conducted by Ranga *et al*.(2009) with the objective to investigate the pesticide residues in vegetables (brinjal, cucumber, okra, ridge gourd and tomato) from Kothapally adarsh watershed in Rangareddy district, Andhra Pradesh, India during 2007 revealed the presence of monocrotophos, chlorpyrifos, cypermethrin and endosulfan etc. in the vegetables. The residues of chlorpyrifos were reported to be above the MRL in 4 samples along with cypermethrin in 2 samples.

The above instances demand for a critical analysis of the pros and cons with the use of pesticides. Especially the resistance (which causes higher doses and more frequent use of pesticides), resurgence of insect pests (which, after removing natural enemies creates more dependence on pesticides), environmental pollution, impacts of pesticides on the health, effects on non-target organisms caused by wrongful use of pesticides etc. are the issues which need consideration (IPM Thailand, 2008). Besides, the pesticide overuse leads to disruption in the food cycle and the food web and leaves residues in food commodities as well (Jeyanthi and Kombairaju, 2005). According to a report, over 98% of sprayed insecticides and 95% of herbicides reached non-target destinations such as other species, air, water and soil (Henkel, n.d.). It is also reported that pesticide drift occurs when pesticides are delivered by aerial method as particles are carried by the wind to other areas, potentially spreading the contamination in the area. Incidentally, pesticides are one of the causes of water pollution as well as soil contamination as some pesticides are persistent and identified as organic pollutants. For instance, in the laboratory analysis in Kasaragod district of Kerala, blood samples collected from the villagers of Kasaragod, revealed very high levels of the pesticide contents especially endosulfan. It was also reported that exposure of people to endosulfan resulted in the diseases like skin problems, cancer and lung complications etc. (Tholkappian and Rajendran, 2011).

2. Rationale of the Study

From the professional health hazard point of view farmers and agricultural workers, engaged in pesticide applications are amongst the most affected people by the overuse of pesticides (Mazumder, 2011). As a consequence, human casualty, pesticide poisonings are reported to be occurring due to mishandling of pesticides (FAO, 2015). It is, therefore, a clear imperative that safe handling of pesticides is inevitable as the farming community can be benefited with the technological innovations while ensuring human safety and environmental protection.

However, it requires no special emphasis that application of innovative tools such as specially designed educational intervention trainings can support the farming community to mitigate causes as well as the impacts of the pesticides. Giannandrea and Iezzi, 2014 mentioned that an increasing number of studies conducted amongst agricultural workers in the past found that reducing exposure to pesticides is possible by emphasizing and encouraging the use of personal protective equipment (PPE) and change in the behaviour while handling the pesticides. Educational programme for the workers in regard to the harmful effects of using high doses of chemicals and training for correct preventive behaviour are the most effective measures to mitigate the exposures to their health as well as to the environment. Considering the importance of the issue, present review is attempted.

The objective of this review is to determine the effectiveness of various types of interventions undertaken to mitigate the harmful effects of mishandling of pesticides and to enhance the knowledge regarding pesticide handling amongst the farming community.

3. Methods

3.1 Search Strategy

In order to collect the secondary information on the study area, relevant cases from peer-reviewed esteemed journals, online technical, and government reports were retrieved using a systematic approach. The search was restricted to the studies published in English only. The data mining enquiry was performed with a combination of the following search words/ terms: “pesticide exposure”, "pesticides", “intervention”, “educational program”, “training”, “protect”, “safety behaviour”, “personal protective equipment”, “crops”, “diseases", “farming”, "agricultural worker", "vegetable grower", “pesticide residue” , “gloves”, “hats”, “knowledge”, “Knowledge Attitude Practice (KAP) Score” etc,.

3.2 Study population

The studies evaluated in this paper, include researches giving information on the evaluation of interventional trainings in respect to pesticide exposure, handling of chemicals, usage of PPE, enhancement of the pesticide handling knowledge etc. These studies focused on the subjects of all ages (adults) and both genders. Subjects include mainly the agricultural workers, professionally involved in agricultural activities associated with pesticides (i.e. mixers, loaders, sprayers; general farm workers etc.). Some cases also studied farming families so as to evaluate the practices of pesticides handling in their homes. Accepting the importance of educational intervention, this paper highlights the concept with the effectiveness observed in various studies.

3.3 Interventions in Social Work

An Intervention is a systematic study of purposive change strategies and is characterized by the design and development of interventions. The internal logic of an intervention can be assessed as the extent to which malleable risk factors are paired with change strategies of sufficient strength to produce positive outcomes. The process of designing an intervention is evaluative and creative. It requires blending existing research and theory with other knowledge to create intervention principles and action strategies. Creating interventions is generative and requires ability to form learning activities that have a cultural and contextual metric. Interventions are developed in a series of pilot studies that lead to larger studies of efficacy and effectiveness (Fraser and Galinksy, 2010)

Through an intervention process, a positive change is introduced into thoughts, feelings, and behaviors of a person who is supposed to undergo the intervention process. In a clear and respectful way, they inform the person of factual information regarding his or her behavior and how it may have affected them. The immediate objective of an intervention is for the self-destructive person to listen and to accept help (Hazelden Betty Ford Foundation, 2015). Interventions range from single technique (motivational interviewing) to multielement programs (assertive community treatment). Some of the commonly used interventional study designs are Randomized controlled trial, Pre/ Post study design, Non-randomized controlled trials, and Quasi-experiments etc.

3.4 Types of Interventions studied

Educational interventions applied to reduce pesticide exposure and change in the behaviour in regard to handling chemicals were taken into account in this paper. Interventions considered, include educational training programs aimed at demonstrating the proficient use of Personal Protective Equipment (PPE), improving safety behaviours such as hand washing after pesticide application and frequent changes of work clothes, increasing the knowledge and awareness of pesticide-associated health risks, storage of pesticides and disposal of empty pesticides containers etc.

Tools used for collection of data in these studies include Structured Interviews and Semi- structured Interviews, Focus Group Discussions, Self-Administered Questionnaires, Mail Questionnaires, Telephonic questionnaires, Surveys, Home visits etc. which were used through Purposive and Randomized Sampling Techniques.

3.5 Inclusion Criteria

This review includes Community based Non- randomized trial intervention, Randomized controlled intervention, Cluster randomized controlled trial, Community-based participatory research, Pre-test/ Post-test trial intervention etc., published in English language in various esteemed journals. Studies, evaluated the effectiveness of educational interventions undertaken to mitigate the harmful effects of misuse of pesticides handling and to enhance the knowledge regarding the same amongst the farming community. Most of the studies targeted at agricultural working population and 4 studies focused on the farming families i. e., women taking care of pesticide exposure at home and washing dirty framework clothes etc. The criteria considered for the inclusion of studies were outcomes considering enhanced adherence to practices of safe pesticide handling, farm workers' behaviour regarding pesticides handling and improved Knowledge Attitude Practice (KAP) scores for pesticide handling.

3.6 Types of Outcomes

Primary researches taken for the review can be categorized into six categories:

- Greater use of effective Personal Protective Equipment
- Effectiveness of Knowledge Acquisition and Awareness
- Reduction in the use of pesticides
- Behavioural change
- Storage of pesticides
- Awareness in regard to instructions written on the packets/ containers of the pesticides

4 Results

The current analysis considered more than 500 abstracts as well as 70 full articles dealing with interventions in the domain of pesticides handling. In order to focus the analysis, the 18 articles were abstracted and included in the review based on the criteria considered for the selection of the paper. The characteristics considered in the researches included in this review are categorized under table # 1to 6. Combinations of interventions of various types were considered here. They include Community based non- randomized trial intervention, Randomized controlled intervention, Cluster-randomized controlled trial, Community-based participatory research, Pre-test/ Post-test trial intervention etc. The target group selected in these studies was mainly farming community. The farmers involved in the pesticides handling in improper way were needed to go under an educational intervention training programme. The focus was to enhance their knowledge and practices. Four studies were also considered which included farming families (home manager) to facilitate in changing their behaviour and storage practices regarding pesticides.

4.1 Greater use of effective PPE

Eleven studies (table # 1) included in this review examined the effectiveness of an educational programme promoting use of some types of personal protective equipment i.e., gloves, hats, full sleeve shirts, long pants, masks/ goggles, coveralls etc. All the studies reported some positive changes in the outcomes following the intervention. Significant improvements in the use of PPE were observed in these studies. The main samples in all of these studies in this review were farmers, handling pesticides in their fields. There were Non- randomized trials, Randomized controlled and Pre-test/Post-test intervention studies, which focused on the greater use of personal protective equipment (PPE). Use of gloves was one type of PPE evaluated by most of the studies. Perry and Layde, 2003 and Salvatore *et. al.,* 2009, measured a significant increase in the use of gloves after educational intervention. Halfacre-Hitchock *et. al.,* 2006 mentioned that there was no significant association observed between training, risk perception and risk reduction behaviours after conducting the study. But statistically significant relationship was observed between the training and glove-use, suggesting that receiving training increases the likelihood of wearing gloves. One study, conducted by Orozco *et. al.*, 2011, had household manager along with crop managers as the sample of the study, found that usage of gloves for washing contaminated clothing also increased after the intervention. One study undertaken by Mandel *et. al., 2000* considered the use of chemically resistant gloves, which showed 12% increase in the use of these types of gloves.

Table # 1 Greater use of effective PPE

Sl.#	Reference	Study Design/ Intervention/ Method	Participants	Outcome	Results
1.	Cole *et. al.* 2007	Community-based non-randomized trial intervention including Farm Field Schools was used. Action-research project named *Ecosalud* was conducted in Ecuador.	A total of 138 small farm families in three Andean farming communities from Ecuador were taken for the study and 29 households participated in the post intervention surveys.	The community intervention increased pesticide related knowledge in regard to labels and exposure related risk factors. It also reduced use of pesticides and skin exposure due to pesticides.	Greater use of effective PPE was consistent with participating household reports of decreased dermal exposures.
2.	Perry and Layde 2003	Randomized controlled intervention. Three-hour educational sessions were conducted in this study with 100 randomly assigned participants.	400 Wisconsin dairy farmers certified to apply pesticides to field crops were taken.	A change in the use of required protective equipment during application and self-reported dermal exposure was observed.	Significant improvement was observed in the use of gloves, that was 62.5% in controlled group and 70% in intervention group. Improvement in the use of other gears was 24% (i.e., from 40% to 64%).
3.	Salvatore *et. al.* 2009	Cluster-randomized, controlled trial of a community-based participatory research (CBPR) worksite intervention was undertaken in this study.	130 farm workers were employed at two strawberry farms in Monterey.	Improvement in farm workers' behaviors at work and after work to reduce occupational and take-home pesticide exposures was observed.	Significant improvements were observed in using gloves from 51% at the time of baseline survey to 79% at the end of intervention.
4.	Strong *et.al.* 2008	Community randomized intervention trial method was undertaken in this study.	554 farmworkers from lower Yakima Valley in Eastern Washington were taken to make them aware about pesticides. Intervention was also done to reduce the take- home pathway of pesticide exposure in farmworker households.	Improvements occurred in the use of protective gears by farming community as an outcome of the intervention.	Percentages of consistent use ranged from 23% for protective lenses or goggles to 82% for wearing a hat. Protective clothing and equipment was used by fewer than half of the respondents.
5.	Mandel *et. al. 2000*	Community based randomized controlled trial intervention method was undertaken. The intervention included both a physician component and a community component. The physician intervention consisted of a seminar for both the counties and the community interventions consisted of an elementary school	508 farmers identified as pesticide users were selected from Minnesota, based on the similar demographic and agricultural production characteristics. (186 farmers from the intervention group and 322 from the controlled group).	The use of gloves and other protective clothing while handling pesticides increased in the intervention group.	For use of chemically resistant gloves, there was an increase in use of gloves by participants in the intervention counties (59 percent before vs. 71 percent after the intervention). After the intervention there was a modest shift to using other protective clothing

		curriculum, educational materials for the intervention group.			also (21 percent vs. 34 percent) The intervention county farmers who had used other protective equipment prior to the intervention also had a higher post –intervention use of such equipment than did the control county farmers.
6.	Jors *et. al.* 2014	The baseline survey was performed in 2002 and follow-up surveys in 2004 and 2009. The Farm Field School (FFS) farmers were trained to improve their Knowledge Attitude and Practice (KAP) concerning pesticide handling and ecological farming methods during 14 theoretical and practical courses of one to two days duration.	After exclusions and drop outs, 23 FFS trained farmers (intervention group) were compared to 47 neighbour farmers (controlled group) for changes in 'knowledge, attitude and practice' (KAP) on Integrated Pest Management (IPM) and symptoms of poisoning when handling pesticides.	Significant difference was seen between FFS farmers and controlled group farmers on all KAP variables. FFS farmers improved their KAP scores markedly during training and there after retained their knowledge.	FFS trained farmers showed improvement in the personal protection practices in comparison to the controlled group.
7.	Vela Acosta *et. al. 2005*	A pretest was administered to all participants prior to the pesticide program. Then, a 60 min. pesticide program (one time intervention) provided training on sources of pesticides, pesticide absorption and toxicity, general chemical safety, first aid, and emergency responses. Within 2 weeks of the pretest the experimental group received the pesticide program, and after 1 week a post-test was administered to all participants.	The pretest was administered to 227 participants, of whom 152 were present to complete the post-test in the experimental (n=77) and in the control (n=75) groups.	This study demonstrated that the pesticide program improved pesticide safety knowledge of farm workers and enhanced their perception of pesticide-related risks.	The behaviors recommended in the Worker Protection Standard (WPS), such as wearing long pants and long sleeve shirts were readily adopted by farmworkers as a result of intervention.
8.	Arcury *et. al.* 2001	Community based participatory research project was undertaken. Data was collected through a community based project called PACE (Preventing Agricultural Chemical Exposure among North Carolina Farm workers). This project was designed to reduce exposure of farm workers to pesticides by developing, testing and disseminating culturally appropriate interventions.	293 Latino farmworkers were given an intervention to reduce pesticide exposure.	The project tried to test the effect of any form of training or information regarding pesticide safety attended and gained by the farm workers working in Mexico.	It was found that 73.8% respondents who used pesticides, also used pesticides safety equipments. It could be as a result of the training /information received by them. It was reported that 72% of the respondents used gloves as pesticide safety equipment and 71% used mask to protect their face. Protective suits were also reported to be used by 35.8% participants.

9.	Halfacre-Hitchock *et. al.* 2006	The following analysis is based on the study conducted in 2002/03. The study focuses on the perception of pesticide exposure risk ('Perception Study'). Questionnaires were administered in community health centers, farm worker labor camps, or individual private residence.	Respondents in the study included 76 migrants and seasonal farmworkers from multiple sampling sites in South Carolina.	As an outcome of the study, no significant association was observed between training, risk perception, and risk reduction behaviours. But statistically significant relationship was observed between the training and glove-use, suggesting that receiving training increases the likelihood of wearing gloves.	As the result of the training received and protective equipments provided to participants, 72% of them reported to use protective equipment while working. Gloves were the most frequently used equipment among the participants. No significant association was observed between training and perception of exposure to pesticides by the respondents. Likewise, there was no association between training and risk reduction activities such as hand washing and removing one's shoes before entering the home after handling pesticides was reported. No significant association was observed between training and use of protective equipments, except the use of gloves. It shows statistical significant association between training and use of protective equipment (i.e. gloves). So, this can be said that receiving training increases the likelihood of wearing gloves.
10.	Orozco *et. al.* 2011	Community based Intervention was used. A longitudinal evaluation design using mixed methods was employed for this purpose. Over a 7-month period, health, education and agricultural interventions were focused upon. Health risks associated with hazardous pesticides, more adequate use and handling of pesticides and better crop management techniques were part of interventions. Data collection included field forms, focus group discussions, structured observations and repeat surveys.	18 agricultural communities in Ecuador were taken for the evaluation with the aim to assess changes in health promotion outcomes related to highly hazardous pesticide use associated with a multi-component community program.	Information on impact of pesticide on health and the pesticide use and handling practices shared in focus groups showed substantial improvement.	The proportion of household managers using gloves for washing contaminated clothing increased from 15% at the time of I survey, to 22% at the time of II survey ($p = 0.0001$). The use of protective equipment was generally low (mean 3.8/10 at the time of I survey) but did improve significantly after the interventions (mean 4.3/10).

11.	Janhong *et. al.* 2005	Pre/post Intervention trial method was employed in this study. A training program of six months duration was undertaken using convenience sampling. Data were collected through interviews.	Thirty-three voluntary Thai farmers were taken to assess their KAP score concerning the safe use of pesticides.	Research findings showed that the mean scores of KAP in the post-test were significantly higher than the pre-test.	After training, the farmers were found to use more protective clothing as compared to before training, such as long-sleeved shirts, long pants, and a hat while spraying the pesticides on plants.

4.2 Effectiveness of Knowledge Acquisition and Awareness

Eleven studies (table # 2) included in this review examined the effectiveness of an educational programme promoting pesticide-related knowledge etc. Significant improvements were observed in all the studies reported in this review.

The changes in the attitude of the participants in terms of the knowledge acquisition and practices were some of the positive outcomes following the interventions in these studies. Similar to these studies, positive outcome was reported by Giannandrea and Iezzi (2014) in their review on assessing effectiveness of interventions to reduce pesticide exposure in agriculture. In their review, the findings suggested that it is possible to have atleast a short-term effect on pesticide application practices and pesticide safety behaviour by increasing knowledge, intentions, and health risk perceptions.

Most of the studies included in this review had farmers as the main sample. There were three studies considered here which had household manager (mainly women) as the main sample of the research. There were Non-randomized trials, Randomized controlled and Pre-test/Post-test intervention studies, which focused on the knowledge enhancement of the participants. In the results shown by Arcury *et. al.*, 2009, participants at the post intervention stage versus pre intervention was reported to be recognizing more pesticide safety messages (3.5 at post intervention stage versus 1.1 at pre intervention stage). There was an increase in knowledge related to the effects of pesticides on children (76.9% at pre intervention versus 90.8% at post intervention). A study conducted by Cole *et. al.,* 2007 measured significantly greater understanding of the meaning of color codes on product labels and the risks associated with potential and actual pesticide-related practices among the participants after the intervention.

Similar study by Forster-Cox *et. al.,* 2007 to educate participants on pesticide safety issues exhibited positive outcomes with the acquirement of less harmful practices. Another study by Quandt *et. al.* 2013 observed increase in the knowledge regarding protection of the family by knowing pesticide exposure symptoms and long-term consequences from 52.4% in pre-test to 89.1% in post-test and 48.3% increase in the knowledge regarding reducing exposure to agricultural pesticides at home, for example, knowledge related to storing and washing of farmwork clothes separately from other family clothes. 61% increase in knowledge in regard to pesticide toxicity was measured by Jors *et. al.,* in 2014. Significant improvements in knowledge scores (8.0 to 9.2) of crop managers regarding the risk of pesticide contamination while mixing and spraying was observed by Orozco *et. al.*, 2011. A study by Feder *et. al.*, 2004, showed increase in the knowledge scores related to the pesticide use from 0.442 to 0.564 as an outcome of the trainings conducted by Farm Field School (FFS). A research was done by Gnana Sam *et. al..*, 2008 with the objective to measure any changes in the baseline Knowledge, attitude and practice (KAP) scores as a result of the intervention and observed significant improvement in knowledge retention. In the similar, way research undertaken by Janhong *et. al.,* 2005, reported increase in the mean scores for knowledge on the safe use of pesticides from 13.3 to 18.7 (maximum score = 20), attitude scores increased from 32.2 to 38.9 (maximum score = 40), and practice score also increased from 23.4 to 35.5 (maximum score = 42) in pre-tests and post-tests, respectively.

Table # 2 Effectiveness of Knowledge Acquisition and Awareness

Sl.#	Reference	Study Design/ Intervention/Method	Participants	Outcome	Results
1.	Gnana Sam 2008	One group pre-test, intervention and post-test method was used. Three point Knowledge attitude and practice (KAP) score assessment method was undertaken in this study.	76 agricultural pesticide handlers of the selected villages of Udupi district in South India were taken as the sample of the study.	The educational intervention among pesticide handlers improved the KAP score for safe pesticide handling.	There was a significant improvement in the total KAP score at the time of first assessment (~45.03) in comparison to the scores observed during baseline assessment (i.e., ~30.88). Knowledge scores significantly improved from baseline (~8.25) to the first follow up (~17.14). There was also a significant improvement in attitude score from baseline (~11.78) to first assessment (~16.97).
2.	Cole *et. al.* 2007	Community-based non-randomized trial intervention including Farm Field Schools was used. Action-research project named *Ecosalud* was conducted in Ecuador.	A total of 138 small farm families in three Andean farming communities from Ecuador were taken for the study and 29 households participated in the post intervention surveys.	The community intervention increased pesticide related knowledge in regard to labels and exposure related risk factors. It also reduced use of pesticides and resultant skin exposure.	In terms of pesticide-related knowledge, greater understanding of the meaning of color codes on product labels and the risks associated with potential and actual pesticide-related practices was observed.
3.	Forster-Cox *et.al.* 2007	One group pre –post test intervention method was used in this study. Environmental health/home safety visits were made by a promotora (Community Health Workers) to every client's residence.	367 clients from US/Mexico border homes were taken to provide practical information regarding safe pesticides application to allow them to make their home safer.	Statistically significant changes were found in the knowledge and behaviour of the clients regarding safe use of pesticides.	A statistically significant increase in perceived knowledge in regard to methods to protect against pesticide exposure was observed when three years data of the project was analysed.
4.	Jors *et.al.* 2014	In this, a baseline survey was performed in 2002 and follow-up surveys in 2004 and 2009. The Farm Field School (FFS) farmers were trained to improve their Knowledge Attitude and Practice (KAP) concerning pesticide handling and ecological farming methods during 14 theoretical and practical courses of one to two days duration.	After exclusions and drop outs, 23 FFS trained farmers (intervention group) were compared to 47 neighbour farmers (controlled group) for changes in 'knowledge, attitude and practice' (KAP) on IPM and symptoms of poisoning when handling pesticides.	Significant difference was seen between FFS farmers and controlled group farmers on all KAP variables. FFS farmers improved their KAP scores markedly during training and there after retained their knowledge.	Knowledge on pesticide toxicity was increased from 30% in first survey to 91% in final survey in intervention group in comparison to only 24% improvement in controlled group.

5.	Vela Acosta *et. al. 2005*	A pretest was administered to all participants prior to the pesticide program. Then, a 60 min. pesticide program (one time intervention) provided training on sources of pesticides, pesticide absorption and toxicity, general chemical safety, first aid, and emergency responses. Within 2 weeks of the pretest the experimental group received the pesticide program, and after 1 week a post-test was administered to all participants.	The pretest was administered to 227 participants, of whom 152 were present to complete the post-test in the experimental (n=77) and in the control (n=75) groups.	This study demonstrated that the pesticide program improved pesticide safety knowledge of the farm workers and enhanced their perception of pesticide-related risks.	The post-test Safety Risk Perception (SRP) indicated a positive enhancement as a result of the training.
6.	Ospina et. al. 2009	Pre/ Post test intervention method was undertaken in this study. A joint efforts involving intervention, self-assessment feedback, structured talks and practical demonstrations were performed in this research.	659 potato farmers were selected from the Boyacá department of Colombia as the sample of the study.	Improvement in terms of knowledge was observed among the participants.	Great improvement was found in the knowledge of occupational hazard concepts related to pesticide handling. The changes in terms of practices of handling pesticides were also observed. Improvement in the practices like mixing pesticides and fertilizers, tendency to use protective equipments, hygienic practices of washing hands and changing clothes after spraying, storing leftovers, attitude to work and reap the harvest were reported.
7.	Feder *et.al.* 2004	Pre/post intervention method was undertaken. Simple model of knowledge acquisition characterized by a logistic progression process was taken as the basic model in this study. The knowledge enhancement was performed through FFS training and the duration of a FFS training was about 8-12 weeks within a single crop-growing season.	Farmers from different villages of Indonesia were taken for the study in three groups i.e., a) farmers who have been directly trained ('graduates'), b) farmers who have been exposed to the knowledge gained by trained graduates ('exposed' farmers), and c) farmers who reside in villages where no farmer has received training and are therefore unaffected by the program ('control' group). The FFS training focused on the effectiveness of diffusion process in enhancing knowledge	The empirical results suggest that graduates of FFS, who undertook an intensive training, got benefited in terms of knowledge regarding pesticide use.	Average knowledge scores of the FFS graduate farmers increased from 0.442 to 0.564,

			regarding approaches in pest management, overall good crop management and use of pesticides.		
8.	Orozco *et. al.* 2011	Community based Intervention was used. A longitudinal evaluation design using mixed methods was employed for this purpose. Over a 7-month period, health, education and agricultural interventions were focused upon. Health risks associated with hazardous pesticides, more adequate use and handling of pesticides, and better crop management techniques were part of interventions. Data collection included field forms, focus group discussions, structured observations and repeat surveys.	18 agricultural communities in Ecuador were taken for the evaluation with the aim to assess changes in health promotion outcomes related to highly hazardous pesticide use associated with a multi-component community program.	Information on impact of pesticide on health and the pesticide use and handling practices shared in focus groups showed substantial improvement.	Improvements in knowledge were shown by several indicators, e.g. pesticide label reading increased significantly to 3.6 scores for household managers and 5.3 scores for crop managers. Crop managers' average knowledge scores regarding risk of pesticide contamination while mixing and spraying increased significantly from 8.0 to 9.2 scores between time I and II survey.
9.	Arcury *et.al.* 2009	Pre/ post test intervention trial method was used. Pre- and post-intervention interviews assessed difference in delivery of the intervention, recognition of the intervention, pesticide knowledge, pesticide exposure behaviour, and integrated pest management behaviours.	The women residing in Western North Carolina and Virginia from farmworker families were selected for the evaluation of the effectiveness of a promotora program for the pesticide safety and increasing pesticide safety behaviors.	Participants in the intervention group showed receipt of pesticide education and greater recognition of the key messages.	The pesticide curriculum participants reported to receive pesticide intervention visits and recognized more pesticide safety messages (3.5 at the post intervention stage versus 1.1 at the pre intervention stage). There was improvement in knowledge regarding the effects of pesticides on children (76.9% at pre intervention versus 90.8% at post intervention).
10.	Janhong *et. al.* 2005	Pre/post Intervention trial method was used. A training program of six months duration was undertaken using convenience sampling. Data were collected through interviews.	Thirty-three voluntary Thai farmers were taken to assess their KAP score concerning the safe use of pesticides.	Research findings showed that the mean scores of KAP in the post-test were significantly higher than the pre-test.	The mean scores for knowledge on the safe use of pesticides increased from 13.3 to 18.7 (maximum score = 20), attitude scores increased from 32.2 to 38.9 (maximum score = 40), and practice score also increased from 23.4 to 35.5 (maximum score = 42) in pre-tests and post-tests, respectively.
11.	Quandt *et. al.* 2013	Community based participation research pre-test/ post-test intervention method was used.	610 farmworker families with atleast one year of agricultural	As an outcome of the educational programme,	Knowledge on the recognition of the symptoms of pesticide

		The educational programme consisted of six lessons to be taught one-on –one in a minimum of five home visits, which lasted 30 to 60 minutes.	experience mainly from Maxico were taken for the study. The focus was to increase participant's knowledge on pesticides and to provide concrete strategies to reduce pesticide exposures.	significant improvements were observed in the knowledge level of participants.	exposure and its long-term consequences increased from 52.4% (in pre-test) to 89.1% (in post-test). Knowledge on the ways to reduce pesticides exposure at home increased from 5.4% (in pre-test) to 53.7% (in post-test).

4.3 Reduction in the use of pesticides

Four studies (table # 3) among the eighteen included in the review examined the effectiveness of an educational programme promoting reduction in the use of pesticides. Considerable improvements in the reduction of pesticide use were observed in all of these studies. Review of the studies regarding reduction in the use of pesticides by participants includes one Non- randomized intervention study, one Randomized controlled intervention study and two Pre-test/Post-test intervention studies. All of these studies had farmers as the main sample with the aim to educate them to reduce the pesticide usage in their crop fields. Cole *et. al.,* in 2007 found 14% reduction in the application of pesticides and 12% reduction in the total amount (weight) of pesticides by the farmers, participated in FFS in comparison to the non- FFS participants. In a similar study undertaken by Perry and Layde, 2003, there was a significant reduction in the total number of pesticides used after three-hour educational sessions with 100 randomly assigned farmers, certified to apply pesticides to field crops. In the research undertaken by Feder *et. al*, 2004, comparison of the results for farmers who have undertaken FFS training at various points of time to the corresponding controlled group of people, showed positive change in pesticide use between 1991-1999. Another research by Janhong *et. al.,* in 2005 also showed the effectiveness of educational intervention through FFS. In this study, farmers changed their behaviour to more appropriate use of pesticides. FFS participation was found to be associated with significant reduction in pesticide use.

Table: 3 Reduction in the use of pesticides

Sl.#	Reference	Study Design/ Intervention/Method	Participants	Outcome	Results
1.	Cole *et. al.* 2007	Community-based non-randomized trial intervention including Farm Field Schools was used. Action-research project named *Ecosalud* was conducted in Ecuador.	A total of 138 small farm families in three Andean farming communities from Ecuador were taken for the study and 29 households participated in post- intervention surveys.	The community intervention increased pesticide related knowledge in regard to labels and exposure related risk factors. It also reduced use of pesticides and skin exposure to pesticides.	About 14% reduction in the application of pesticides and 12% in the total amount of the pesticides used by the farmers, were reported in the intervention FFS group as compared to the non-participants.
2.	Perry and Layde 2003	Randomized controlled intervention was undertaken in this study. Three-hour educational sessions with 100 randomly assigned participants were used.	400 Wisconsin dairy farmers certified to apply pesticides to field crops were taken for this study.	A change in use of required protective equipment during application and dermal exposure was observed as	Significant reduction in the total number of pesticides used was reported as a result of the intervention.

				an outcome of this study.	
3.	Feder *et. al* 2004	Pre/post intervention method was used. Simple model of knowledge acquisition characterized by a logistic progression process was taken as the basic model in this study. The knowledge enhancement was performed through FFS training and the duration of FFS training was about 8-12 weeks within a single crop-growing season.	Farmers from different villages of Indonesia were taken for the study in three groups i.e., a) farmers who have been directly trained ('graduates'), b) farmers who have been exposed to the knowledge gained by trained graduates ('exposed' farmers), and c) farmers who reside in villages where no farmer has received training and are therefore unaffected by the program ('control' group). The FFS training focused on the effectiveness of diffusion process in enhancing knowledge regarding approaches in pest management, Overall good crop management and use of pesticides.	The empirical results suggest that graduates of FFS, who undertook a fairly intensive training, benefited in terms of knowledge.	A comparison of the results for farmers who have undertaken FFS training at various points of time to the corresponding ones who have received no training at all, suggests that there are changes in pesticide use between 1991 and 1999 that can be attributed to FFS but are rather modest.
4.	Janhong *et. al.* 2005	Pre/post Intervention trial method was used. A training program of six months duration was undertaken using convenience sampling. Data were collected through interviews.	Thirty-three voluntary Thai farmers were taken to assess their KAP score concerning the safe use of pesticides.	Research findings showed that the mean scores of KAP in the post-test were significantly higher than the pre-test.	After training, the farmers changed their behaviour to use pesticides in appropriate manner. The scores for safe use of pesticides also increased from 13.3 to 18.7

4.4 Behavioural change

Seven studies (table # 4) included in this review examined the effectiveness of an educational programme promoting behavioral changes regarding pesticides application and hygienic protection. Significant improvements were observed in all the studies reported in this review. The changes in the attitude of the participants in terms of practices like washing their hands immediately after work, changing farmwork clothes outside the home, removing their boots or shoes prior to entering the home etc. were some of the positive outcomes following the interventions in these studies.

A research by Mancini *et. al* in 2009, observed 15% reduction in the use of highly toxic organophosphates and 15% rise in using the botanical products. Behavioural changes were observed in regard to spending less time in the field while working in a recently sprayed field. If talk about the behavioral changes regarding the hygienic practices in using pesticides, some of the studies observed the similar findings, eg. Salvatore *et. al.,* in 2009, observed significant improvement in wearing clean work clothes (23% at baseline to 38% after intervention) and washing hands before going home (54% at baseline to 73% after intervention), improvements were also seen in the practice like removing work shoes outside home (95% to 98%). Strong *et.al.,* 2008, found that, about 60% participants reported to be usually washing their hands immediately after work, removing their boots or shoes prior to entering the home and changing out of work clothes within 1 hour of arriving home.

In the study by Arcury *et. al.*, 2009, participants were reported to improve their behaviour in changing work clothes from 44.2% at pre- intervention to 59.3% at post intervention. Janhong *et. al.,* 2005 observed that after training, the farmers changed their behaviour to use pesticides more appropriately. They always took a bath, washed their hair with soap and shampoo, and changed into clean clothes after spraying. Quandt *et. al.* in 2013 observed the change in the practice of changing framework clothes outside the home , that change was 4.3% (18.9% at pre-test and 23.2% at post-test). Separate storage of dirty framework clothes from other clothes increased from 93.4% to 99.5% and separate washing of dirty framework clothes increased from 96.6% to 99.7% in the same study.

Table 4: Behavioral change

Sl.#	Reference	Study Design/ Intervention/ Method	Participants	Outcome	Results
1.	Mancini *et. al.* 2009	Intervention programme at Farm Field Schools was undertaken. Weekly training exercises aimed to increase farmer's awareness in regard to the hazards due to use of pesticides were employed in this study.	65 farmers from three villages in Andhra Pradesh who were using pesticides and had experienced the symptoms of acute pesticide poisoning were taken as the sample of the study.	A reduction in adverse health effects were reported as a result of reduction in exposure to toxic pesticides. Behavioural changes were also observed.	Behavioural changes were reported like informants were observed to be spending less time working in a recently sprayed field, 15% reduction in the use of highly toxic organophosphates and 15% rise in the botanical products were also reported. Overall, the pesticide use spectrum shifted towards lower WHO Hazard Classes.
2.	Salvatore *et. al.* 2009	Cluster-randomized, controlled trial of a community-based participatory research (CBPR) worksite intervention was employed in this study. Four-weekly field-based educational sessions were conducted to increase awareness of respondents to pesticide exposures and to promote safe practices at work and after work.	130 farm workers were employed at two strawberry farms in Monterey.	Improvement in farm workers' behaviours at work and after work to reduce occupational and take-home pesticide exposures observed.	Significant improvement was observed in wearing clean work clothes (23% at baseline to 38% after intervention) and washing hands before going home (54% at baseline to 73% after intervention). There was improvement from 95% to 98%. in the practice of removing work shoes outside home.
3.	Strong *et.al.* 2008	Community randomized intervention trial method was undertaken in this study.	554 farmworkers from lower Yakima Valley in Eastern Washington were taken to make them aware about pesticides. Intervention was also done to reduce the take- home pathway of pesticide exposure in farmworker households.	Improvements occurred in the use of protective gears by farming community as an outcome of the intervention.	About 60% participants reported to be usually washing their hands immediately after work, removing their boots or shoes prior to entering the home and changing out of work clothes within 1 hour of arriving home as a result of the intervention programme.
4.	Jors *et.al.* 2014	The baseline survey was performed in 2002 and follow-up surveys in 2004 and 2009. The FFS farmers were trained to improve their Knowledge Attitude and Practice (KAP) regarding pesticide handling and	After exclusions and drop outs, 23 FFS trained farmers (intervention group) were compared to 47 neighbour farmers (controlled group) for changes in 'knowledge, attitude and practice'	Significant difference was seen between FFS farmers and controlled group farmers on all KAP variables.	Only 13% FFS farmers reported to be not using WHO class I pesticide in first survey and that percentage increased to 74% in the final survey. FFS farmers improved their KAP scores markedly during training and there after retained their knowledge.

		ecological farming methods during 14 theoretical and practical courses of one to two days duration.	(KAP) on IPM and symptoms of poisoning when handling pesticides.		
5.	Arcury *et. al.* 2009	Pre/ post test intervention trial method was used. Pre- and post-intervention interviews assessed difference in delivery of the intervention, recognition of the intervention, pesticide knowledge, pesticide exposure behaviour, and integrated pest management behaviours.	The women residing in Western North Carolina and Virginia from farmworker families were selected for the evaluation of the effectiveness of a promotora program for the pesticide safety and increasing pesticide safety behaviors.	Participants in the intervention group showed significant increase in pesticide education and greater recognition of the key messages.	A change was reported in the behaviour of the participants as the result of the study. For example, practice regarding changing work clothes outside home increased from 44.2% to 59.3%.
6.	Janhong *et. al.* 2005	Pre/post Intervention trial method was used. A training program of six months duration was undertaken using convenience sampling. Data were collected through interviews.	Thirty-three voluntary Thai farmers were taken to assess their KAP score concerning the safe use of pesticides.	Research findings showed that the mean scores of KAP in the post-test were significantly higher than the pre-test.	After training, the farmers changed their behaviour to use pesticides appropriately. They always took a bath, washed their hairs with soap and shampoo, and changed into clean clothes after spraying of pesticides.
7.	Quandt *et. al.* 2013	Community based participation research pre-test/ post-test intervention method was used. The educational programme consisted of six lessons to be taught one-on –one in a minimum of five home visits, which lasted 30 to 60 minutes.	610 farmworker families with atleast one year of agricultural experience, mainly from Maxico were taken for the study. The focus was to increase participant's knowledge on pesticides and provide concrete strategies to reduce pesticide exposures.	As an outcome of the educational programme, significant improvements were observed in the knowledge level of participants.	The result of this study showed a change in behavioural practices of participants eg., changing farmwork clothes outside the home was 18.9% at pre-test and 23.2% at post-test, change in washing of dirty farmwork clothes separately increased from 96.6% to 99.7%

4.5 Storage of pesticides

Six studies in the reviewed article were found to be promoting effective pesticides storage practices, using intervention method. Bonabana *et. al.,* n.d., conducted a survey of 430 farmers and found a significant difference between the experimental and controlled groups. It was found that 55% participants in the non-intervention areas, stored pesticides in the main house thereby exposing themselves to potential health risks, while 99% of participant farmers in the intervention areas stored pesticides in the farm store as a result of the effective intervention. Forster-Cox *et. al.,* 2007 selected 367 clients from US/Mexico border homes to provide practical information regarding safe practices related to pesticide storage to enhance their awareness in order to make their homes safer. Significant changes were found in the behaviour of the clients regarding safe use of pesticides, it was observed that 57% clients had child –proofed pesticides storage by the time of second assessment after interventional programme.

Liebman and Juarez-Carrillo, 2007, found change in the behaviour of 273 farmworkers and farmworker family members from Southern New Mexico related to pesticide storage practices. There was an increase of 25% in safe storage practices after receiving the educational intervention programme.

In order to reduce the number of severe poisoning due to pesticides, various organizations like WHO, the UN Food and Agricultural Organization (FAO) etc. are promoting safe pesticides storage (as mentioned by Konradsen, 2007). In this regard, some studies having focus on reducing the deaths, occurring due to impulsive acts of self –harming by pesticide users were taken into account under this section. Study by Konradsen *et. al,* 2007 was conducted to determine community perception and use of in-house safe storage boxes for pesticides in Sri Lanka. As a result, there was 80% increase in the practice of keeping pesticides safe in lockable containers in the houses of the participants. Similarly, Weerasinghe *et. al.,* in 2008 found that there was increase in the total percentage of participants storing pesticides in lock storage devices from 5% in baseline survey to 68% in follow up survey. It was also reported that there was a decrease in storage of pesticides in the field from 33% to 9%. In the research by Hawton *et.al.,* 2009, the reasons given by the participants for popularity of the locked boxes were, convenience for keeping pesticides, general security and avoidance of wastages or damages to pesticides, protection from children, protection against theft etc. So, different types of provision of secure storage devices for keeping pesticides safe under the lock were observed in these studies.

Table 5: Storage of pesticides

Sl.#	Reference	Study Design/ Intervention/ Method	Participants	Outcome	Results
1.	Forster-Cox *et.al.* 2007	One group pre –post test intervention method was used in this study. Environmental health/home safety visits were made by a promotora (Community Health Workers) to every client's residence.	367 clients from US/Mexico border homes were taken to provide practical information in order to make them aware about safe practices of pesticides storage.	Statistically significant changes were found in the knowledge and behaviour of the clients regarding safe use of pesticides.	Increase in the safe pesticide storage practices was observed after dissemination of the information. 57% of the respondents were found to have child –proofed stored pesticides at the time of second assessment (after intervention).
2.	Bonabana *et.al.* n.d.	Surveys were conducted using structured questionnaires and focus group discussions in both the areas to collect information on use of pesticides and handling practices performed by farmers.	430 farmers from both experimental and controlled groups were taken to establish and compare pesticide use and handling practices in the IPM intervention and non-intervention areas. Risks involved in pesticide use were also identified.	A significant difference is seen between the experimental and controlled groups in terms of pesticide exposure and risks involved in pesticide handling.	The findings of the research show positive results in case of storage practices followed by the participants. It was found that 99% of farmers in the intervention areas stored pesticides in the farm store, 55% in the non-intervention areas stored theirs pesticides in the main house thereby exposing themselves to potential health risks.
3.	Weerasinghe *et. al.* 2008	Surveys, community meetings and focus group discussions were conducted in the selected villages in Sri Lanka in order to obtain information regarding the agricultural practices followed by the participants.	200 households in two villages were provided with in-house safe storage devices and follow-up surveys were conducted after seven and 24 months of distribution.	The study focuses on reducing the deaths occurring due to impulsive acts of self –harming by using pesticides with the provision of secure storage devices for keeping pesticides safe under the lock. The main emphasis was on the design and use of different lockable storage devices for secure pesticides usage.	It was reported that there was increase in the total percentage of participants storing pesticides in lock storage devices from 5% in baseline survey to 68% in followup survey. It was also reported that there was a decrease in storage of pesticides in the field from 33% to 9%.

4.	Konradsen *et. al.* 2007	Transect walks, surveys and focus group discussions were employed to discuss the perceived advantages and disadvantages of pesticide storage boxes, general issues of pesticide use and storage and possible health impacts of pesticides.	172 households using pesticides in agricultural activities were selected and again contacted after 7 months of baseline survey.	The study was conducted to determine community perception and use of in-house safe storage boxes for pesticides in Sri Lanka. It was observed that the farming community started making safer storage facilities for pesticides.	At the time of baseline survey, there were 33% households who kept their pesticides in houses while only 2% were keeping them in locked containers and 31% in the open. But at the time of follow-up survey after 7 months, there was 80% increase in the practice of keeping pesticides safe in lockable containers in the houses of the participants.
5.	Hawton *et. al.* 2009	Collection of the information was done through the interviews with the participants. Local hospitals as well as local police were approached to collect information related to self- harming episodes due to pesticides for both experimental and controlled groups.	The impact of the introduction of storage box was assessed through the analysis of the households. The number of participants using pesticides at the time of II survey was 294, that was increased to 362 at the time of III survey.	It was found that informants accepted that the given box was useful as safer device for storing pesticides.	The analysis of the research indicates that participants preferred the boxes introduced to them. There was 95% increase in the use of locked boxes for storing pesticides from Time 1 to Time 4 of the study. The reasons given by the participants for popularity of these boxes were, convenience for keeping pesticides, general security and avoidance of wastages or damages to pesticides, protection from children, protection against theft etc.
6.	Liebman and Juarez-Carrillo 2007	Community-based educational intervention was used. The farmworkers and their families were successfully trained and educated through innovative training curricula, informal participatory educational techniques and culturally sensitive outreach methods.	273 farmworkers and farmworker family members from Southern New Mexico were selected in order to be trained in reducing exposures to pesticides in their homes and at work place.	The participants found to have better understanding of knowledge regarding the routes of exposure, decrease in the signs and symptoms of pesticide poisonings and the ways to minimize pesticide exposures.	As a result of the research, change in the behaviour related to pesticide storage practices was found. 63% reported to have safe storage practices prior to the intervention while after receiving the education, there was an increase of 25% made it to the total 88% .

4.6 Awareness in regard to instructions written on the packets/ containers of the pesticides

Four studies (table # 6) included in this review examined the effectiveness of an educational programme promoting safe disposal of pesticides and improvement in the trends of reading instructions on the packets/ containers of the pesticides before application of pesticides. Significant improvements were observed in all the studies reported in this review. The changes in the attitude of the participants in terms of practices like safe disposal of containers and reading instructions before using pesticides were observed in these studies. Further highlighting the fact, Jors *et. al.,* 2014 reported that 30% famers from Farm Field School (FFS), could read instruction on pesticide containers before use during I survey, which got improved to 96% in the final survey analysis. Major improvements in correct interpretation of pesticide label reading were found for household managers (3.6 score) and crop managers (5.3 score) in the study undertaken by Orozco *et. al.*, 2011. Similarly Bombana *et. al.* n.d. reported that 60% of farmers in the intervention areas followed usage instructions while 74% farmers of the studied sample in non-intervention areas did not even bother to read and understand the instructions given on the pesticide packets.

Table 6: Awareness in regard to instructions written on the packets/ containers of the pesticides

Sl.#	Reference	Study Design/ Intervention/ Method	Participants	Outcome	Results
1.	Bonabana *et. al.* n.d.	Surveys were conducted using structured questionnaires and focus group discussions in both the areas to collect information on use of pesticides and handling practices performed by farmers.	430 farmers from both experimental and controlled groups were taken to establish and compare pesticide use and handling practices in the IPM intervention and non-intervention areas. Risks involved in pesticide use were also identified.	A significant improvement was observed in the experimental group as compared to the controlled group.	It was found that 60% of farmers in the intervention areas followed usage instructions while 74% farmers of the studied sample in non-intervention areas did not even bother to read and understand the instructions given on the pesticide packets.
2.	Jors *et. al.* 2014	The baseline survey was performed in 2002 and follow-up surveys in 2004 and 2009. The FFS farmers were trained to improve their Knowledge Attitude and Practice (KAP) regarding pesticide handling and ecological farming methods during 14 theoretical and practical courses of one to two days duration.	After exclusions and drop outs, 23 FFS trained farmers (intervention group) were compared to 47 neighbour farmers (controlled group) for changes in 'knowledge, attitude and practice' (KAP) on IPM and symptoms of poisoning when handling pesticides.	Significant difference was seen between FFS farmers and controlled group farmers on all KAP variables. FFS farmers improved their KAP scores markedly during training and there after retained their knowledge.	It was reported that 30% famers from FFS, could read instruction on pesticide containers before use during I survey, which got improved to 96% in the final survey analysis.
3.	Orozco *et. al.* 2011	Community based Intervention was used. A longitudinal evaluation design using mixed methods was employed for this purpose. Over a 7-month period, health, education and agricultural interventions were focused upon. Health risks associated with hazardous pesticides, more adequate use and handling of pesticides and better crop management techniques were part of interventions. Data collection included field forms, focus group discussions, structured observations and repeat surveys.	18 agricultural communities in Ecuador were taken for the evaluation with the aim to assess changes in health promotion outcomes related to highly hazardous pesticide use associated with a multi-component community program.	Information on impact of pesticide on health and the pesticide use and handling practices shared in focus groups showed substantial improvement.	Significant improvements in knowledge scores were shown by several indicators, e.g. correct interpretations of pesticide label reading increased significantly from 1.2 to 3.6 for household managers and from 2.6 to 5.3 for crop managers.
4.	Janhong *et. al.* 2005	Pre/post Intervention trial method. A training program of six months duration was undertaken using convenience sampling. Data were collected through interviews.	Thirty-three voluntary Thai farmers were taken to assess their KAP score concerning the safe use of pesticides.	Research findings showed that the mean scores of KAP in the post-test were significantly higher than the pre-test.	After training, the farmers were reported to change their behavior to use pesticides more appropriately. They showed the ability to read pesticide labels and to select a lower concentration pesticide formula before purchasing a pesticide.

5. Conclusions

It can be observed from the cases considered in the current study that Educational Intervention Training Programmes have more or less positive results on the participants. In these studies, participants are mainly farmers who got intervened through interventional training programmes for the effective use of pesticides, safe handling of pesticides especially using personal protective equipments, effectiveness of knowledge acquisition and awareness, reduction in the use of pesticides, behavioural change, storage of pesticides, awareness in regard to instructions written on the packets/ containers of the pesticides. In this review, it was found that farmers in non- intervention areas were less aware about the exposure due to pesticides and the safe handling of pesticides and Personal Protective Equipments (PPE) in comparison to the farmers in the intervention area.

Therefore, it can be said that farmers and farming community in non-intervention areas were more exposed to the pesticides. As an outcome of the Intervention training programmes, improvements have been observed in the use of gloves for mixing and application of the pesticides and there was a reduction in the total number of pesticides used. Significant improvements in the use of PPE and awareness about the harmful effects of pesticides may be viewed as the effectiveness of these educational interventions. This study further provides scope for these kinds of reviews in order to make the people especially farming community aware about the facts related to the safe handling of pesticides simultaneously improving crop yield without harming themselves and protecting the ecology.

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