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**Research Article**


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# Awareness of farmers about specialized pests and pesticide use efficiency in *Bt* cotton production in Punjab

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## Abstract

The perception of farming community, their constraints and technical knowledge of Integrated Pest Management (IPM) played a vital role for the development of an effective pest management program. A broad-spectrum field survey based on farmer's perception was conducted according to well pre-designed questionnaire on *Bacillus thuringiensis* (*Bt*) cotton growing areas of District Bahawalnagar during 2018. The factors studied to assess farmer's knowledge and perception about identification, damage strategies to control pests and evaluate farmers' knowledge about secondary pest outbreaks. We randomly selected one hundred and six (160) cotton growers and interviewed according to schedule. The majority of the farmers faced some difficulties regarding identification. Unsurprisingly the farmers had little awareness about damage symptoms and economic decision levels however most of the farmers relied on pesticides usage. Our result showed that majority of the farmers (39.6%) take consultation with pesticide companies; about 33.0% of the farmers sprayed their crop according to calendar and 14.2% farmers followed their neighbors. Very small frequency of farmers (2.8%) argued that they followed economic decision levels, with similar frequency and improve crop with the consultation of extension workers. Majority of the farmers (47.2%) buy these chemicals from the local companies so that the trend of haphazardly usage of chemicals increased day by day. At the end it is concluded that there is a dire need to develop IPM approaches, strengthening of extension technical staff and also create an informal training program for farming community to boost up and sharing their knowledge about modernization.

**Keywords:** IPM; survey; Bt; strengthening; insecticides; frequency; Bahawalnagar; Southern; Punjab

## Introduction

*Bt* cotton are not effective against sucking pests (Abro *et al*., 2004; Sharma and Pampapathy, 2006). The adoption of *Bt* cotton reduces pest pressure and the number of insecticide treatments (Periak *et al*., 2001; Qaim, 2003). This reduction in insecticidal treatments keeps primary pests under control, but exposure and outbreak of secondary pests (Turnipseed *et al*., 1995; Naranjo, 2010). Cotton growers primarily rely on chemical measures for managing pests; however, the majority of the growers are not competent of judicious use of these measures owing to the fact of limited knowledge of pest management (Yang *et al*., 2005; Midega *et al*., 2012). In addition, the regional persons engaged in the business of pesticides, usually take the advantage of lack of knowledge of the farmers and motivate them to use more pesticides than the recommended doses. However higher values of pesticide residues found in different crops and vegetables especially in brinjal (Tariq, 2005; Hassan *et. al*., 2005; Iqbal *et al*., 2007; 2009)**.** Haphazard use of pesticides created resistance against different insect pests (Khan *et al*., 2002). Farmers' perception of insect pests and their management is one of the key factors affecting pesticide usage. The studies revealed that wrong perception of farmers among the issues between pesticides and pest management was strongly associated with excessive pesticide usage resulting failures in pest management techniques (Chen *et al*., 2013; Khan *et al*., 2015). There is a dire need to educate the growers regarding IPM; so that rural communities could be well informed about insect pests identification and its management practices. Extensive surveys of farming community is helpful in setting the research plan, designing extension schemes, assessing the usefulness of projects (Khan *et al*., 2013). The main objectives of this appraisal were (1) to check the farmers' knowledge about regular sucking pests of transgenic cotton (2) check out farmers management practices (3) evaluate farmers' awareness regarding secondary pest outbreaks after the widespread adoption of *Bt* cotton in Agro-Ecological Zone of District Bahawalnagar.

## Materials and Methods

### Study area

There are four provinces of Pakistan, about which 76% annual foodstuff productions contributed by Punjab. The questionnaire was consisted of mainly three parts: 1) demographic characteristics of farmers, 2) questions about identification, damage, ETL and non-target pest outbreaks in *Bt* cotton, 3) farmers' knowledge and perception about management of insect pests in *Bt* cotton.

### Data collection and analyses

Bunch varietal technique was adopted for the purpose to collect data (Khan and Damalas, 2015). After selection of the district, three tehsils were chosen and from each tehsil at least three union councils were selected randomly for the survey. By identifying well-informed person, a list of fifty *Bt* cotton growers was prepared from the randomly selected union councils of each tehsil. One hundred and six (106) farmers (40 from Fort Abbas, 34 from Chishtian and 32 from Haroon Abad) were successfully interviewed (Table-1).

Table 1. General overview of the questionnaire.

| Data type | Description of questions |
|---|---|
| Farmers bio data and farm details | Marital status; age; educational level; land tenure; farm size |
| Integrated Pest Management | Identification; damage, and economic threshold levels of regular sucking pests; secondary pest outbreaks |
| Pest management through pesticides | Pesticide companies; when to apply; number of insecticide applications; insecticide trends; insecticides effectiveness |

To measure farmers' knowledge for sucking pests, four levels were prepared. Among sucking pests, whitefly, jassid and thrips are equally important and regularly found in conventional as well as transgenic *Bt* cotton. For pest identification viz. level = 1 (a farmer did not aware about sucking pests), level = 2 (a farmer who could identify one regular sucking pest), level = 3 (a farmer who was able to identify two regular sucking pests) and level = 4 (a farmer could identify all the regular sucking pests), similarly for the damage symptoms and ETL. These levels were renamed as 1 = no knowledge, 2 = low knowledge, 3 = medium knowledge and 4 = high knowledge. There are four levels for the collection of variables i.e. Level = 1 (insecticides killed 10–40% targeted pests), level = 2 (insecticides killed 41–70% targeted pests), level = 3 (insecticides killed 71–100% targeted pests) and level = 4 (farmers had no idea about insecticides effectiveness). These levels were also renamed so that 1 = low, 2 = moderate, 3 = high and 4 = no knowledge.

### Data analysis

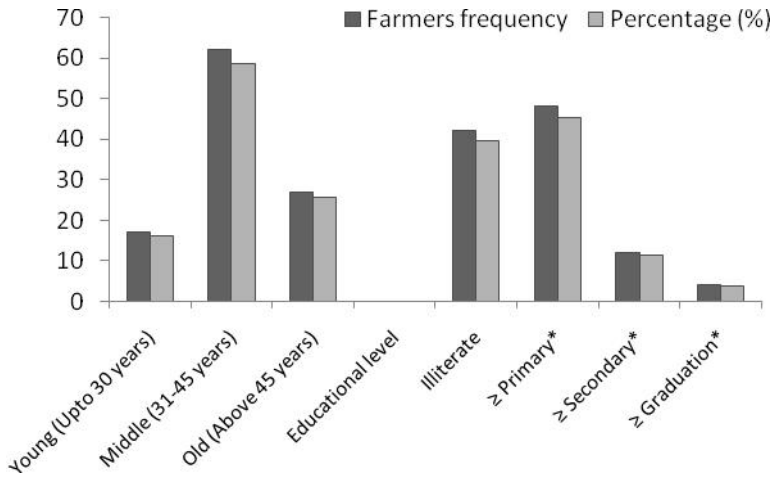
In order to analyze the data, initially numerical codes were allocated to predictable answers on the planned questionnaire and for the facilitation of analysis answers were categorized. After this, the data were entered in the Microsoft Office Excel, 2010. As soon as the data initially entered, it was carefully checked for possible entry errors. Finally, Chi-square analysis was carried out to determine relative frequencies.

## Results

### Demographic characteristics of the respondents

Farmers of this survey were categorized in three age and four education groups (Table 2). Most of the farmers were in age groups 31-45 (58.5%), and above 45 years (25.5%). The result showed that 39.6% respondents were illiterate and the other was literate (61.4%). Among the literate (45.3%) respondents had primary education, while some had secondary (11.3%) and graduation level (3.8%) schooling.

**Table 2 showing the comparisons of the respondents**

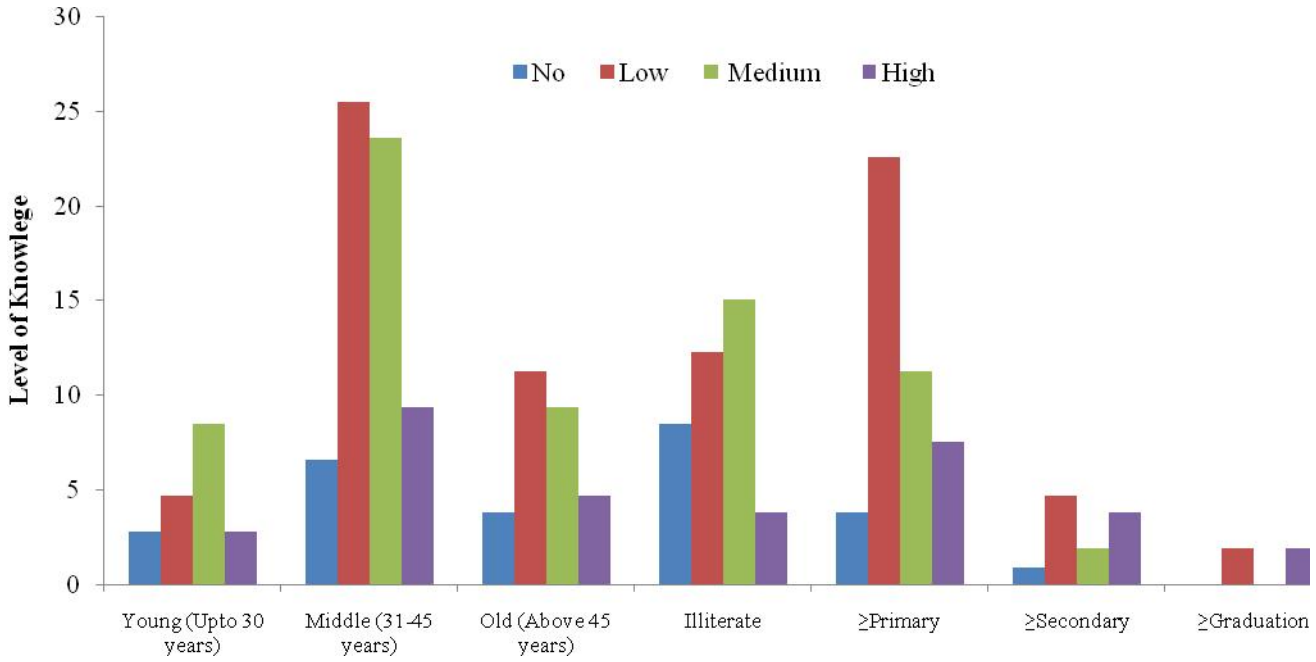



*****Terms of the education system in Pakistan: primary for 1-8 grade schooling, secondary for 9-10 grade schooling, while graduation for university level education

### Farmers' perception about identification of regular sucking pests

The information was collected for regular sucking pests of transgenic cotton, that how much information of farmers had? In response to the question pertaining to recognition of specialized insects of cotton, only 17.0% respondents could distinguish them. The respondents (41.5%) could identify only one pest out of three and those could not identify pest were 13.2%. Large frequency of the farmers (28.3%) had medium knowledge and could recognize two pests only (Table 3).

**Table 3 showing correlation of age versus level of knowledge**




## Farmers' perception about sucking insects

During collection of data from the respondents and distinguish the symptoms of damage; majority of the farmers (36.8%) were unable to differentiate the damage except one. Survey results indicated that only few respondents (4.7%) distinguished the damage of all the three pests having high level of knowledge. But 27.4% respondents recognized the damage of two pests. Respondents (31.1%) had no knowledge and could not identify the damage of the pests (Table 4).

Table 4. Perception of cotton growers about damage of regular sucking pests of Bt cotton.

| | Level of knowledge | | | |
|---|---|---|---|---|
| **Farmer categories** | **No n (%)** | **Low n (%)** | **Medium n (%)** | **High n (%)** |
| **Age** | | | | |
| Young (Upto 30 years) | 4 (3.8) | 5 (4.7) | 8 (7.5) | 0 (0.0) |
| Middle (31-45 years) | 18 (17.0) | 23 (21.7) | 19 (17.9) | 2 (1.9) |
| Old (Above 45 years) | 11 (10.4) | 11 (10.4) | 2 (1.9) | 3 (2.8) |
| **Education** | | | | |
| Illiterate | 20 (18.9) | 15 (14.2) | 5 (4.7) | 2 (1.9) |
| ≥Primary | 11 (10.4) | 19 (17.9) | 18 (17.0) | 0 (0.0) |
| ≥Secondary | 2 (1.9) | 3 (2.8) | 4 (3.8) | 3 (2.8) |
| ≥Graduation | 0 (0.00) | 2 (1.9) | 2 (1.9) | 0 (0.0) |
| **Total** | 33 (31.1) | 39 (36.8) | 29 (27.4) | 5 (4.7) |

## Farmers' perception about ETL of regular sucking pests

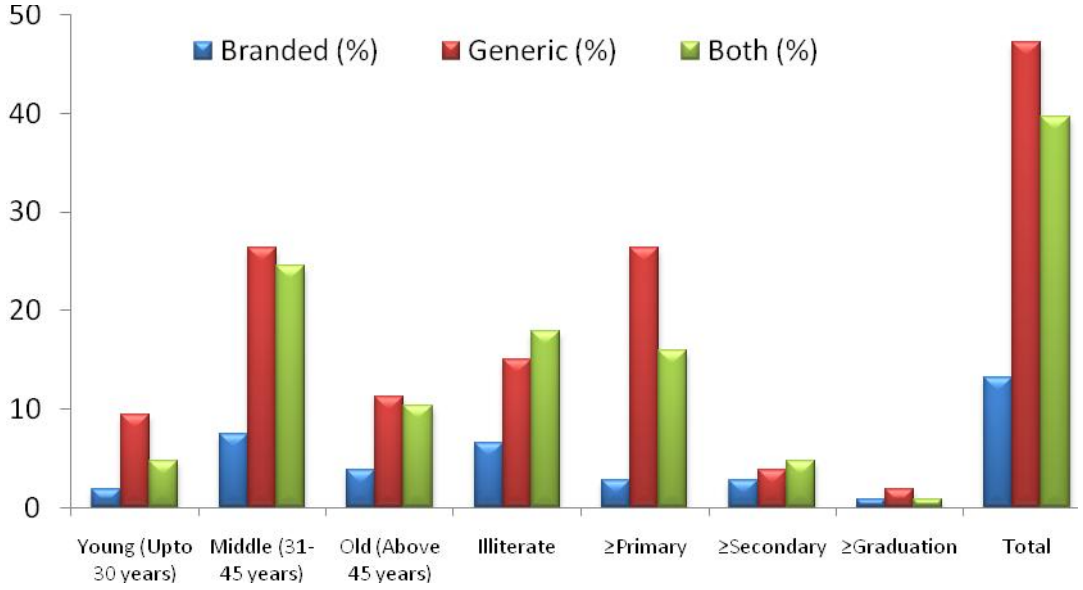
Majority of the farmers did not know about threshold level of sucking insects. Results revealed that small number of farmers (4.7%) were able to identify ETL of regular pests. The respondents (19.8%) identified the ETL of two pests out of three and 35.8% identified the ETL of only one pest. Majority of the respondents (39.6%) could not identify the ETL of the pests (Table 5).

Table 5. Perception of cotton growers about economic threshold levels of regular sucking pests of Bt cotton.

| Farmer categories | Level of knowledge | | | |
|---|---|---|---|---|
| | No<br>n (%) | Low<br>n (%) | Medium<br>n (%) | High<br>n (%) |
| **Age** | | | | |
| Young (Upto 30 years) | 4 (3.8) | 7 (6.6) | 5 (4.7) | 1 (0.9) |
| Middle (31-45 years) | 27 (25.5) | 19 (17.9) | 15 (14.2) | 1 (0.9) |
| Old (Above 45 years) | 11 (10.4) | 12 (11.3) | 1 (0.9) | 3 (2.8) |
| **Education** | | | | |
| Illiterate | 23 (21.7) | 15 (14.2) | 4 (3.8) | 0 (0.0) |
| ≥Primary | 17 (16.0) | 18 (17.0) | 11 (10.4) | 2 (1.9) |
| ≥Secondary | 2 (1.9) | 3 (2.8) | 5 (4.7) | 2 (1.9) |
| ≥Graduation | 0 (0.00) | 2 (1.9) | 1 (0.9) | 1 (0.9) |
| **Total** | 42 (39.6) | 38 (35.8) | 21 (19.8) | 5 (4.7) |

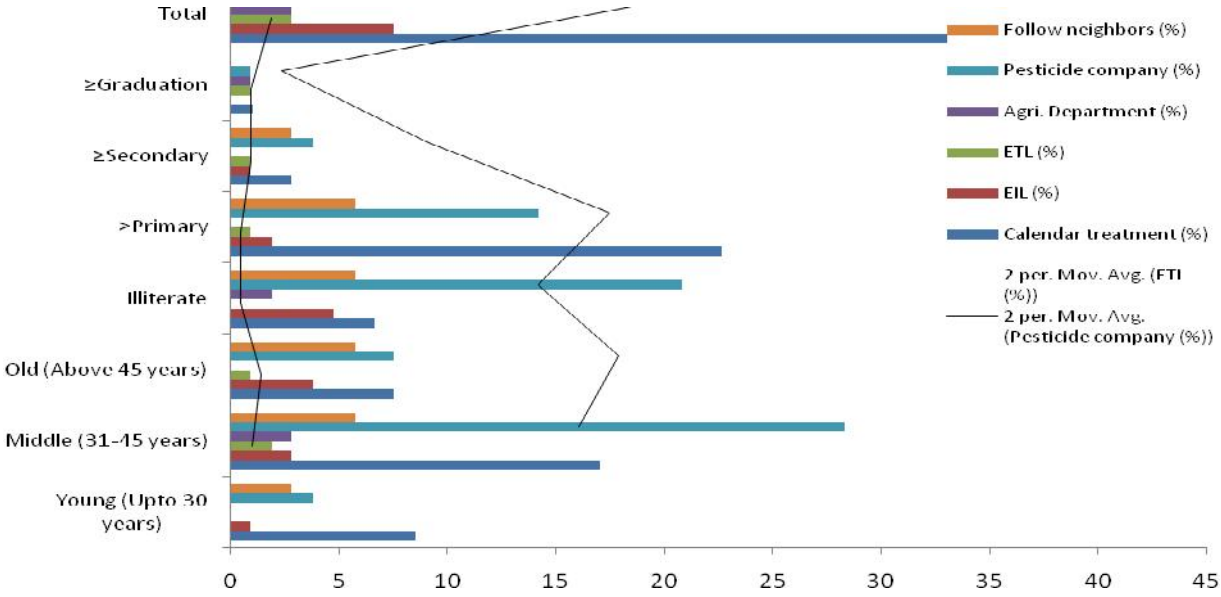
## Farmers' perception regarding the purchase of insecticides

All the farmers used synthetic pesticides for controlling pests. Majority of the farmers were highly dependent on generic pesticides for pest control. A generic chemical is manufactured and sold by a company other than the original manufacturer with same active ingredients (Hicks, 1994). Whereas companies (Bayer, Arysta Life Science, FMC Corporation and Syngenta) invested million dollars for testing, researching and formulating the active ingredients. Once an active ingredient is patented, the company who formulated it has 17 to 20 years of uniqueness, on expiry of patent other companies can purchase the rights to the active ingredient and create their own generic pesticides (Anonymous, 2015). Result revealed that 13.2% respondents purchased brand pesticides while the respondents (47.2%) purchased pesticides from generic names. Whereas 39.6% respondents purchased insecticides both from generic and brand companies (Table 6).



## Farmers' perception regarding the timing of insecticide applications

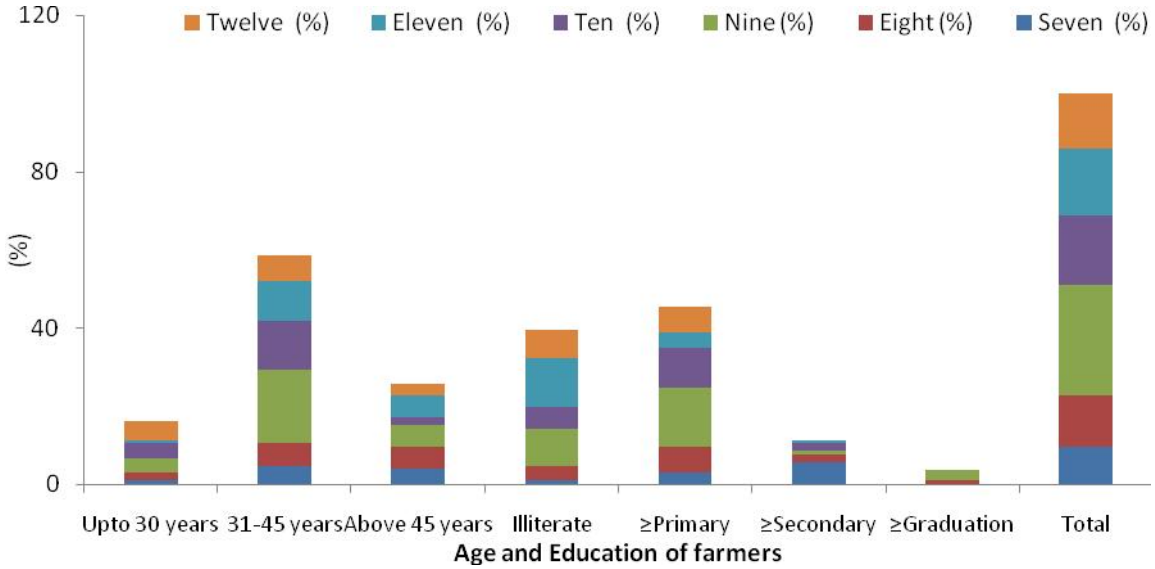
For the management purpose almost all the farmer's sprayed insecticides but the timing of insecticide application varies from farmer to farmer. Low frequency of farmers followed the economic decision levels and some farmers applied insecticides on visibility of damage. Results indicated, small number of respondents (2.8%) consulted agricultural extension and plant protection staff following the spray applications at ETL (2.8%), at EIL (7.5%), follow neighbors (14.2%), and farmers made calendar treatments (33.0%) in ascending order. Survey results pointed out that majority of the farmers (39.6%) consulted pesticide companies for pest solution (Table 7).




## Farmers' perception regarding the total number of insecticide treatments

The number of insecticide treatments differed from farmer to farmer. This extensive survey indicated that the farmers made, seven, eight, nine and ten insecticide treatments were, 9.4%, 13.2%, 28.3% and 17.9%, respectively. Where, the respondents made eleven and twelve insecticide treatments were, 17.0% and 14.2% (Table 8).

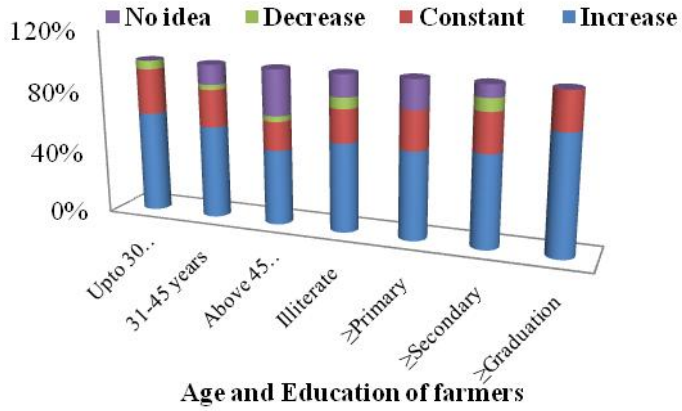
**Figure 8 showing number of insecticide treatment sprayed by the farmers during whole season**



## Farmers' perception about insecticide trends

This study revealed that 57.5% of growers said that the trend of pesticide usage increasing, whereas the respondents (23.6%) argued the steady apply of insecticides was greatly less significant and 15.1% farmers had no suggestion on insecticide trends (Table 9). The minority farmers (3.8%) privileged the decline trends of insecticides.

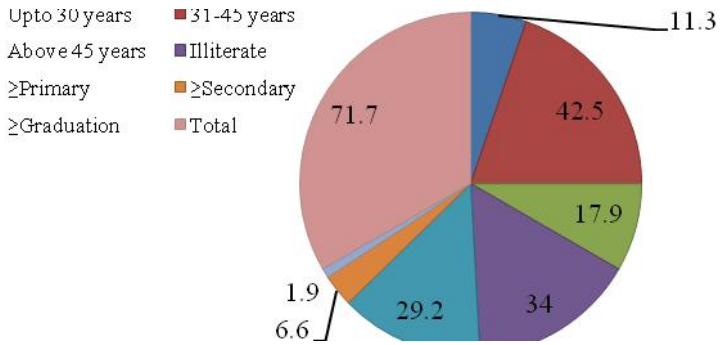
**Table 9 showing farmer's perception about the insecticide trends**




## Farmers perception about insecticides effectiveness

High frequency of the respondents (71.7%) complained the lower effectiveness of chemicals. Farmers (18.9%) reported the moderate effectiveness of used insecticides followed by the farmers (9.4%) had no idea regarding its efficiency. None of the respondents favored the higher insecticides effectiveness (Table 10).

**Table 10 showing farmer's perception about effectiveness of insecticides**




## Farmers perception about secondary pest outbreaks

Our outcome indicated that 80.2% of the growers agreed about the non-targeted pests population increased by the cultivation of *Bt* however 5.7% growers disagreed and respondents (14.2%) had no idea (Table 11).

Table 11 showing farmers perception about generalist pests due to cultivation of *Bt* cotton

| Farmer categories | Agree n (%) | Disagree n (%) | Undecided n (%) |
|---|---|---|---|
| **Age** | | | |
| Young (Upto 30 years) | 13 (12.3) | 0 (0.0) | 4 (3.8) |
| Middle (31-45 years) | 54 (50 9) | 2 (1 9) | 6 (5 7) |
| Old (Above 45 years) | 18 (17.0) | 4 (3.8) | 5 (4.7) |
| **Education** | | | |
| Illiterate | 29 (27.4) | 4 (3.8) | 9 (8.5) |
| ≥Primary | 41 (38.7) | 2 (1.9) | 5 (4.7) |
| ≥Secondary | 12 (11 3) | 0 (0 0) | 0 (0 0) |
| ≥Graduation | 3 (2.8) | 0 (0.0) | 1 (0.9) |
| **Total** | 85 (80.2) | 6 (5.7) | 15 (14.2) |

## Discussion

The need to identify particular insect species or closely related species often arises in pest management (Trowell and East, 1993). Lack of information about a pest led to choose the selection of wrong insecticide must be avoided. The resistance in whitefly against insecticides (bifenthrin, buprofezin and neo nicotinamoids) has been reported (Basit *et al*., 2012, 2013a, b). Some farmers did not distinguish the pests correctly, un-necessary and multiple application of spraying resulting economic loss (Trowell *et al*., 2000). In the present survey, farmers had awareness to some extent regarding identification of the regular sucking pest problems, but felt difficulties while identifying their injury signs.

Generic companies were dominant in the surveyed area and the majority of the farmers purchased insecticides from them because they are less expensive and easily available compared to brand products. A product (Admiral) of FMC Corporation contained an active ingredient pyriproxyfen, a new chemistry insecticide used for control of whitefly is six times expensive than the generic product. The reasons for such high prices of branded products are quality and reliability, customer and product support and continued product innovation (Anonymous, 2015). For pest solution, farmers mostly contact pesticide company's regardless applying insecticides at specific economic levels. The *Bt* farmers consulted pesticide sellers for the solution of pest problems and depend heavily on synthetic pesticides (Arshad *et al*., 2009).

The majority of the farmers from the surveyed area emphasized an increased trend of insecticide usage, but the lower effectiveness of pesticide. Low efficacy of pesticides may cause panic environment among the farming community who would go to increase the pesticide dosage to control insect pests (Hashemi and Damalas, 2010) with ultimate effect on the development of insecticide resistance and environmental pollution (Ngowi *et al*., 2007).

The current survey confirmed that due to knowledge gap in IPM more research was required to fulfill this program (Stern *et al*., 1959).

## Conclusion

At the end it is concluded that education programs was needed to strengthen the knowledge of farming community regarding IPM; insect pests identification; their damage symptoms; selection and judicious use of pesticides for sustainability of agriculture sector. This task can be accomplished through the services of technical staff, print and electronic media.

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