

Citrus growers' perceptions about the natural enemies of insect pests and hazardous impacts of pesticides on human health in district Toba Tek Singh (Punjab), Pakistan

Zunaira Shaheen¹, Naureen Rana¹, Muhammad Zakaria Yousuf Hassan³, M. Ather Javed Khan², Shahla Nargis¹ and Shabana Naz³

¹ Department of Zoology, Wildlife & Fisheries, University of Agriculture, Faisalabad, Pakistan

² Department of Continuing Education, University of Agriculture, Faisalabad, Pakistan

³ Agriculture Officer(HQS), Muzaffargarh, Punjab, Pakistan

⁴ Department of Zoology, Govt. College University, Faisalabad, Pakistan

Abstract

The present study was conducted to address the "Citrus growers' perceptions about the natural enemies of insect pests and hazardous impacts of pesticides in district Toba Tek Singh (Punjab), Pakistan" for weighing of co-ordination level between scientist and farmers regarding the acceptance of new approaches in agriculture. Wherein regarding awareness about natural enemies of insect pests, results of Chi-square Analysis regarding age of respondents were non-significant among all tehsils i.e. Toba Tek Singh ($\chi^2 = 3.12$; P-value = 0.210), Gojra ($\chi^2 = 1.63$; P-value = 0.441), Kamalia ($\chi^2 = 5.07$; P-value = 0.079) and Pir Mahal ($\chi^2 = 0.272$; P-value = 0.873). In case of education, results of Chi-square Analysis were highly significant from all tehsils i.e. Toba Tek Singh ($\chi^2 = 13.98$; P-value = 0.007), Gojra ($\chi^2 = 19.58$; P-value ≤ 0.001), Kamalia ($\chi^2 = 34.72$; P-value ≤ 0.001) and Pir Mahal ($\chi^2 = 27.68$; P-value ≤ 0.001). Whereas, regarding citrus producing experience, results from

Toba Tek Singh tehsil were significant ($\chi^2 = 8.86$; P-value = 0.012) and were highly significant from Gojra ($\chi^2 = 15.53$; P-value ≤ 0.001), Kamalia ($\chi^2 = 19.52$; P-value ≤ 0.001) and Pir Mahal ($\chi^2 = 19.78$; P-value ≤ 0.001). Nevertheless regarding hazardous impacts of pesticides, results of Chi-square Analysis pertaining to age of respondents were significant from tehsil Toba Tek Singh ($\chi^2 = 8.13$; P-value = 0.017), highly significant from Gojra ($\chi^2 = 10.43$; P-value = 0.005); and non-significant from Kamalia ($\chi^2 = 1.48$; P-value = 0.476) and Pir Mahal ($\chi^2 = 0.053$; P-value = 0.974). In case of education, results of Chi-square Analysis were highly significant from all tehsils i.e. Toba Tek Singh ($\chi^2 = 14.11$; P-value = 0.007) and Gojra ($\chi^2 = 23.41$; P-value ≤ 0.001); while significant results were recorded from Kamalia ($\chi^2 = 13.86$; P-value = 0.016) and Pir Mahal ($\chi^2 = 13.14$; P-value = 0.023). Whereas, regarding citrus producing experience, results from Toba Tek Singh tehsil were non-significant ($\chi^2 = 5.43$; P-value = 0.066) and were significant from Gojra ($\chi^2 = 8.72$; P-

value = 0.013). While, results were recorded non-significant from Kamalia ($\chi^2 = 5.18$; P-value = 0.075) and Pir Mahal ($\chi^2 = 4.04$; P-value = 0.133). Finally, it was concluded that areas with better education level were having better perceptions rather than other variables.

Keywords: *Citrus growers, bio-control, pesticides, mankind*

1. Introduction

Cosmopolitan, while discussing the environmental issues, we consider only air and soil problems and ignore the fundamental factors e.g. relevant knowledge about casual risks and capabilities of community to resolve these problems. Those are affecting our life abruptly and are profound threats for upcoming generation. Use of pesticides to control invading insect pests in agriculture sector is one of these problems; having hazardous impacts for mankind and environment as well. With the passage of time, it is increasing over many folds (Iqbal, 2009; Tahir *et al.*, 2012). While, agriculture sector has strategic place in country economy earning and being principal earning sector, it provides way of life to million families in Pakistan and over the world. It builds nearly 15% shares in overall GDP of the country and citrus has major contribution in this earning and in foreign exchange sector (Govt. of Pakistan, 2016; World Bank, 2005). However, insect pests along with other casual factors (sudden ecological successions and diseases) are introducing heavy losses toward the yield. These losses vary region to region e.g. Asia, Africa and Latin America; regardless of this, agriculture is very much crucial activity in these areas (Govt. of Pakistan, 2016; Tahir *et al.*, 2012). To manage these losses, use of xenobiotic chemicals is under practice and this practice is much high in developing countries (Tahir *et al.*, 2012; EJJ, 2002, 2003); in spite of this, their usage is hazardous for mankind and environmental sustainability (Tahir *et al.*, 2012; Iqbal, 2009). According to previous reports, they bring in numerous syndromes to mankind e.g. asthma attacks and skin rashes, chronic problems (cancer, emphysema, Parkinson's and ALS or Lou Gehrig's disease and prostate cancer (Smith and Smith, 1998; EJJ, 2002; John Gannage, 2002; Chitra *et al.*, 2007; Tahir *et al.*, 2012). Sandler (2008) reported that pesticides are cause of diabetes and obesity. Consequently, due to unawareness about these hazards, citrus grower farmers are using these pesticides and facing risks towards their health. In addition to this, they are also facing environmental problems regarding growth and yield (Tahir *et al.*, 2012). Therefore, scientists and researchers are

advocating to rely on natural and biological control, instead of chemical control. It is long lasting and friendly for mankind as well as for relating environment (Tahir *et al.*, 2012; Smith and Smith, 1998; EJJ, 2002; John Gannage, 2002). Natural predators e.g. Ladybirds (Predatory Lady Beetles), Green lacewing, Spiders, Syrphid flies and Wasps; display their predatory activities in citrus orchards by unique way which can suppress the pest population up to ETL (economic threshold level) (Tahir *et al.*, 2012; Iqbal, 2009; Smith and Smith, 1998). Their higher abundance can play imperative role for pragmatic pest control (Pearce *et al.*, 2004). Ladybirds belongs to family Coccinellidae, and generally known as small beetles, and have imperative role to control Sternorrhyncha "aphids and scale insects" (key pests of agricultural fields, orchards, gardens and other analogous habitats) but also prey on genus *Stethorus* (small black ladybirds) and non-Sternorrhyncha. Generally, they concentrate on mites, particularly *Tetranychus* spider mites (eminent example of biological control) (Hodek *et al.*, 2012). Greenlacewings are belong to family Chrysopidae and being bio-control agent, they display their predatory activities according to environmental conditions and can eat 100 aphids in a week; in several countries, they are reared commercially to sale for biological control of insect and mite pests in orchards, agricultural crops and gardens (Iqbal, 2009; Engel and Grimaldi, 2007). Spiders are preeminent arthropods belonging to order Araneae, and owing to their carnivorous nature, they can consume a large number of preys without any damage to plant and because of distinctive life style; they can serve their lives in all agro-ecosystems. Whereas, owing to wide host range, unique strategies to search prey, poly-phagous nature and ease in multiplication, they exploit their role to buffer the prey densities (Pearce *et al.*, 2004). Syrphid flies are belonging to insect family Syrphidae and many species larvae are insectivores and prey on plant sucking insects e.g. aphids and thrips. (Campbell *et al.*, 2012; Stoklet *et al.*, 2011). Wasps (are member of order Hymenoptera, and they play a critic role in natural control of insects' pest population in agriculture sector without any damage to crops. Furthermore, most species of adult parasitic wasps do not take any nutrients from their prey, and, much like bees, butterflies, and moths (Yamane *et al.*, 2009; Sühs *et al.*, 2009; Ortolani, and Cervo, 2009). Keeping in view the predatory importance of these natural and biological control agents, harmful effects of invading insect pests on citrus orchards and their growers' health, and hazardous impacts of pesticides on human health, the present study was conducted to record the citrus growers' perceptions about the natural enemies of insect pests and hazardous

impacts of pesticides on human health. Collection of data was made through interview by questionnaires with an open ended discussion for suggestions to managing their life and health as well as environmental risks among citrus orchards in district Toba Tek Singh.

2. Methodology:

2.1 Study Design

Pakistan's topography ranges between semi-arid to subtropical climate and agriculture sector has strategic place in its economy earning. But, little and non-formally educated agricultural farmers and citrus growers of Pakistan have least perceptions about the usage and hazardous impacts of pesticides and its alternative for the control of invading insects pest among these fields. They are frequently using pesticides to control insect pests of citrus to increase productivity without studying their residual effects on their own health and environment. Whilst, use of pesticides is one of key problems having hazardous impacts on mankind and environment; and with the passage of time it is increasing over many folds. Therefore, weighing of perceptions by community regarding this issue is much dire. During the present study, perceptions of the citrus growers regarding the natural enemies of insect pests and hazardous impacts of pesticides were evaluated through interview by questionnaires. The study was completely based on purpose sampling techniques to access the perceptions about predatory importance of these natural and biological control agents, harmful effects of invading insect pests on citrus orchards and their growers' health, and hazardous impacts of pesticides on human health from randomly selected citrus growers of district Toba Tek Singh.

2.2 Selection of Cite

District Toba Tek Singh is situated between 30°33' to 31°2' N and 72°08' to 72°48' E. The district consists of plain soil and entire soil of the district is very much fertile (Govt. of Pakistan, 2014). It is located in central Punjab and occupies total area 807,238 acres, cultivated 631,891 acres and non-cultivated 175,343 acres and is made up of large areas of lowlands which flooded frequently during the rainy season; the floods originate from the Ravi River that runs along the southern and southeastern borders. According to the 2008 estimate the population had risen to 1.39 million. According report of Govt. of Pakistan (2014), Toba Tek Singh district is one of the best producers of oranges "locally known as Kinnow". It contributes towards export standard quality of oranges produced in all Pakistan. The

majority of people living in this district work in agriculture and the region produced several kinds of agricultural and dairy products, including meat, eggs, cotton, maize, several pulses, peaches, guava, tomato, melon, water melon, mangoes, tobacco and onion. District Toba Tek Singh is administratively subdivided into four tehsils (Gojra, Kamalia, Toba Tek Singh and Pir Mahal) and 82 Union Council (Govt. of Paskistan, 2014).

2.3 Data collection

Collection of information about natural enemies of insect pests and hazardous impacts of pesticides from different citrus growers of Toba Tek Singh district weremade through interview by questionnaire. Five villages from each tehsil were selected randomly and ten farmers were interviewed from each village. By this way, total 200 citrus growers were interviewed as per objectives of the study. Demographic characters (independent variables) were consist of age, education, size of land holdings, type of tenure, farming experience and experience of citrus growing of the respondents. Whereas, dependent variables were consist of perceptions of the respondents (citrus growers' farmers) about natural enemies insect pests such as Ladybirds (Predatory Lady Beetles), Green lacewing, Spiders, Syrphid flies and Wasps; harmful insects (Aphid, Gall Wasp, Cottony Cushion Scale, Crusader Bug, Fuller's Rose Weevil, Thrips, Katydid, Moths, Mealy Bug, Fruit Fly, Mites and Spined Citrus Bug) of citrus; predatory role of these natural predators, beneficial and hazardous impacts of pesticides in citrus fields. The collected data was analyzed statistically through SPSS software and independent variables were compared with dependent variables through Chi-Square test and they were interpreted for pertinent conclusions (Tahir *et al.*, 2012).

3. Results & Discussion

3.1 Demographic Features

Age of an individual play a superficial role in his life with regard to "Learning and Conducting Activities". By birth, an individual without few inherited characters, he knows nothing about his life activities and learns different kind of things in his surroundings on daily wages. So, during present study to evaluate the correlation between age age and learning perceptions, age ratio of respondents was also recorded pertaining to interviewed respondents. Basically, respondents were divided into to three categories age wise e.g. young (18-25 years old), middle (26-50 years old) and old (above 50 year age). Among four thesils, ratio of young indulge in citrus producing was high

in tehsil Kamalia 44.00% (N = 22), followed by Pir Mahal 40.00% (N = 20), Gojra 32.00% (N = 16) and Toba Tek Singh 30.00% (N = 15). In case of middle age, maximum ratio was recorded from tehsil Toba Tek Sing 60.00% (N = 30), followed by Gojra 56.00% (N = 28), Pir Mahal 30.00% (N = 15) and Kamalia 26.00% (N = 13). For old age, maximum and equal respondents were recorded from tehsil Kamalia and Pir Mahal 30.00% (N = 15), followed by Gojra 12.00% (N = 06) and Toba Tek Singh 10.00% (N = 05).

Thereafter age, educations plays a principal in developing his school of thought, understanding things in his surroundings in a best fitted manner as well as comprehend different policies made regarding his life and for others members of the community. Hence, education status of the respondents was also recorded. Education level was divided into six (06) categories e.g. Illiterate, up to Primary, up to Middle, up to Matric, up to Intermediate and up to University. There was no illiterate respondents pertaining to citrus growing community in Toba Tek Sing and Gojra tehsils; while 10.00% (N = 05) equal and constant number of respondents were recorded illiterate from Kamalia and Pir Mahal Tehsils. While, maximum 20.00% (N = 10) respondents were up to Primary in tehsil Pir Mahal; however, 10.00% (N = 05) equal and constant number of respondents were having education up to Primary in tehsil Toba Tek Sing, Gojra and Kamalia. Middle level education ratio was recorded maximum from Pir Mahal 30.00% (N = 15) and least from Toba Tek Singh 10.00% (N = 05). As far as Matric level education was concerned, maximum respondents were up to matric in tehsil Kamalia 30.00% (N = 15), followed by 20.00% (N = 10) in Gojra, 16.00% (N = 08) in Toba Tek Singh and 14.00% (N = 07) in Pir Mahal. Intermediate level of education was more pronounced in tehsil Toba Tek Sing 50.00% (N = 25), followed by Gojra 40.00% (N = 20), but Kamalia and Pir Mahal tehsil were recorded with equal and least ratio 20.00% (N = 10). Peak of education level e.g. up to University was recorded with least frequency – utmost and only 14.00% (N = 07) respondents in Toba Tek Singh tehsil were having education up to University, equal and constant ratio was recorded in tehsil Gojra and Kamalia 10.00% (N = 05) and least number was recorded in thsil Pir Mahal 6.00% (N = 03).

Ownership also provides wisdom to an individual in a best way in spite to a labor. Ownership communities try to understand things in most excellent way than others. So, data was recorded about size of land holding of the respondents. It was categorized in three levels e.g. small land holders (up to 12.5 Acres), medium (up to 12.5-25 Acres) and large (above 25 Acres). Wherein

quite a large number of citrus grower respondents were small land holders in tehsil Toba Tek Singh 90.00% (N = 45), while situation in other three tehsil was also similar i.e. 80.00% (N = 40) in tehsil Gojra and 70.00% (N = 35) constant and equal ratio was recorded in tehsil Kamalia and Pir Mahal. However, medium group was existing chiefly in tehsil Kamalia and Pir Mahal 20.00% (N = 10), followed by 16.00% (N = 08) in tehsil Gojra and least 8.00% (N = 04) in thesil Toba Tek Singh. Large size was recorded in similar status but with half frequency of afore mentioned status among all tehsils.

Nature of tenure affects the cultivation processes to large extent. Citrus growers with their own land usually care least than owner-cum-tenant and tenant. Because they have to pay extra expenditures with regard to owner by way of land rent and thereafter they have to sustain their mandatory expenses. So, data about type of tenure of the citrus grower respondents was also collected in three categories e.g. owner, owner-cum-tenant and tenant. However, an overwhelming majority of respondents 80.00% (N = 40) were owner in tehsil Toba Tek Sing and Gojra, followed by tehsil Kamalia 60.00% (N = 30), and Pir Mahal 50.00% (N = 25). Whereas, owner-cum-tenant were equally high in tehsil Kamalia and Pir Mahal 30.00% (N = 15) and least in Toba Tek Singh and Gojra tehsil 10.00% (N = 05). Nevertheless, tenant were high only in tehsil Pir Mahal 20.00% (N = 10) and equal as well as constant ratio was recorded from tehsil Toba Tek Singh, Gojra and Kamalia 10.00% (N = 05).

An individual harvesting and cultivating citrus, learn many things on the spot to manage the citrus orchards from invading pests and plague to safe guard yield. As well as they share these farming experience with friends and neighbors for their betterment. Consequently, he safeguards the country by huge damage. So, data about their overall farming experience was also collected. Farming experience was divided into four categories e.g. 01-15 years farming experience, 16-30 years farming experience and above 30 years farming experience. For first category (1-15 year), maximum ratio was recorded from tehsil Gojra 32.00% (N = 16), followed by Toba Tek Singh 30.00% (N = 15), Pir Mahal 26.00% (N = 26) and Kamalia 20.00% (N = 10). In case of 2nd category (16-30 year farming experience), utmost ratio was recorded from tehsil Pir Mahal 56.00% (N = 28), followed by Kamalia 52.00% (N = 26), Toba Tek Singh 50.00% (N = 25) and least was recorded from tehsil Gojra 40.00% (N = 20). While, for 3rd category (above 30 year), tehsil Gojra and Kamalia was recorded with maximum and constant frequency 28.00% (N = 14), followed by Toba Tek Singh 20.00% (N = 10) and least from tehsil Pir Mahal 18.00% (N = 09).

As the life pass, a man learn more from his daily experience to understand the incidence in a realistic way and try to handle the challenges in good manner. Furthermore, it also tries to convert the challenges into opportunities to run life peacefully. If, he is indulge in the single or unique field e.g. only handling one sector, he decide in a best way by his experience as in the case of citrus producing experience. A citrus grower farmer, when he only cultivating citrus, he will observe the impacts of temperature rise and fall, wind flow, rain fall, sudden ecological changes, shortage of rain fall, nature of irrigation and fertilization etc. and thus record links about these problems with regard to plague and pest attacks as well as fruit quality and quantity and finally he decide about these issues to manage the hazards. So, level of experience only in the form of citrus producing was also recorded from the selected respondents for pertinent analysis and conclusions. Data was collected in three catagories i.e. 01-10 year experience, 11-20 year farming experience and above 20 years farming experience (Table – 06). In case of 1st category (1-10 year experience), quite a large number of respondents were having such experience from tehsil Kamalia 80.00% (N = 40), followed by Toba Tek Singh 72.00% (N = 36); while, Gojra and Pir Mahal were recorded with constant and equal ratio 70.00% (N = 35). For 2nd type (11-20 year), maximum ratio was recorded from tehsil Toba Tek Singh 22.00% (N = 11) and least from Kamalia 14.00% (N = 07). However, tehsil Gojra and Pir Mahal was recorded with equal and constant ratio 20.00% (N = 10). Whereas, in case of 3rd category (above 20 year experience for citrus producing), least respondents were recorded overall. Highest ratio was recorded from tehsil Gojra and Pir Mahal 10.00% (N = 05); while Toba Tek Singhand Kamalia were recorded with least and constant ratio 6.00% (N = 03) (Table - 01).

Table 1: Demographic Features of the interviewed Respondents

Age Structure of Citrus Grower Community				
Age (Years)	Toba Tek Singh	Gojra	Kamalia	Pir Mahal
	% (N)	% (N)	% (N)	% (N)
Young (18-25)	30.00 (15)	32.00 (16)	44.00 (22)	40.00 (20)
Middle (26-50)	60.00 (30)	56.00 (28)	26.00 (13)	30.00 (15)
Old (Above 50)	10.00 (05)	12.00 (06)	30.00 (15)	30.00 (15)
Education level among Citrus Grower Respondents				
Educational Level	Toba Tek Singh	Gojra	Kamalia	Pir Mahal
	% (N)	% (N)	% (N)	% (N)
Illiterate	00.00 (0)	00.00 (0)	10.00 (05)	10.00 (05)
Up to Primary	10.00 (05)	10.00	10.00	20.00

		(05)	(05)	(10)
Up to Middle	10.00 (05)	20.00 (10)	20.00 (10)	30.00 (15)
Up to Matric	16.00 (08)	20.00 (10)	30.00 (15)	14.00 (07)
Up to Intermediate	50.00 (25)	40.00 (20)	20.00 (10)	20.00 (10)
Up to University	14.00 (07)	10.00 (05)	10.00 (05)	6.00 (03)
Land holding status of Citrus Grower respondents				
Size of land holding (Acres)	Toba Tek Singh	Gojra	Kamalia	Pir Mahal
	% (N)	% (N)	% (N)	% (N)
Small (upto 12.5)	90.00 (45)	80.00 (40)	70.00 (35)	70.00 (35)
Medium (upto 12.5-25)	8.00 (04)	16.00 (08)	20.00 (10)	20.00 (10)
Large (Above 25)	2.00 (01)	4.00 (02)	10.00 (05)	10.00 (05)
Type of Tenure				
Type of Tenure	Toba Tek Singh	Gojra	Kamalia	Pir Mahal
	% (N)	% (N)	% (N)	% (N)
Owner	80.00 (40)	80.00 (40)	60.00 (30)	50.00 (25)
Owner-cum-Tenant	10.00 (05)	10.00 (05)	30.00 (15)	30.00 (15)
Tenant	10.00 (05)	10.00 (05)	10.00 (05)	20.00 (10)
Farming Experience				
Experience (Years)	Toba Tek Singh	Gojra	Kamalia	Pir Mahal
	% (N)	% (N)	% (N)	% (N)
Farming (1-15)	30.00 (15)	32.00 (16)	20.00 (10)	26.00 (13)
16-30	50.00 (25)	40.00 (20)	52.00 (26)	56.00 (28)
Above 30	20.00 (10)	28.00 (14)	28.00 (14)	18.00 (09)
Citrus Producing Experience				
Experience (Years)	Toba Tek Singh	Gojra	Kamalia	Pir Mahal
	% (N)	% (N)	% (N)	% (N)
(1-10)	72.00 (36)	70.00 (35)	80.00 (40)	70.00 (35)
11-20	22.00 (11)	20.00 (10)	14.00 (07)	20.00 (10)
Above 20	6.00 (03)	10.00 (05)	6.00 (03)	10.00 (05)

3.2 Hazardous Impacts of Pesticides:

Perceptions of selected respondents among citrus growing community were recorded about hazardous impacts of pesticides on human health (Table – 02). Response of respondents about hazardous affects by use of pesticides with regard to “Dizziness” was recorded maximum 50.00% (N = 25) from tehsil Toba Tek Singh, followed by Gojra 42.00% (N = 21), Kamalia 30.00% (N = 15) and least was recorded from tehsil Pir Mahal 20.00% (N = 10). Whereas a simple majority showed response about “Headache” from four tehsils. It was recorded maximum and equal from Toba Tek Sing and Kamalia tehsil 70.00% (N = 35), followed by Gojra

62.00% (N = 31) and Pir Mahal 58.00% (N = 29). While, awareness of respondents about “Vomiting” with regard to hazardous impacts of pesticides was recorded maximum from Pir Mahal tehsil 74.00% (N = 37), followed by Gojra 68.00% (N = 34), Kamalia 58.00% (N = 29) and least from tehsil Toba Tek Singh 56.00% (N = 28). However, awareness about “Nausea” was recorded maximum from tehsil Toba Tek Singh 50.00% (N = 25), followed by Gojra 40.00% (N = 20), Pir Mahal 38.00% (N = 19) and least from tehsil Kamalia 34.00% (N = 17); and “Muscle Convulsions” response was recorded maximum from the respondents in tehsil Gojra and Kamalia equally and constant 50.00% (N = 25), followed by Pir Mahal 46.00% (N = 23) and least from Toba Tek Singh tehsil 34.00% (N = 17). Whilst, response about “Hand Tremors” was recorded much low from the all tehsils. It was recorded maximum from tehsil Kamalia 26.00% (N = 13), followed by Gojra 22.00% (N = 11), Pir Mahal 20.00% (N = 10) and much least from Toba Tek Singh tehsil 10.00% (N = 05); and response about “Confusion” was also poor among all tehsils. Maximum awareness was recorded from tehsil Kamalia 34.00% (N = 17), followed by Pir Mahal 30.00% (N = 15), Gojra 20.00% and least from Toba Tek Singh Tehsil 18.00% (N = 09). While, “Sore Throat” response was convincing from four tehsils. Majority of the respondents were aware about it. Maximum and equal awareness level was recorded from Gojra and Kamalia tehsils (80.00%; N = 40); while tehsil Toba Tek Singh and Pir Mahal were recorded with equal frequency 68.00% (N = 34). But, “Skin Irritation” response was again excellent in all tehsils. Quite a large number of respondents were aware about this problem. It was recorded maximum from tehsil toba Tek Singh (90.00%; N = 45); and other three tehsils were recorded with equal response (80.00%; N = 40); however, response about “Cough” was again high from four tehsils. It was recorded maximum from Toba Tek Singh (94.00%; N = 47), followed by equally and constant ratio from in Gojra and Kamalia Tehsils (90.00%; N = 45) and least was recorded from Pir Mahal 86.00% (N = 43).

Table 02: Frequency distribution of respondents according to the awareness about hazardous impacts of pesticides used against Citrus Pests

(Note: Response was more than 01)

Hazardous Effects	Toba Tek Singh % (N)	Gojra % (N)	Kamalia % (N)	Pir Mahal % (N)
Dizziness	50.00 (25)	42.00(21)	30.00 (15)	20.00 (10)
Headache	70.00 (35)	62.00(31)	70.00 (35)	58.00 (29)
Vomiting	56.00 (28)	68.00(34)	58.00 (29)	74.00 (37)

Nausea	50.00 (25)	40.00(20)	34.00 (17)	38.00 (19)
Muscle Convulsions	34.00 (17)	50.00 (25)	50.00 (25)	46.00 (23)
Hand tremors	10.00 (05)	22.00 (11)	26.00 (13)	20.00 (10)
Confusion	18.00 (09)	20.00 (10)	34.00 (17)	30.00 (15)
Sore throat	68.00 (34)	80.00 (40)	80.00 (40)	68.00 (39)
Skin irritation	90.00 (45)	80.00 (40)	80.00 (40)	80.00 (40)
Cough	94.00 (47)	90.00 (45)	90.00 (45)	86.00 (43)

3.3 Awareness about Bio-control

IPM strategies depend on farmers’ awareness about bio-control programme and other related issues i.e. natural predators, engineers and their competitor role. So, awareness of selected respondents of citrus growers’ was also recorded to formulate durable recommendations for community and country for future concern as well as friendly environment. Data regarding various aspects is presented below.

Data pertaining to awareness of respondents about beneficial insects of citrus orchards was collected (Table – 3) and maximum response was recorded about “Ladybirds (Predatory Lady Beetles)” from tehsil Toba Tek Singh (50.00%; N = 25), followed by Gojra (46.00; N = 23); while least respondents were aware about it in tehsil Kamalia and Pir Mahal i.e. 22.00% (N = 11) and 18.00% (N = 09), respectively. While, “Green lace wing” awareness was not up to the mark among four tehsils. Maximum response was recorded from Toba Tek Singh 46.00% (N = 23), followed by Gojra 38.00% (N = 19); while least respondents were aware about it in tehsil Kamalia and Pir Mahal i.e. 28.00% (N = 14) and 22.00% (N = 11), respectively. However, response about “Spider” was appreciating to some extent in Toba Tek Singh and Gojra tehsil i.e. 56.00% (N = 28) and recorded low in Kamalia and Pir Mahal tehsil i.e. 40.00% (N = 20) and 38.00% (N = 19), respectively; and response about “Syrphid flies” was appreciating only and to some extent in Toba Tek Singh tehsil i.e. 50.00% (N = 25), followed by Gojra 40.00% (N = 20) and it was recorded low in Kamalia and Pir Mahal tehsil i.e. 34.00% (N = 17) and 20.00% (N = 10), respectively. Nonetheless, response about “Wasps” was appreciating to some extent in Toba Tek Singh and Gojra tehsil i.e. 54.00% (N = 27) and 50.00% (N = 25) and recorded low and equal in Kamalia and Pir Mahal tehsil i.e. 46.00% (N = 23).

Table 3: Frequency distribution of respondents according to their awareness about the beneficial insects of citrus

Note: Response was more than (01)

Beneficial Insects	Toba Tek Singh	Gojra	Kamalia	Pir Mahal
	% (N)	% (N)	% (N)	% (N)
Ladybirds	50.00 (25)	46.00 (23)	22.00 (11)	18.00 (09)
Green lace wing	46.00 (23)	38.00 (19)	28.00 (14)	22.00 (11)
Spider	56.00 (28)	56.00 (28)	40.00 (20)	38.00 (19)
Syrphid flies	50.00 (25)	40.00 (20)	34.00 (17)	20.00 (10)
Wasps	54.00 (27)	50.00 (25)	46.00 (23)	46.00 (23)

Keeping in view the afore mentioned assessments of independent variables, it is quite obvious that knowledge, wisdom and experience are factors those make life of an individual prefect and play role for overall nation’s success. However, knowledge has fundamental importance to uplift the wisdom and experience of an individual. It gains with age, education and experience. Hence, as per procedure and protocol of the present research, to highlight the efficacy of dependent variables (age, education and citrus producing experience) against independent variables (awareness about hazardous impacts of pesticides and biological importance of beneficial insects of citrus), Chi-square test was applied as “Independent Variables vs Dependent Variables”. Data presented in table (4) is pertaining to Chi-square analysis results regarding “Awareness about Natural Enemies of Insect Pests vs Age, Education and Citrus Producing Experience” in four tehsils of the district Toba Tek Singh. Results of Chi-square Analysis in case of age were non-significant among all tehsils i.e. Toba Tek Singh ($\chi^2 = 3.12$; P-value = 0.210), Gojra ($\chi^2 = 1.63$; P-value = 0.441), Kamalia ($\chi^2 = 5.07$; P-value = 0.079) and Pir Mahal ($\chi^2 = 0.272$; P-value = 0.873). In case of education, results of Chi-square Analysis were highly significant from all tehsils i.e. Toba Tek Singh ($\chi^2 = 13.98$; P-value = 0.007), Gojra ($\chi^2 = 19.58$; P-value ≤ 0.001), Kamalia ($\chi^2 = 34.72$; P-value ≤ 0.001) and Pir Mahal ($\chi^2 = 27.68$; P-value ≤ 0.001). Whereas, regarding citrus producing experience, results from Toba Tek Singh tehsil were significant ($\chi^2 = 8.86$; P-value = 0.012) and were highly significant from Gojra ($\chi^2 = 15.53$; P-value ≤ 0.001), Kamalia ($\chi^2 = 19.52$; P-value ≤ 0.001) and Pir Mahal ($\chi^2 = 19.78$; P-value ≤ 0.001). Whilst, Chi-square analysis results regarding “Hazardous Impacts of Pesticides vs Age, Education and Citrus Producing Experience” in four tehsils of the district Toba Tek Singh. Results of Chi-square

Analysis were significant from tehsil Toba Tek Singh regarding age (Table – 5) ($\chi^2 = 8.13$; P-value = 0.017), highly significant from Gojra ($\chi^2 = 10.43$; P-value = 0.005); and non-significant from Kamalia ($\chi^2 = 1.48$; P-value = 0.476) and Pir Mahal ($\chi^2 = 0.053$; P-value = 0.974). In case of education, results of Chi-square Analysis were highly significant from all tehsils i.e. Toba Tek Singh ($\chi^2 = 14.11$; P-value = 0.007) and Gojra ($\chi^2 = 23.41$; P-value ≤ 0.001); while significant results were recorded from Kamalia ($\chi^2 = 13.86$; P-value = 0.016) and Pir Mahal ($\chi^2 = 13.14$; P-value = 0.023). Whereas, regarding citrus producing experience, results from Toba Tek Singh tehsil were non-significant ($\chi^2 = 5.43$; P-value = 0.066) and were significant from Gojra ($\chi^2 = 8.72$; P-value = 0.013). While, results were recorded non-significant from Kamalia ($\chi^2 = 5.18$; P-value = 0.075) and Pir Mahal ($\chi^2 = 4.04$; P-value = 0.133).

Table 4: Relationship between age, education & experience of the respondents with biological importance of beneficial insects

Variables	Toba Tek Singh		Gojra		Kamalia		Pir Mahal	
	χ^2 value	P-value	χ^2 value	P-value	χ^2 value	P-value	χ^2 value	P-value
Age	3.12	0.210NS	1.63	0.441NS	5.07	0.079NS	0.272	0.873NS
Education	13.98	0.007**	19.58	0.001**	34.72	0.001**	27.68	0.001**
Experience	8.86	0.012*	15.53	0.001**	19.52	0.001**	19.78	0.001**

$\chi^2_{tab} = .599$

$\chi^2_{tab} = 11.07$

D.F. of age and experience = 2

D.F. of education = 5

NS = Non-significant

* = Significant

** = Highly significant

Table 5: Relationship between age, education & experience of the respondents with their awareness about hazardous effects

Variables	Toba Tek Singh		Gojra		Kamalia		Pir Mahal	
	χ^2 value	P-value	χ^2 value	P-value	χ^2 value	P-value	χ^2 value	P-value
Age	8.13	0.017*	10.43	0.005*	1.48	0.476NS	0.053	0.974NS
Education	14.11	0.007**	23.41	0.000**	13.86	0.016*	13.14	0.023*
Experience	5.43	0.066	8.72	0.013*	5.18	0.075NS	4.04	0.133NS

$\chi^2_{tab} = .599$

$\chi^2_{tab} = 11.07$

D.F. of age and experience = 2

D.F. of education = 5

NS = Non-significant

* = Significant

** = Highly significant

However, the overall results of the study showed that independent variables experience significant relationship with almost all the dependent variables except in few cases. Age is one of the key factor that create ability in an individual to learn and express different experiences, those he gained time to time (Hassan *et al.*, 2002) but, it might be positive or negative (Kotile and Martin, 2000) and in some cases age had negative or non-significant relationship with dependent variables as already reported by Siddiqui *et al.* (2003).

Considering these issues, in south India, relationship between the extent of pesticide-use and signs and symptoms of illnesses due to exposure among farmers of Thanjavur District was appraised by interviewing 631 farmers using pre-tested interview questionnaire schedule during a cross sectional survey (537 men and 94 women). 433 (68.6%) farmers (of whom 4 were women) sprayed pesticides by themselves and therefore were directly exposed to pesticides. More than 75% of farmers used either “moderately” or “highly hazardous” pesticides. 88% did not use any form of protection, while handling pesticides. About 50% of sprayers mixed different brands of pesticides, many of which were substitutable to each other. 56% of farmers obtained information on pesticides from retail shop owners. Farmers reported the following acute signs and symptoms: “excessive sweating” (36.5%), “burning/stinging/ itching of eyes” (35.7%), “dry/sore throat” (25.5%), “excessive salivation” (14.1%). These signs and symptoms had a higher prevalence among the sprayers. Among men, “excessive sweating” (RR=1.43), “burning/stinging/ itching eyes” (RR=1.5), “Dry/sore throat” (RR=1.84) were significantly associated with exposure to pesticides. There is need for creating more awareness among the farmers and authorities in enforcing and ensuring the use of protective gear while handling pesticides (Chitra *et al.*, 2007). At present, India is the largest producer of pesticides in Asia and ranks 12th in the world for the use of pesticides with an annual production of 90,000 tons (Gupta, 2004). A vast majority of the population in India (56.7%) is engaged in agriculture and is therefore, exposed to the pesticides used in agriculture. Pesticides being used in agricultural tracts are released into the environment and come into human contact directly or indirectly. Humans are exposed to pesticides found in environmental media (water, soil, air and food) by different routes of exposure such as inhalation, ingestion and dermal contact. Exposure to pesticides results in acute and chronic health problems. These range from temporary acute effects like irritation of eyes, excessive salivation to chronic diseases like cancer, reproductive and developmental

disorders etc. (Yassi *et al.*, 2001; Mancini *et al.*, 2005). The use of pesticides is not also peaceful for future due to – effects on Non-Target Species – 90% pesticides (fenoxycarb, diflubenzuron, carbamates, organophosphates, ethyl-eneebis-dithio-carbamates, pyrethroids and chlorophenoxy herbicides). Because, we use them without intended targets and consequently, many beneficial organisms (natural enemies of invading and existing pests) got killed and poisoned inadvertently due to toxic effects of these pesticides (Olszak *et al.*, 1992; Samu *et al.*, 1997; Mackenzie *et al.*, 1998; Miller, 2004). Furthermore, Creation of New Pests – Agricultural pests like aphids, grasshopper and moth larvae, those eat plants and their population kept under control by wasps, lady bugs and praying mantises. These natural predators knocked out when we used broad spectrum pesticides leaving herbivores pests free and they got status of major pests (Mackenzie *et al.*, 1998; Miller, 2004). Wherein, their persistence and mobility in the environment owing to use in agricultural sectors from many decades and move freely through air, water and soil. This situation has reduced bio-magnification period e.g. mothers' in these agricultural areas have levels of these chlorinated hydrocarbons – inducing un-reversed mutation in milking baby (Mackenzie *et al.*, 1998; Miller, 2004). However, they also induce cancer, birth defects, immunological and physiological disorders, Parkinson's disease and other chronic degenerative diseases (Mackenzie *et al.*, 1998; Miller, 2004). Finally, it is to acknowledge that the results of present study were a scholastic acknowledgement with Iqbal (2009); Tahir *et al.* (2012); Olszak *et al.* (1992); Miller (2004); Yassi *et al.* (2001); Mancini *et al.* (2005); Chitra *et al.* (2007).

4. Conclusions

It has been concluded that education level is principal limiting factor to learn the management policies. Wherein pesticides are major handicap for human community and to overcome the situation, bio-control strategies are best one.

5. Suggestions

Farmers have suggested that for identification about different natural predators among different orchards through campaign by Govt. agencies and private agencies so that they would be able to use them in agro-ecosystem, and they are eager to using the natural enemies of insect pests as bio-control agent among citrus orchards if they were trained about their predatory role and conservational strategies in different crops and would try to boost up their conservation when properly trained and motivated.

6. Recommendations

After entire survey from four tehsils of district Toba Tek Singh, it is recommended to create awareness level of local community about bio-control of cotton pests and pesticides hazardous, we should launch such programmes with purposeful efforts along with keen interest of GOs and NGOs to educate the local community (young and old alike) about bio-control strategies so that, they can take keen interest in its implementation; however, Technology Transfer Unit (TTU) should be so active that can provide material/awareness about modern techniques on daily wages to farming community and try best to create progressive links between farmers and researching scientists.

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