THIRD PARTY VALIDATION/ SURVEY REPORT OF COTTON IPM PLOTS 2022

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University of Agriculture, Faisalabad

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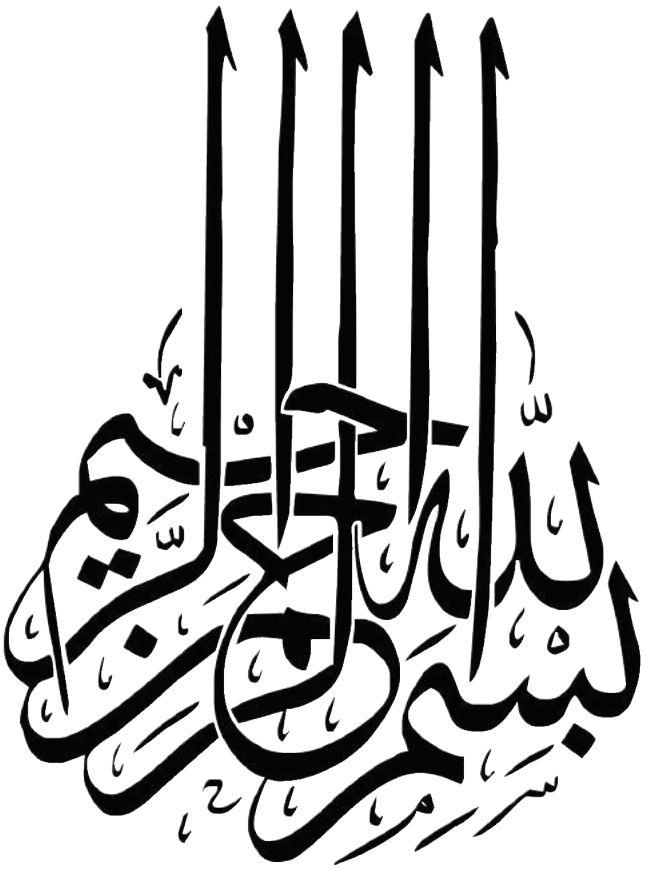

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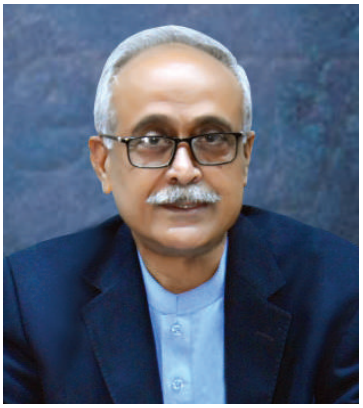

Cotton is the most important cash crop in Pakistan; cotton products export account for 55 percent of all foreign exchange earnings of the country. Cotton production accounts for 4.5 percent of the value added in AgGDP and 0.8 percent of the GDP. Despite its importance, cotton productivity in Pakistan has been underwhelming. The country ranks 4th in an area under cotton cultivation and 39th in cotton productivity per hectare worldwide. There are multiple factors that resulted in the cotton productivity decline; unavailability of quality and certified seeds, susceptibility to insect pest attacks, changes in climatic factors, the substitution of cotton-wheat Agro-ecological zones, high cost of production, low return of investment on cotton compared to substitutional crops like sugarcane and maize, low productivity per hectare, short fiber length.

Effective strategies to mitigate the decline of cotton production are to revise the agriculture policies, a significant focus on the highlighted points, in addition, enhance and timely pest scouting by the agriculture department, and educate farmers about relevant pesticide applications and judicial use, cotton seed quality is a perpetual issue with low germination rate.

The data were collected through a comprehensive survey conducted by the Department of Entomology, University of Agriculture, Faisalabad through a surveying tool conducting face-to-face interviews of the farmers and conducting field visits of the IPM blocks. This survey would certainly enhance the knowledge gap for the policymakers, and stakeholders to revive the cotton by employing various strategies.

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EXECUTIVE SUMMARY

Cotton is a major fiber and cash crop of Pakistan having largest area after wheat as compared to other crops. The country earns largest export revenues and in addition to the lint, the seed of cotton processes oil and meal which accounts for 90% of the national production of oilseed. Cotton and its related products contribute about 55-60% to foreign exchange earnings of the country. The core cotton growing areas includes Multan, Khanewal, Vehari, Lodhran, Bahawalnagar, Bahawalpur, Dera Ghazi Khan, Rajan Pur, Muzaffargarh, Layyah and Rahim Yar Khan districts. While non-core areas include Faisalabad, Toba Tek Singh, Jhang, Chiniot, Sahiwal, Okara and Pakpattan districts. Both Bt and non-Bt cotton varieties have been cultivated, however Bt shares more than 80% of total area. However, there are a number of factors of low yield, which includes cultivated area reduction, climate change, attack of insect pests and unavailability of quality seeds. The production was 9.18 million bales during 2019-20, whereas it was 12.77 million bales during 2013-14 as the area under cotton was decreased to 2.53 million hectares in 2015-16 as compared to 2.90 million hectares in 2013-14. The country witnessed record production of cotton in 2014, but a steady decline has limited its production to 7/8 million bales per annum in the recent years.

Realizing the gravity of this alarming situation, the Government of the Punjab constituted committees on several occasions comprising different Govt. institutes including University of Agriculture Faisalabad to find out the reasons and factors responsible for cotton decline and to suggest the way forward for its restoration. Furthermore, it was noticed that only insecticides cannot be effective to manage cotton insect pests especially whitefly and pink bollworm that has developed resistance to pesticides in Bt. cotton varieties. Keeping all in view alternate option were investigated to mitigate the insecticides uses. Finally, it was decided to adopt the IPM model to avoid insecticides at early stages of crop sowing to conserve the beneficial insect fauna in cotton crop. In case of severe pest infestation recommendations were given to apply plant extracts that has considerable effects on insect pests and safer for beneficial insect fauna.

To demonstrate the integrated management strategies IPM blocks were established in different cotton growing zones and were managed by the Agriculture Extension Department. Farmers capacity building regarding IPM model was done continuously by field activities, demonstrations, hands on trainings and workshops throughout the cotton season. Farmers were trained regarding biopesticides formulations, their selection and applications techniques. Moreover, social media i.e. WhatsApp, TV, Radio and print media also played a significant role to convey the message at grass root level. The


monitoring was done by teams of Agriculture Department, Agriculture Extension and Pest Warning officers, and workers in all districts of cotton zone. Finally, for evaluation of IPM blocks Govt. constituted a third-party survey and assignment was given to Prof. Dr. Muhammad Jalal Arif Chairman, Department of Entomology, University of Agriculture Faisalabad. The survey team of Department of Entomology, University of Agriculture Faisalabad got responses from 168 cotton farmers from Faisalabad division and 167 farmers from Sahiwal division throughout cotton zone of Punjab and enquired the detailed causes of success/failure of cotton and analyzed the whole data. According to our survey overall 96-100% respondents in different districts replied in "Yes" that Agriculture Department was the main source that conveyed advices, suggestions and did counseling timely about cotton production and protection technology. The other advisory was about biopesticides knowledge to famers and 77-95% responds in "Yes". The next step was about the delay of insecticides for 2 months and the survey results depict that about 63.04-87.27% respondents of the survey districts replied in "Yes" and noded that they acted on the advice of the Agriculture Department and delayed the first spray of synthetic insecticides up to 60 days. Regarding first application of insecticide against cotton pests a respondent's percentage range of 89.09-93.22%, 80.0-84.08%, 50.72-63.46%, 30.43-38.89%, 13.04-19.57%, 7.25-10.87% and 5.57-15.38% declared that they had executed first spray against whitefly, jassid, thrips, mites, aphid, mealybug and other pests, respectively.

In addition to insecticides the respondents who applied 4-5 sprays of biopesticides during current year ranged between 81.48-88.41%, being higher in Sahiwal district followed by Toba Tek Singh, Pakpattan, Jhang, Okara and Faisalabad districts. The expenditures on biopesticides depicts that the maximum respondents (61.02-69.23%) declared that the cost of sprays of biopesticides was in the range of 201-400 PKR per acre followed by 21.15-27.12% respondents with 401-600 PKR per acre. While some of the respondents (2.90-3.85%) declared that the cost was in the range of 601-800 PKR per acre. Concerning the total number of synthetic insecticides sprays, during the current year the maximum respondents (89.13-92.75%) declared that they applied 4-5 sprays of synthetic insecticides which were found 2 times less than the number of sprays declared by the maximum respondent (9-10 sprays) during previous year (2021). While minimum percentage of respondents (1.45-3.85%) declared that they applied 2-3 sprays of synthetic insecticides during current year, while 6-8 sprays of synthetic insecticides during current year ranged between 5.08-8.70% respondents. The survey also depicts that cost of synthetic insecticides was about 10000-15000 PKR per acre during previous year per acre compared to 5000-10000 PKR in the current year according to maximum farmers responses (81-85%).

Interestingly more than 90% respondents declared presence of natural enemies in the field compared to 3-4% respondents during previous year in cotton crop. Moreover, farmers were also asked regarding the most devastating factor of cotton decline during the survey. About 71.19-77.78%, 67.80-74.07% and 64.41-71.01% respondents highlighted poor quality and unregistered seeds, unfavourable and unusual harsh weather/climate and ineffective pesticides are major factors respectively responsible for

cotton decline in Pakistan. The maximum percentage of respondents (69.23-93.22%) nodded in "Yes" when they were asked if they agreed on the positive effects of biopesticides. The maximum percentage of respondents (78.26-100%) nodded in "Yes" when they were asked if they would adopt demonstrated IPM model next year. The percentage of respondents, who positively agreed on adopting IPM model next year, was found maximum (100.0%) in Faisalabad and Jhang followed by Toba Tek Singh (96.61% respondents), Sahiwal (92.75% respondents), Okara (88.46% respondents) and Pakpattan (78.26% respondents) districts.

Overall, keeping in view the farming community have well acknowledged the efforts taken by agriculture department to provide technical and logistic support to farmer's community. Moreover, the initiative taken by the agriculture department and survey done by third party member by team University of Agriculture Faisalabad has been greatly acknowledged.

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INTRODUCTION

Cotton is an important cash crop of Pakistan, and it is crucial to the country's economic sustainability. Cotton contributes 0.8% of the country's GDP and 60% in foreign exchange profits. The cotton sector employs more over 40% of the industrial level, either directly or indirectly. Pakistan's two primary cotton-producing provinces are Sindh and Punjab. The 70% of the overall output comes from Punjab province. A 10 million-acre land in Pakistan has the capacity to produce 30 million bales. However, despite reaching a milestone of 14.8 million bales in 2011–2012, Pakistan's cotton output had been averaging about 10 million bales, which is far less than its potential. Moreover, cotton output has been dropping since 2015, and the most recent estimate, 5.6 million bales, is the lowest in the previous 35 years. Climate change, seed quality, outdated Bt. Bollgard-I technology, pest issues, especially pink bollworms and whiteflies, cotton leaf curl virus disease, insecticide resistance, labour shortages for picking, high weed infestation, slow adoption of mechanisation, and low profitability are the main obstacles to cotton productivity in Pakistan (Nazeer et al., 2023).

Cotton is a crucial commodity, especially for the textile industry, and an essential source of revenue worldwide (Tokel et al., 2022). The world produced 26.96 million tonnes of cotton in 2011–12, with China continuing to contribute the most with 7.40 million tonnes, followed by India, the United States, Pakistan and Brazil with 5.69, 3.39, 2.35, and 2.00 million tonnes, respectively. Around 2835 thousand hectares of cotton were grown in Pakistan in the 2011–12 crop year, an increase of 5.4% over the previous crop year whereas the nation's total cotton production was 13595 thousand bales, a remarkable rise of 18.6 percent over the previous year. The average seed cotton output for the 2011–12 growing season was 815 kg per hectare, an increase of 12.6% over the production of 724 kg per hectare during the 2010–11 growing season (Farooq et al., 2021). Recently, Pakistan is ranked as fifth-largest cotton grower in the world. Cotton high-quality fibre is produced in Pakistan to support the nation's leading textile industry (Abbas, 2022). It is mostly farmed for fibre, and it makes a substantial contribution to the local oil industry by being utilised as a vegetable oil. The 18.1% of Pakistan's demands for edible oil

are met by cottonseed oil. The entire demand for this purpose will be 5.5 million tonnes in 2030, with a local supply of 2 million tonnes.

Currently, more than 90% of Pakistan's cotton production is Bt cotton, which was to eradicate three dangerous lepidopteran insects (Arshad et al., 2022). Yet, several sucking and chewing insect/mite species are likely to attack cotton, resulting in a considerable drop in both crop quantity and quality (Basit et al., 2021). For the past ten years, global cotton output has dramatically decreased (Razzaq et al., 2021). Whitefly (Bemisia tabaci) is known as worldwide pest of ornamentals, vegetables, home plants, and cotton. It harms the host plants by sap feeding, and secreting honeydew that encourages sooty mold fungus development on leaves and fruit and reducing photosynthesis (Parola et al., 2022).

Pesticide overuse poses serious risks to both people and the environment. Despite Pakistan's leadership position in the usage of pesticides, the country's environmental exposure and effect have not yet undergone a thorough study Pakistan was found to have excessive pesticide usage compared to the global average, with an alarming growth of 1169% in the previous two decades. A further issue is that farmers frequently misuse or overuse pesticides owing to a lack of understanding of the dangers, which increases the dangers of occupational exposure (Rashid et al., 2022).

Biopesticides are substances that exist naturally and are used to control pests in a safe and ecologically responsible manner. Biopesticides represent less of a threat to the environment and to human health since they are live things (natural enemies) or products. Plant-incorporated protectants (PIPs), semiochemicals, and substances generated from plants and microorganisms are among the three major groups of biopesticides that are increasingly employed in pest management. Biopesticides are gaining popularity because to their benefits for the environment, target-specificity, effectiveness, biodegradability, and usefulness in integrated pest management (IPM) programs. The annual global production of biopesticides is around 3000 tonnes, and this figure is growing quickly (Chakraborty et al., 2023).


The majority of agricultural pesticides are used to combat cotton pests, which might lead to additional concerns like the emergence of secondary pests, the spread of pesticide resistance, a decline in the population of beneficial insects, and health problems for field workers, cotton pickers and farmers. When applied repeatedly, chemical pesticides have a negative influence on the environment and human health. Whiteflies are a sucking pest that can be controlled alternatively by employing trap crops and biopesticides etc. In contrast to tobacco (Nicotina tabbacium) and trooh (Citrullus collocynthus), neem (Azadirachta indica) extracts were used to manage the sucking pest population. On a Bt cotton crop, sucking insects like jassid, whiteflies, and thrips were managed using a variety of plant extracts, including neem oil, garlic, eucalyptus, and datura (Ali et al., 2022).

All cotton pests severely harm the crop if they are not managed. Controlling a current or new pest infestation requires structurally integrated pest management because only biocontrol agents on cotton does not completely eradicate pest populations. To make decisions on the best pest management strategies to use, it is crucial to gather and research information about pests. The benefit of employing biopesticides over just relying on synthetic pesticides is that these biocontrol agents are less expensive, more specialized, effective in very tiny doses, minimise pesticide resistance, environmentally and human-friendly. Biocontrol agents must not be viewed as a replacement for synthetic pesticide. Thus integration with other crop protection techniques in the IPM programme is required to fully understand the benefit of utilizing biocontrol agents (Malinga and Laing, 2022).

METHODOLOGY

Development of Questionnaire

Data were collected to examine the influence of IPM methods on the characteristics of closest farmers. The study employed a structured questionnaire created by the Department of Agriculture, Central Punjab, and the Institute of Plant Protection, University of Agriculture, Faisalabad.

Site Selection

The research was carried out in significant agricultural areas in central Punjab, Pakistan. The survey was conducted in two divisions including Faisalabad division (number of respondents= 168) and Sahiwal division (number of respondents= 167). In Faisalabad division, questionnaire survey was carried out in three districts including Faisalabad, Jhang and Toba Tek Singh. The details of tehsils, Markaz and union councils with respective number of respondents and IPM plots are given below.

Locations for cotton IPM surveys in Faisalabad and Sahiwal Divisions of central Punjab

Faisalabad Division (168 respondents)

- **Faisalabad districts (54 respondents)**
  - **Samundri Tehsil**
    - Samundri Markaz (175 GB union council) (1 IPM plot) (19 respondents)
    - 45 GB Markaz (225 GB union council) (1 IPM plot) (12 respondents)
  - **Tandlianwala Tehsil**
    - Tandlianwala Markaz (411 GB union council) (1 IPM plot) (11 respondents)
    - Garh Markaz (Kilianwala union council) (1 IPM plot) (12 respondents)

- **Jhang district (55 respondents)**
  - **Jhang Tehsil**
    - Jhang Sadar Markaz (Pakaywala union council) (1 IPM plot) (09 respondents)
    - Jhang Sadar Markaz (Ashaba union council) (1 IPM plot) (11 respondents)
  - **Shorkot Tehsil**
    - Shortkot Markaz (Bhango union council) (1 IPM plot) (08 respondents)
    - Waryamwala Markaz (Chianwala union council) (1 IPM plot) (08 respondents)
  - **Ahmad Pur Sial Tehsil (A.P. Sial)**
    - A.P. Sial Markaz (Peer A. Rehman union council) (1 IPM plot) (09 respondents)
    - A.P. Sial Markaz (2/2-L union council) (1 IPM plot) (10 respondents)

- **Toba Tek Singh district (59 respondents)**
  - **Toba Tek Singh Tehsil**
    - Rajana Markaz (183/GB union council) (1 IPM plot) (08 respondents)
    - Chutiana Markaz (344/GB union council) (1 IPM plot) (08 respondents)
  - **Pir Mahal Tehsil**
    - Pir Mahal Markaz (330/GB union council) (1 IPM plot) (09 respondents)
    - Pir Mahal Markaz (Plot C union council) (1 IPM plot) (10 respondents)
  - **Gojra Tehsil**
    - Mongi Banglow Markaz (180/GB union council) (1 IPM plot) (11 respondents)
    - Gojra Markaz (Peer 423/JB union council) (1 IPM plot) (13 respondents)


Sahiwal Division (167 respondents)

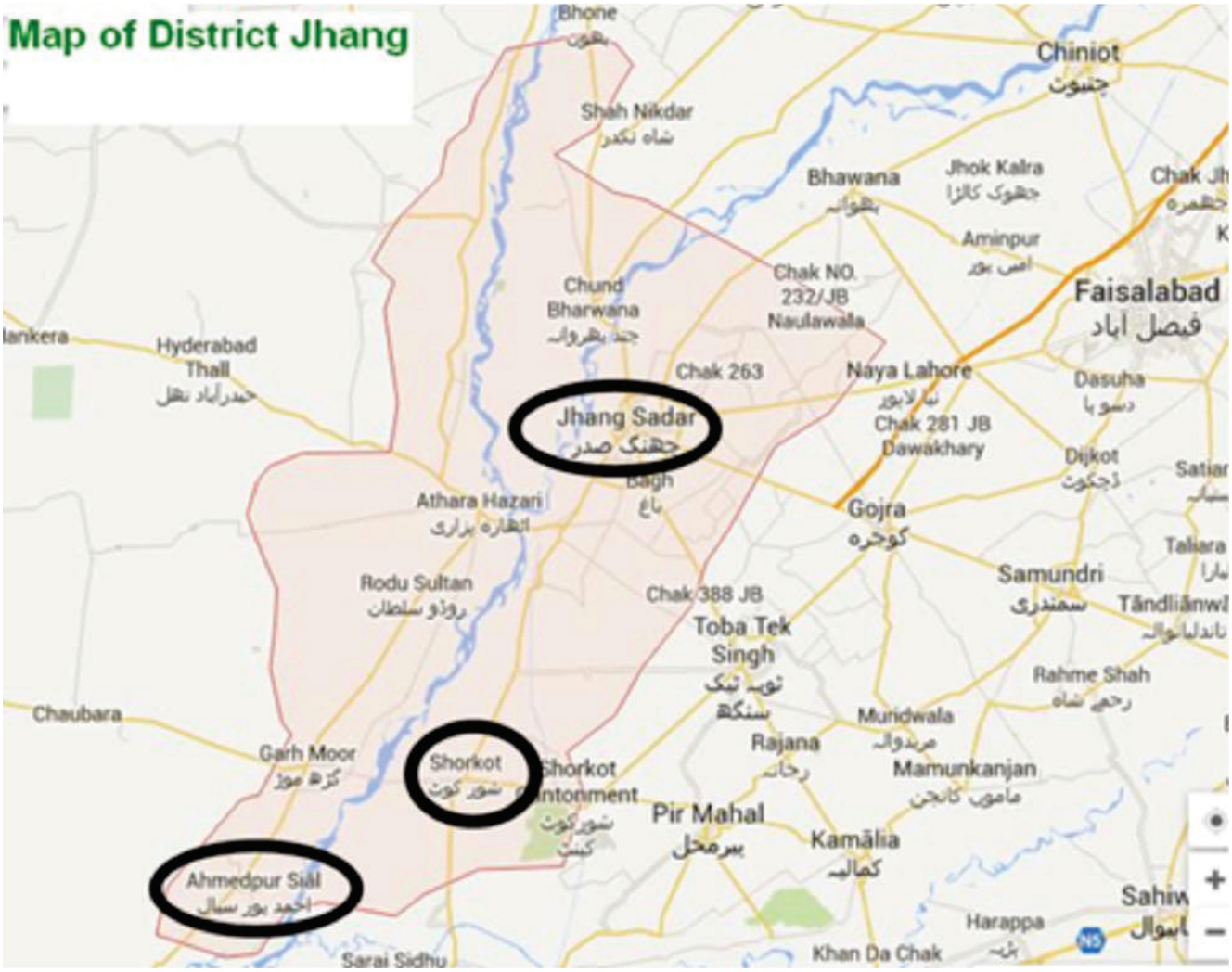
- **Sahiwal districts (69 respondents)**
  - **Chichawatni Tehsil**
    - Chichawatni Markaz (36/12L union council) (1 IPM plot) (19 respondents)
    - Ghaziabad Markaz (18/11L union council) (1 IPM plot) (14 respondents)
  - **Sahiwal Tehsil**
    - Sahiwal Saddar Markaz (78/5L union council) (1 IPM plot) (21 respondents)
    - Kamir Markaz (114/9L union council) (1 IPM plot) (15 respondents)

- **Okara districts (52 respondents)**
  - **OkaraTehsil**
    - Shahbore Markaz (52/2.L union council) (1 IPM plot) (10 respondents)
    - Shahbore Markaz (32/2.L union council) (1 IPM plot) (09 respondents)
  - **Renala Khurd Tehsil**
    - Akhtarabad Markaz (33/1AL union council) (1 IPM plot) (10 respondents)
    - Akhtarabad Markaz (9/1.AL union council) (1 IPM plot) (07 respondents)
  - **Depalpur Tehsil**
    - Depalpur Markaz (Soba Ram union council) (2 IPM plots) (`16 respondents)

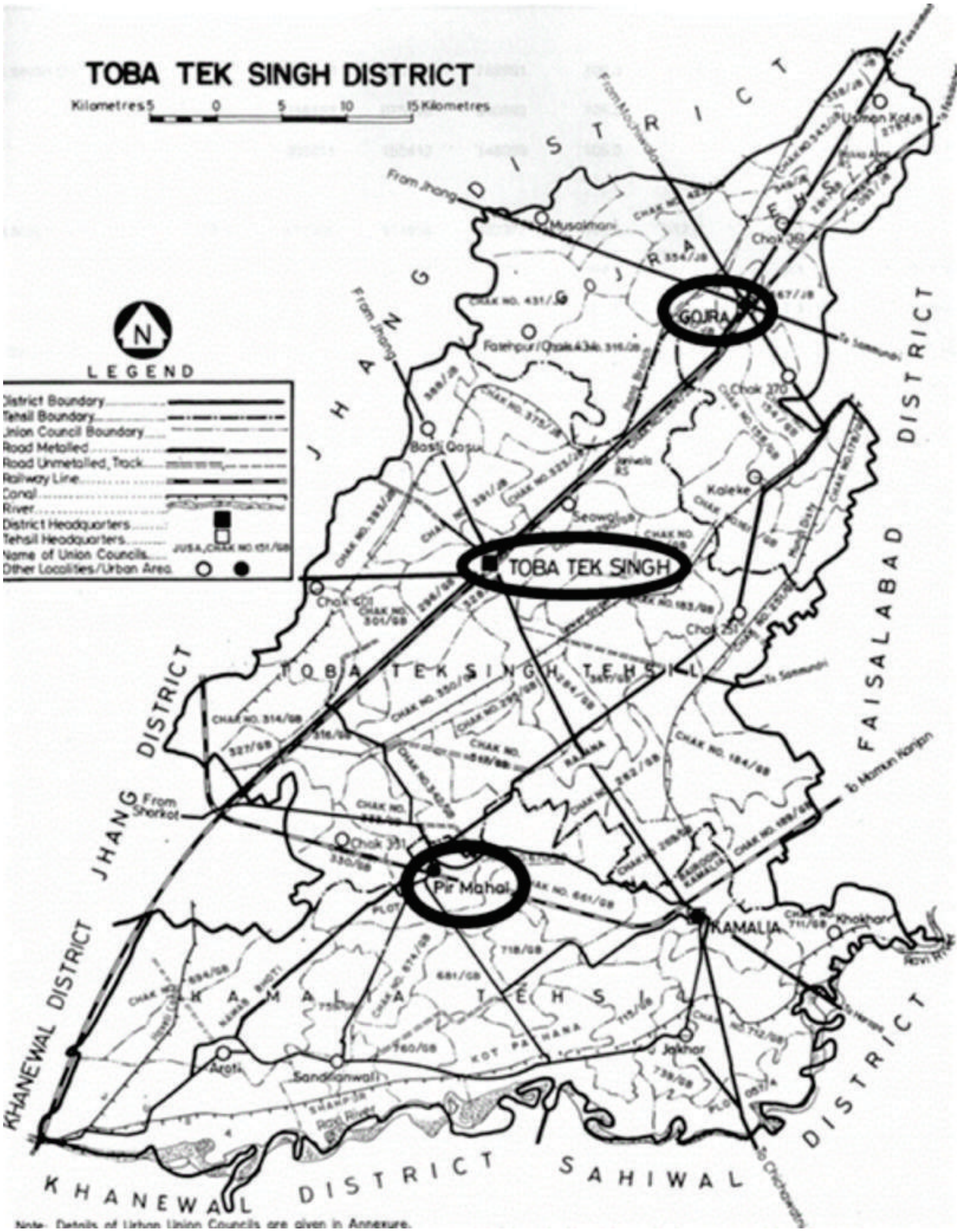
- **Pakpattan districts (46 respondents)**
  - Pakpattan Tehsil
    - Malka Hans Markaz (Dhawna union council) (1 IPM plots) (13 respondents)
    - Pakpattan Markaz (Jagga Baloach union council) (1 IPM plot) (9 respondents)
  - Arifwala Tehsil
    - Qabula Markaz (Machi Singh union council) (1 IPM plots) (11 respondents)
    - Arifwala Markaz (34 EB union council) (1 IPM plots) (13 respondents)

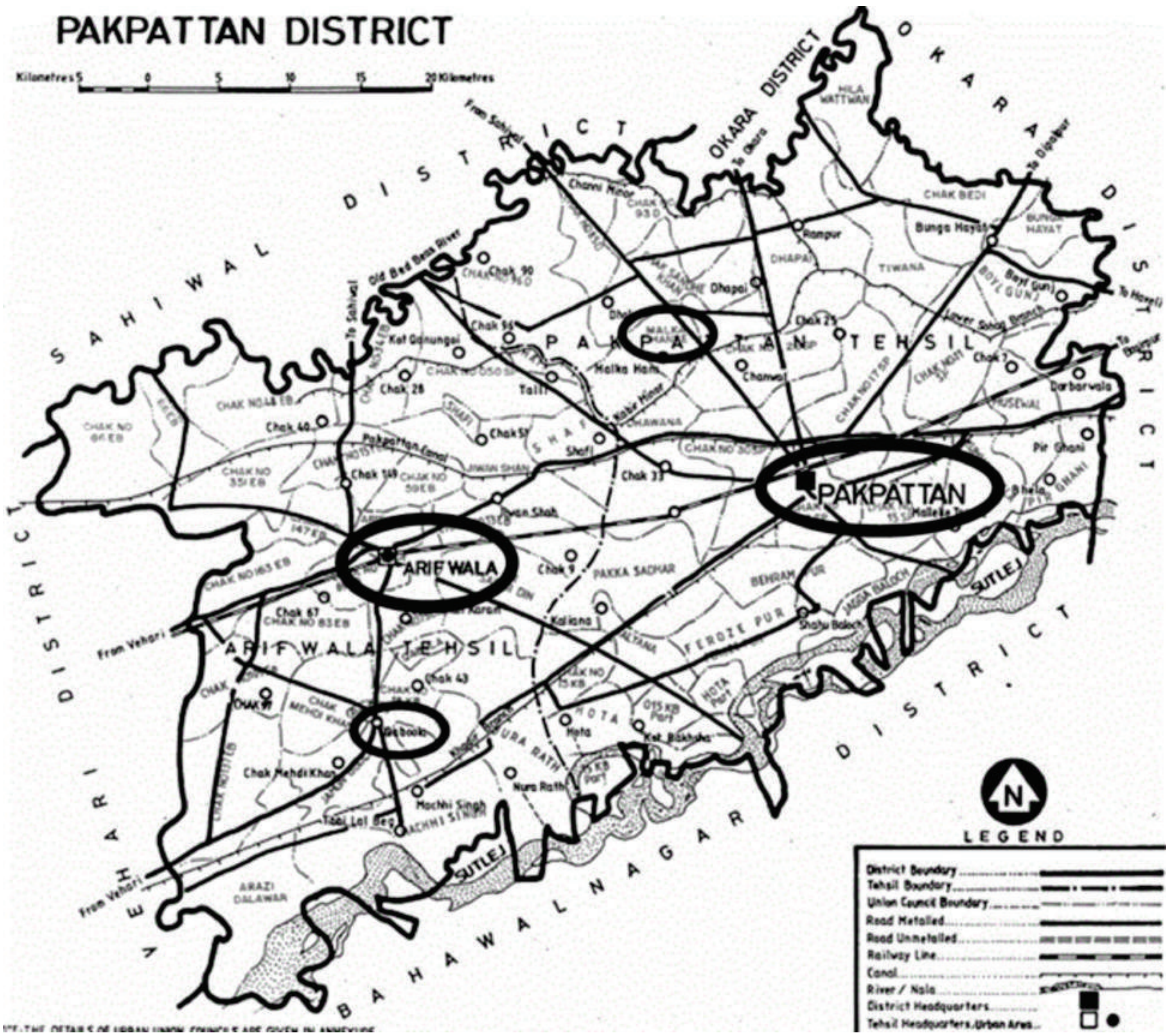

1 - Murree
2 - Lahore
3 - Mandi Bahauddin
4 - Nankana Sahib
5 - Toba Tek Singh
6 - Wazirabad
Attock
Rawalpindi
Talagang
Chakwal
Jhelum
Mianwali
Gujrat
Sialkot
Narowal
Khushab
Sargodha
Hafizabad
Gujranwala
Chiniot
Sheikhupura
Bhakkar
Jhang
Faisalabad
Qasur
Taunsa
Layyah
Okara
Sahiwal
Kot Addu
Khanewal
Pakpattan
Dera Ghazi Khan
Multan
Vehari
Muzaffargarh
Lodhran
Bahawalnagar
Rajanpur
Bahawalpur
Rahim Yar Khan


PAKISTAN
INDIA
Attock
Rawalpindi
Chakwal
Mianwali
Jehlum
Gujrat
Mandi Bahauddin
Sialkot
Khushab
Sargodha
Norwal
Gujranwala
Hafzzabad
Nankana Sahib
Bhakkar
Sheikhpura
Jhang
Faisalabad
Lahor
Layyah
Kasur
Toba Tek Singh
Okara
Sahiwal
Muzaffargarh
Khanewal
Pakpattan
Dera Ghazi Khan
Multan
Vehari
Bahawalnagar
Odhran
Rajanpur
Bahawalpur
Rahim Yar Khan


Map of District Jhang
Bhone
Chiniot
Shah Nikdar
Bhawana
Jhok Kalra
Aminpur
Chak NO. 232/JB Naulawalla
Chund Bharwana
Faisalabad
Hyderabad Thall
Chak 263
Naya Lahore
Chak 281 JB Dawakhary
Dasuha
Jhang Sadar
Dijkot
Bagh
Athara Hazari
Gojra
Rodu Sultan
Chak 388 JB
Samundri
Toba Tek Singh
Rahme Shah
Chaubara
Muridwala
Garh Moor
Shorkot
Rajana
Mamunkanjan
Pir Mahal
Kamālia
Ahmedpur Siāl
Harappa
Khan Da Chak
Sarai Sidhu


Rajoa Sadat
Chak
Jhumra
Bhowana
Dhanola
Khurianwala
فیصل آباد
Faisalabad
پروکیانوالا
Prokianwala
Makkuana
سدھار
Sidhar
Naya
Lahore
پینسرہ
Painsra
Dasuha
ڈجکوٹ
Dijkot
گوجرہ
Gojra
Chak
367 JB
سمندری
Samundri
ٹانڈلیاں والا
Tandlianwala
رحمے شاہ
Rahme
Shah
Phalor
مریدوالہ
Muridwala
Kot Mian
Abdul Ghafoor
Noor Shah
Mamu
Kanjan


TOBA TEK SINGH DISTRICT
Kilometres 5 0 5 10 15 Kilometres
LEGEND
District Boundary
Tehsil Boundary
Union Council Boundary
Road Metalled
Road Unmetalled, Track
Railway Line
Canal
River
District Headquarters
Tehsil Headquarters
Name of Union Councils
Other Localities/Urban Area
GOJRA
TOBA TEK SINGH
Pir Mahal
KAMALIA
JHANG DISTRICT
FAISALABAD DISTRICT
KHANEWAL DISTRICT
SAHIWAL DISTRICT
TOBA TEK SINGH TEHSIL
KAMALIA TEHSIL
GOJRA TEHSIL
Note: Details of Urban Union Councils are given in Annexure.


PAKPATTAN DISTRICT
SAHIWAL DISTRICT
OKARA DISTRICT
VEHARI DISTRICT
BAHAWALNAGAR DISTRICT
PAKPATTAN TEHSIL
ARIFWALA TEHSIL
PAKPATTAN
ARIFWALA
SUTLEJ
LEGEND
District Boundary
Tehsil Boundary
Union Council Boundary
Road Metalled
Road Unmetalled
Railway Line
Canal
River / Nala
District Headquarters
Tehsil Headquarters,Urban Area

RESULTS

Responses of respondents on whether Agriculture Department gives consultations/ counselings about cotton

The respondents were asked whether the Agriculture department had given advices, consultations, suggestions, or counselling about cotton giving them options of "yes" and "No". Responding to this question, 100% respondents in districts Faisalabad, Jhang, Toba Tek Sigh and Sahiwal replied in "yes" While approximately 3.85% (96.15% yes) and 2.17% (97.83% yes) respondents resplied in "No" in districts Okara and Pakpattan, respectively. The respondents in districts Okara and Pakpattan further explained that they got motivation on cotton from their contact cotton growers (Figure 1).

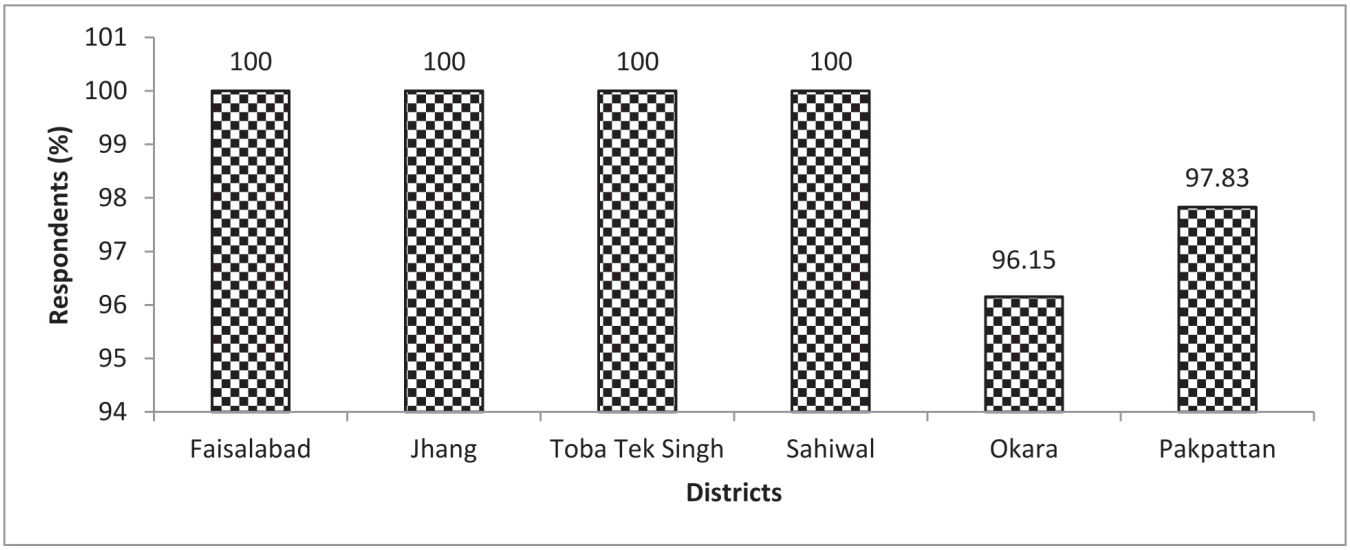


Figure 1: Responses of the respondents on whether Agriculture Department gives consultations/ counselings about cotton

Responses of respondents on sources of information about cotton cultivation

To respond the question "From where do you get information about cotton cultivation?", the respondents were given four options including: 1) Department of Agriculture; 2) Agriculture Company; 3) Television; and Telephone, as cotton information-gaining source. A range of variations in responses were obtained from the respondents of six districts of Sahiwal and Faisalabad divisions of Punjab. A significantly higher number of respondents (94.55-96.30% respondents) replied that they obtained the

information about cotton cultivation from the Agriculture department. In all surveyed districts, almost similar percentages of respondents obtained cotton cultivation relevant information from Agriculture Department. The replies of respondents of six surveyed district also indicate that cotton information-gaining source of 58.70-75.93% respondents was agriculture companies. The higher percentage of respondents who obtained cotton cultivation relevant information from agriculture companies was from district Faisalabad (75.93%) followed by Jhang (74.55%), Sahiwal (73.91%), Toba Tek Sigh (67.80%), Okara (63.46% and Pakpattan (58.70%). The responses of respondents from six survey districts of Sahiwal and Faisalabad divisions demonstrated that percentages of responses, who declared TV as cotton information-gaining source along with Agriculture department, ranged between 11.59-23.91%, being higher in Pakpattan district and lower in Sahiwal district. The percentages of respondents who used telephone as cotton information-gaining source along with Agriculture department, ranged from 7.25% to 10.87%% (Figure 2).

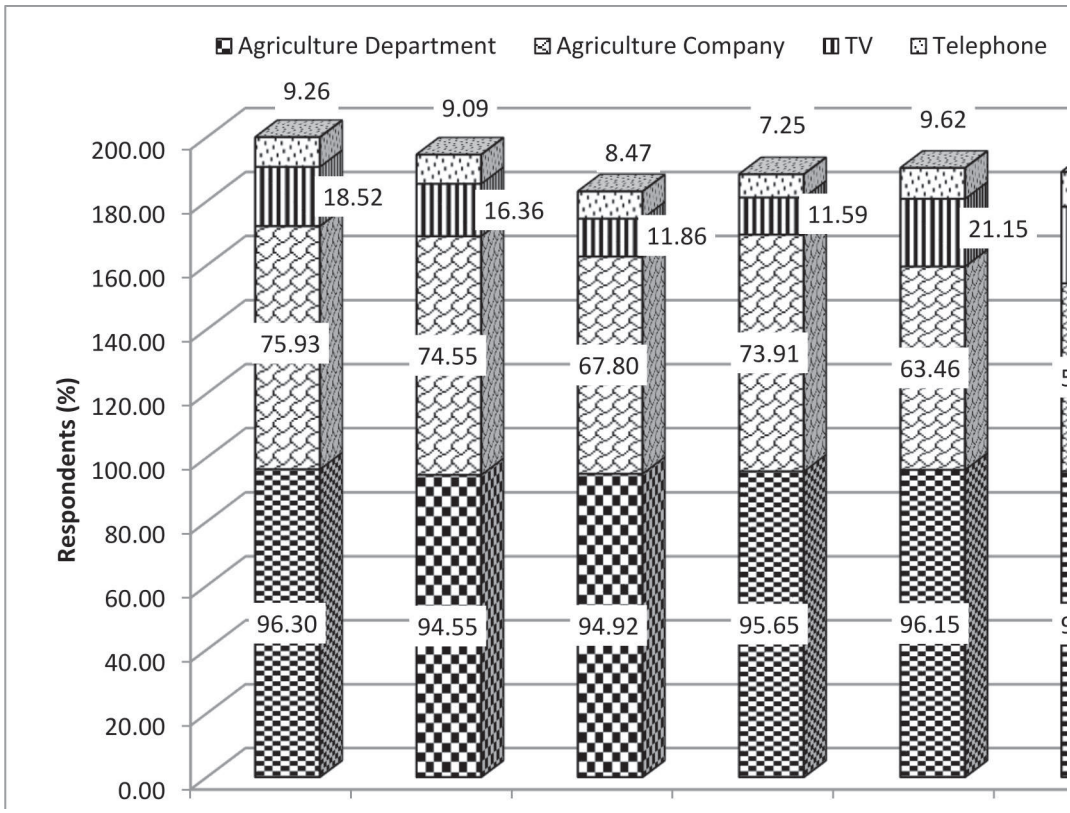


Figure 2: Responses of the respondents on different cotton cultivation information sources in different districts of Sahiwal and Faisalabad divisions

Knowledge of respondents about biopesticides

The six districts of Sahiwal and Faisalabad divisions were surveyed to gather information of the respondents' levels of knowledge about biopesticides. The survey results depict that about 76.92-98.31% respondents of the survey districts replied in "Yes" when they were asked whether they had knowledge on biopesticides, being higher respondents percentage in district Toba Tek Singh following by Jhang (96.36%), Faisalabad (94.44%), Sahiwal (86.96%), Pakpattan (84.78%) and Okara (76.92%). A range of respondents percentage between 1.69-23.08% were found to lack knowledge about biopesticides as they replied in "No" when they were asked about their knowledge on biopesticides. The higher percentage of respondents lacking biopesticide's knowledge were found in Okara (23.08%) district followed by Pakpattan (15.22%) and Sahiwal (13.04%) districts (Figure 3).

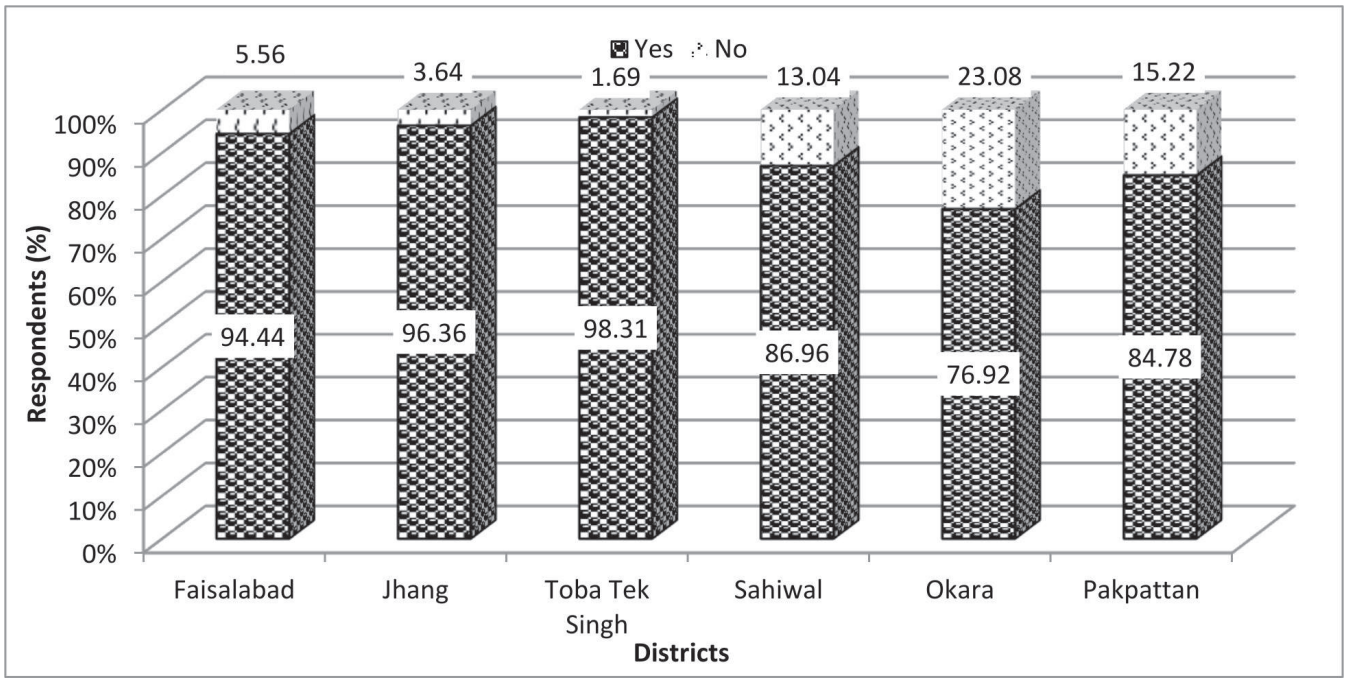


Figure 3: Responses of the respondents in different districts of Sahiwal and Faisalabad divisions on their knowledge about biopesticides

Responses of respondents about timing/delay, frequency and cost of insecticidal sprays delay in first spray of synthetic insecticides

The six districts of Sahiwal and Faisalabad divisions were surveyed to dig out the information on whether the respondents acted upon the advice of not executing first spray upto 60 days of initial cotton growth period. The survey results depict that about 63.04-87.27% respondents of the survey districts replied in "Yes" and noded that they acted on the advice of the agriculture department and delayed the first spray of synthetic insecticides upto 60 days. The higher percentage of respondents, who delayed the first spray of synthetic insecticides upto 60 days, were found in Jhang (87.27%) followed by Faisalabad (83.33%), Toba Tek Singh (77.97%), Okara (71.15%), Sahiwal (68.12%) and Pakpattan (63.04%). A range of respondents' percentage between 12.73-36.96% did not delay first spray of synthetic insecticides and showed no compliance to the direction of Agriculture department as they replied in "No" when they were asked whether first spray was delayed or not. The higher percentage of respondents, not complying in the delay of first spray, were found in Pakpattan (36.96%) district followed by Sahiwal (31.88%), Okara (28.85%), Toba Tek Singh (22.03%), Faisalabad (16.67%) and Jhang (12.73%) districts (Figure 4).

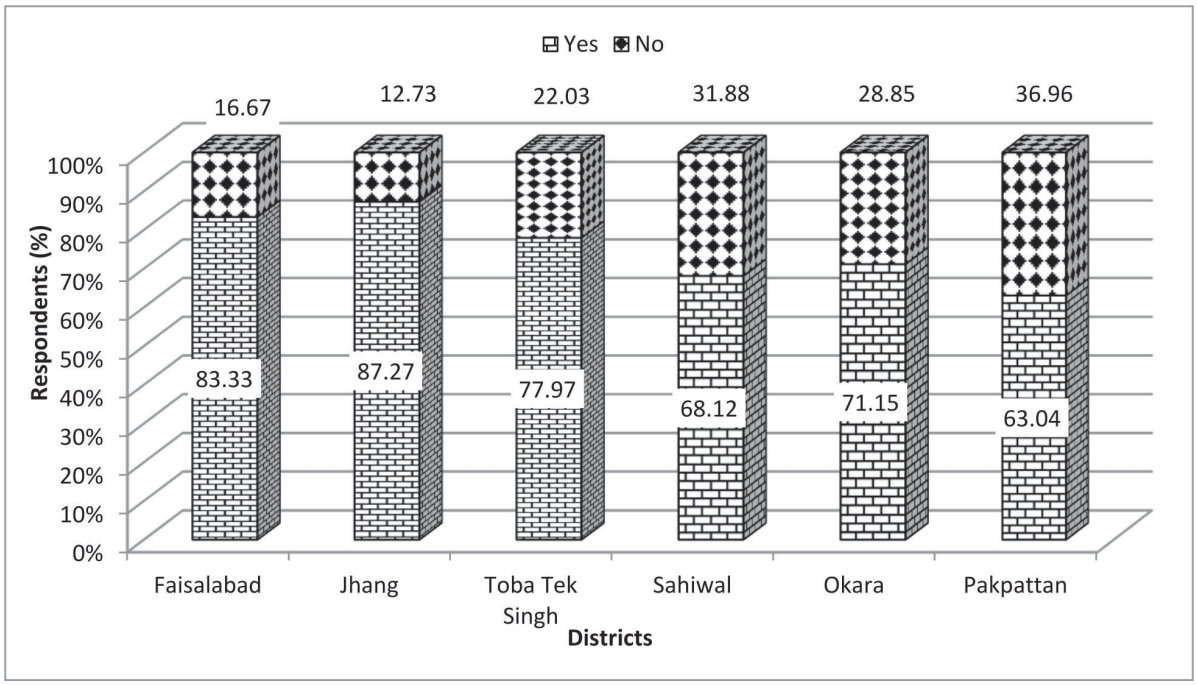


Figure 4: Responses of the respondents about compliance on delay of first spray of synthetic insecticides upto initial 60 days

Timing of first spray

When the respondents of different districts of Sahiwal and Faisalabad divisions were asked when they had executed first spray of insecticides, variable responses were obtained from different respondents in both divisions. In Sahiwal division, the percentage of respondents who executed first insecticide spray after a period of 25-30 days ranged between 48.08-52.17%, being higher respondents' percentage in Pakpattan followed by Sahiwal and Okara. However, in Faisalabad division, the percentage of respondents who executed first insecticide spray after a period of 25-30 days ranged between 15.25-25.93%, being higher respondents' percentage in Faisalabad followed by Jhang and Toba Tek Singh (Figure 5). In Sahiwal division, the percentage of respondents who executed first insecticide spray after a period of 45-50 days ranged between 34.78-42.03%, being higher respondents' percentage in Sahiwal followed by Okara and Pakpattan. However, in Faisalabad division, the percentage of respondents who executed first insecticide spray after a period of 45-50 days ranged between 64.81-79.66%, being higher respondents' percentage in Toba Tek Singh followed by Jhang and Faisalabad. A very low range of respondents (5.08-15.38%) responded that they used to execute first insecticide spray after a period of 60-75 days (Figure 5).

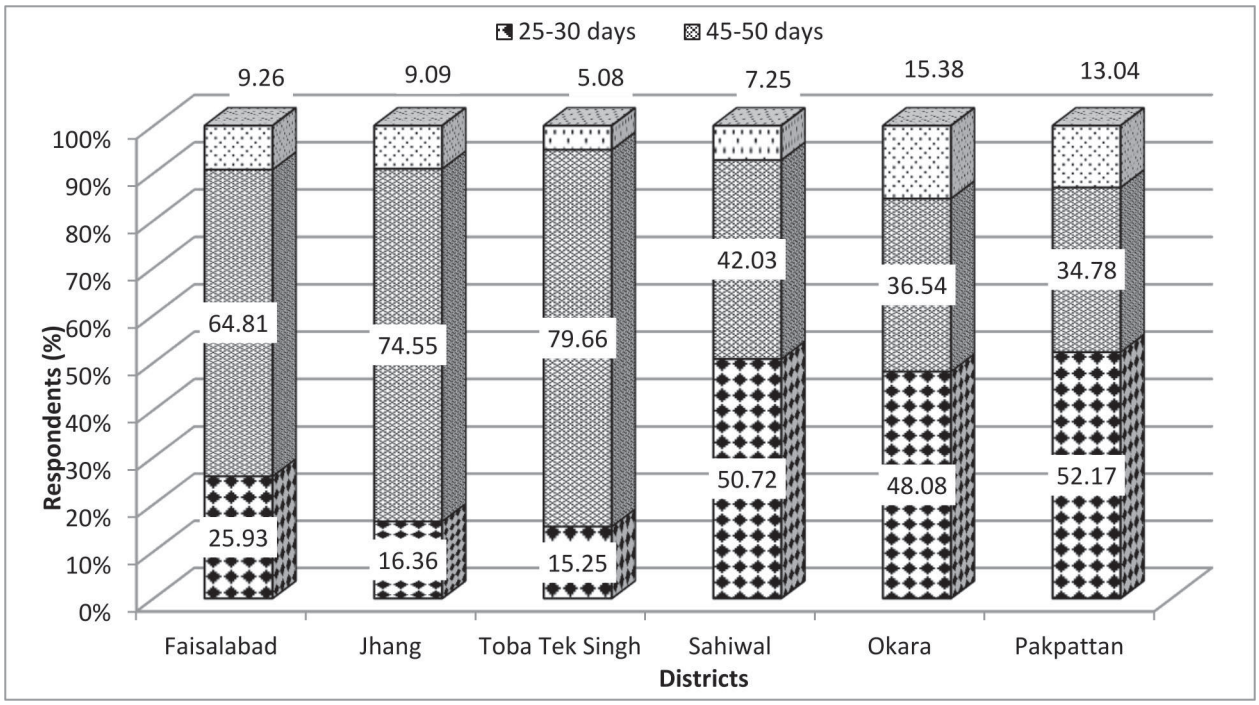


Figure 5: Responses of the respondents about timing of first spray on cotton crop

Target insect pest

In response to the question regarding the target insect pests against which they executed first insecticide's spray, variable responses of the respondents of different districts of both divisions were recorded in the questionnaire. A respondent's percentage range of 89.09-93.22%, 80.0-84.08%, 50.72-63.46%, 30.43-38.89%, 13.04-19.57%, 7.25-10.87% and 5.57-15.38% declared that they had executed first spray of insecticide on cotton crop against whitefly, jassid, thrips, mites, aphid, mealybug and other pests, respectively. Majority of the respondents replied that whitefly, jassid and thrips were the major pests attacking cotton crop in complex form at initial growth stages and first spray had to be executed to suppress these pest. Some respondents declared that along with these pests, infestation of mites, aphid or mealybug were also the causative of the first spray of insecticides on cotton crop (Figure 6).

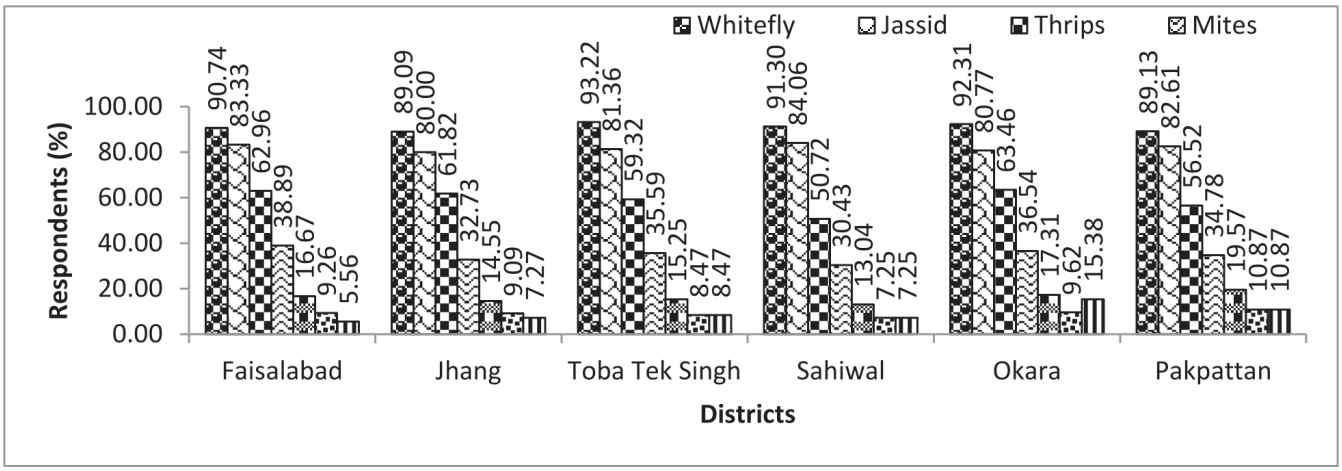


Figure 6: Responses of the respondents about insect pest targeted by first spray on cotton crop

Number of sprays of biopesticides: comparison of current and previous years

When the respondents were asked about the number of sprays of biopesticides on cotton during the current and previous years, a variation in the responses of the respondents was observed. None of the respondents adopted the application of biopesticides during previous year. However, different responses of the respondents regarding number of sprays of biopesticides during current year were recorded during survey. The percentage of respondents, who executed 2-3 biopesticides' sprayed during current year, ranged between 11.59-18.52%, being higher in Faisalabad district followed by Okara, Jhang, Pakpattan, Toba Tek Singh and Sahiwal districts. The greater percentage of respondents declared that they applied 4-5 sprayed of biopesticides on cotton against insect pests during current years. The percentage of respondents, who applied 4-5 sprays of biopesticides during current year, ranged between 81.48-88.41%, being higher in Sahiwal district followed by Toba Tek Singh, Pakpattan, Jhang, Okara and Faisalabad districts (Figure 7).

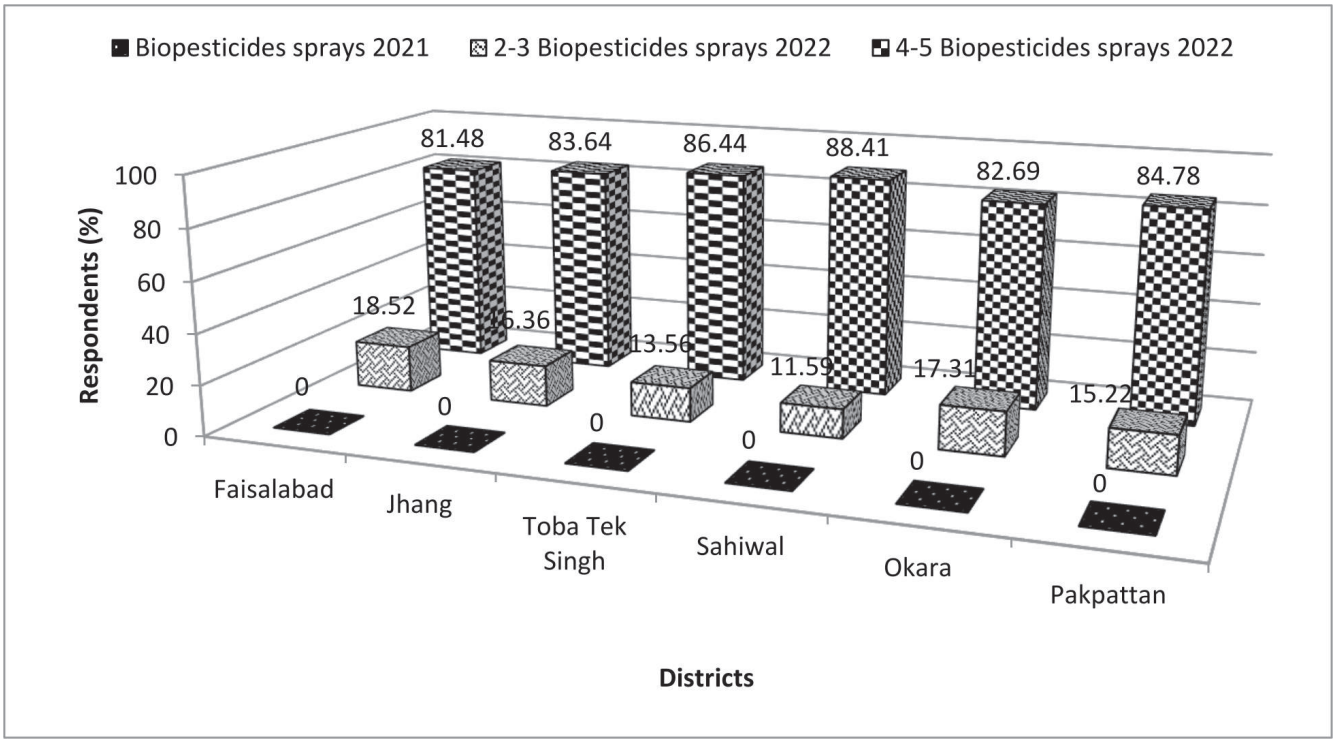


Figure 7: Responses of the respondents about number of sprays of biopesticides on cotton crop during previous (2021) and current (2022) years.

Expenditure of sprays of biopesticides: comparison of current and previous years

During previous year of cotton season 2021, no biopesticides was sprayed on cotton so none of the respondents sprayed biopesticides and calculated their cost. However, during cotton current season (2022), biopesticides were sprayed on cotton and their cost was estimated by the respondents. According to the results of the survey, the maximum respondents (61.02-69.23%) declared that the cost of sprays of biopesticides was in the range of 201-400 PKR per acre followed by the percentage of respondents (21.15-27.12%) who declared that the cost of sprays of biopesticides was in the range of 401-600 PKR per acre. About 5.45-9.26% respondents declared that the cost of sprays of biopesticides was in the range of 150-200 PKR per acre. However, the minimum percentage of respondents (2.90-3.85%) declared that the cost of sprays of biopesticides was in the range of 601-800 PKR per acre (Figure 8).

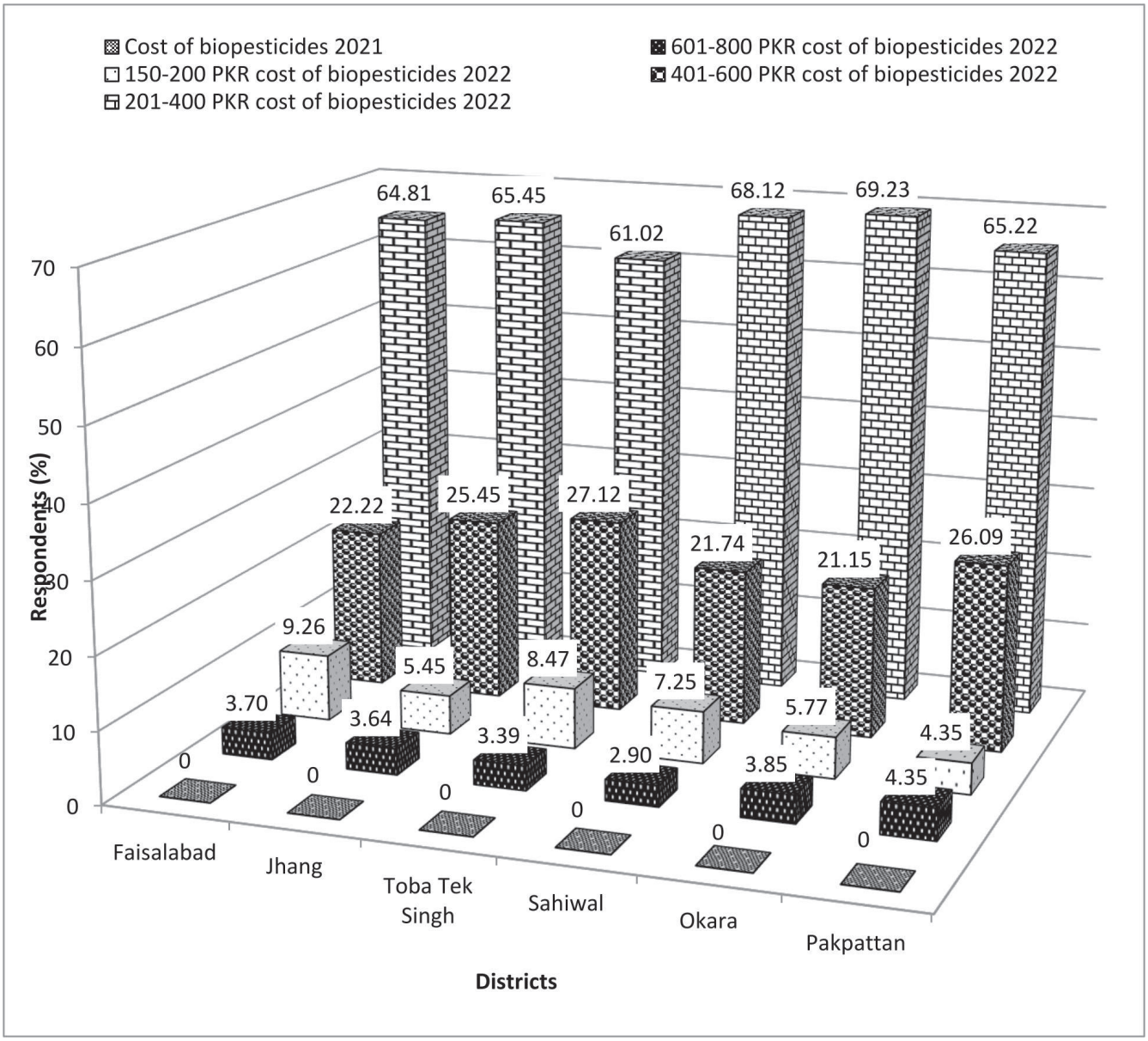


Figure 8: Responses of respondents regarding cost of sprays of biopesticides on cotton crop during previous (2021) and current (2022) years.

Number of sprays of synthetic insecticides: comparison of current and previous years

When the respondents were asked about the number of sprays of synthetic insecticides applied on cotton during the current and previous years, a variation in the responses of the respondents was observed.

The maximum percentage of respondents (45.45-50.72%) responded that they applied 9-10 sprays of synthetic insecticides during previous year (2021); while 34.78-38.47% respondent declared that they applied 11-12 sprays of synthetic insecticides during previous year (2021). The percentage of respondents, who applied 12-13 sprays of synthetic insecticides during previous year (2021), ranged between 7.69-12.73%; while the percentage of respondents, who applied 7-8 sprays of synthetic insecticides during previous year (2021), ranged between 2.90-7.41%; (Figure 9).

During current year (2022), the maximum percentage of respondents (89.13-92.75%) declared to apply 4-5 sprays of synthetic insecticides which were found 2 times less than the number of sprays declared by the maximum respondent (9-10 sprays) during previous year (2021); while minimum percentage of respondents (1.45-3.85%) declared that they applied 2-3 sprays of synthetic insecticides during current year (2022). The percentage of respondents, who applied 6-8 sprays of synthetic insecticides during current year (2022), ranged between 5.08-8.70% (Figure 10).

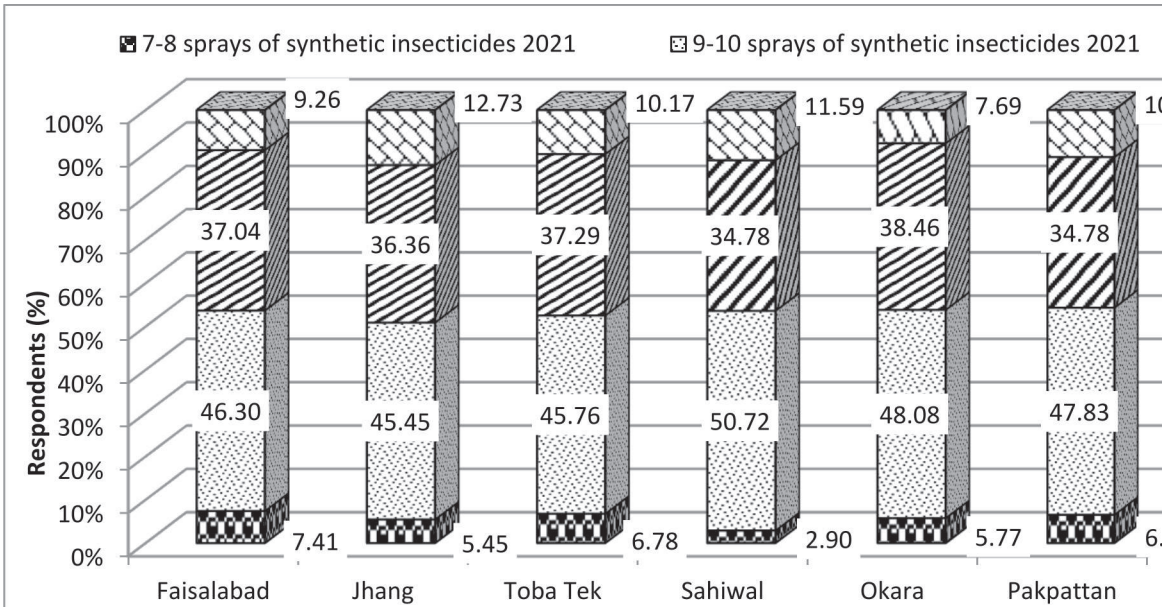


Figure 9: Responses of the respondents about number of sprays of synthetic insecticides applied on cotton during year 2021

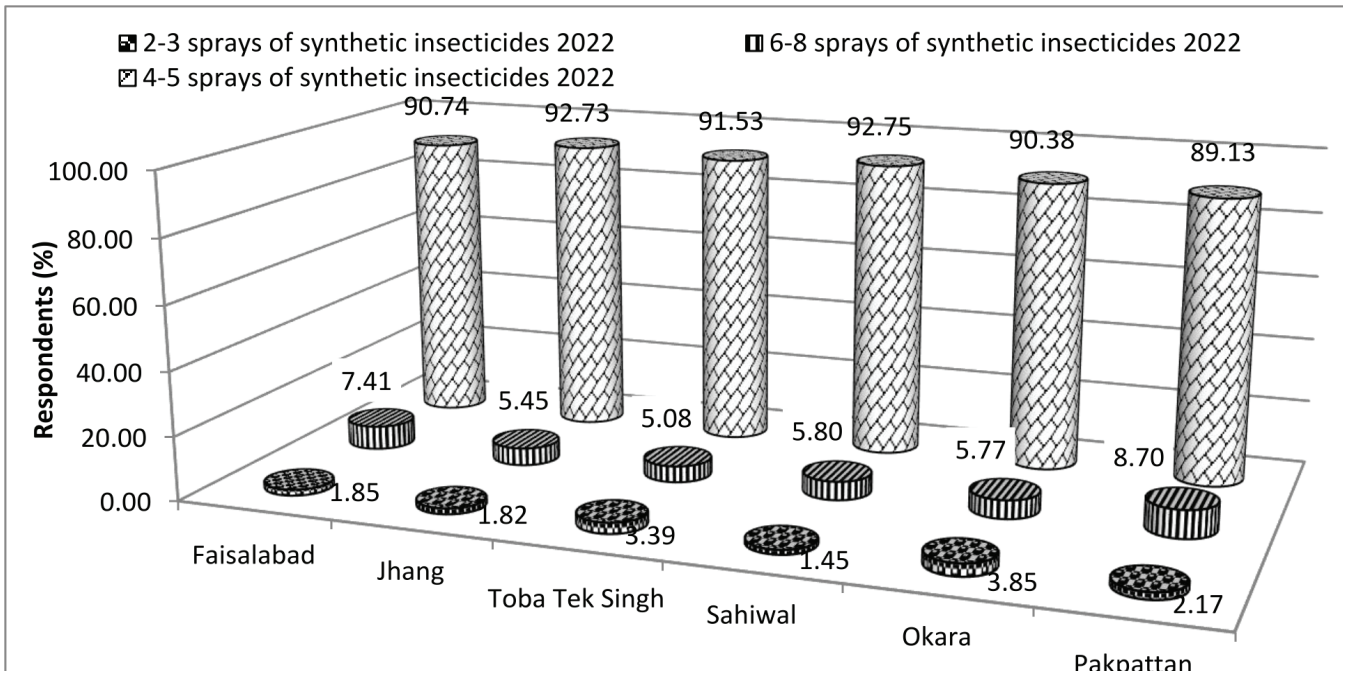


Figure 10: Responses of the respondents about number of sprays of synthetic insecticides applied on cotton during year 2022

Cost of sprays of synthetic insecticides: comparison of current and previous years

During previous (2021) current (2022) year of cotton season, synthetic insecticides were sprayed on cotton so the respondents calculated cost of sprays. According to the results of the survey, the maximum respondents (81.82-84.75%) declared that the cost of sprays of synthetic insecticides was in the range of 10000-15000 PKR per acre during previous year (2021) followed by the percentage of respondents (9.62-11.11%) who declared that the cost of sprays of synthetic insecticides was in the range of 5000-10000 PKR per acre during previous year (2021). However, the minimum percentage of respondents (5.08-6.52%) declared that the cost of sprays of synthetic insecticides was in the range of 15000-20000 PKR per acre during previous year (2021) (Figure 11).

For the current year (2022), the maximum respondents (81.82-84.75%) declared that the cost of sprays of synthetic insecticides was in the range of 5000-10000 PKR per acre followed by the percentage of respondents (2.90-4.35%) who declared that the cost of sprays of synthetic insecticides was in the range of 10000-15000 PKR per acre during current year (2022). However, no respondents declared that the cost of sprays of synthetic insecticides was in the range of 15000-20000 PKR per acre during current year (2022) (Figure 12).

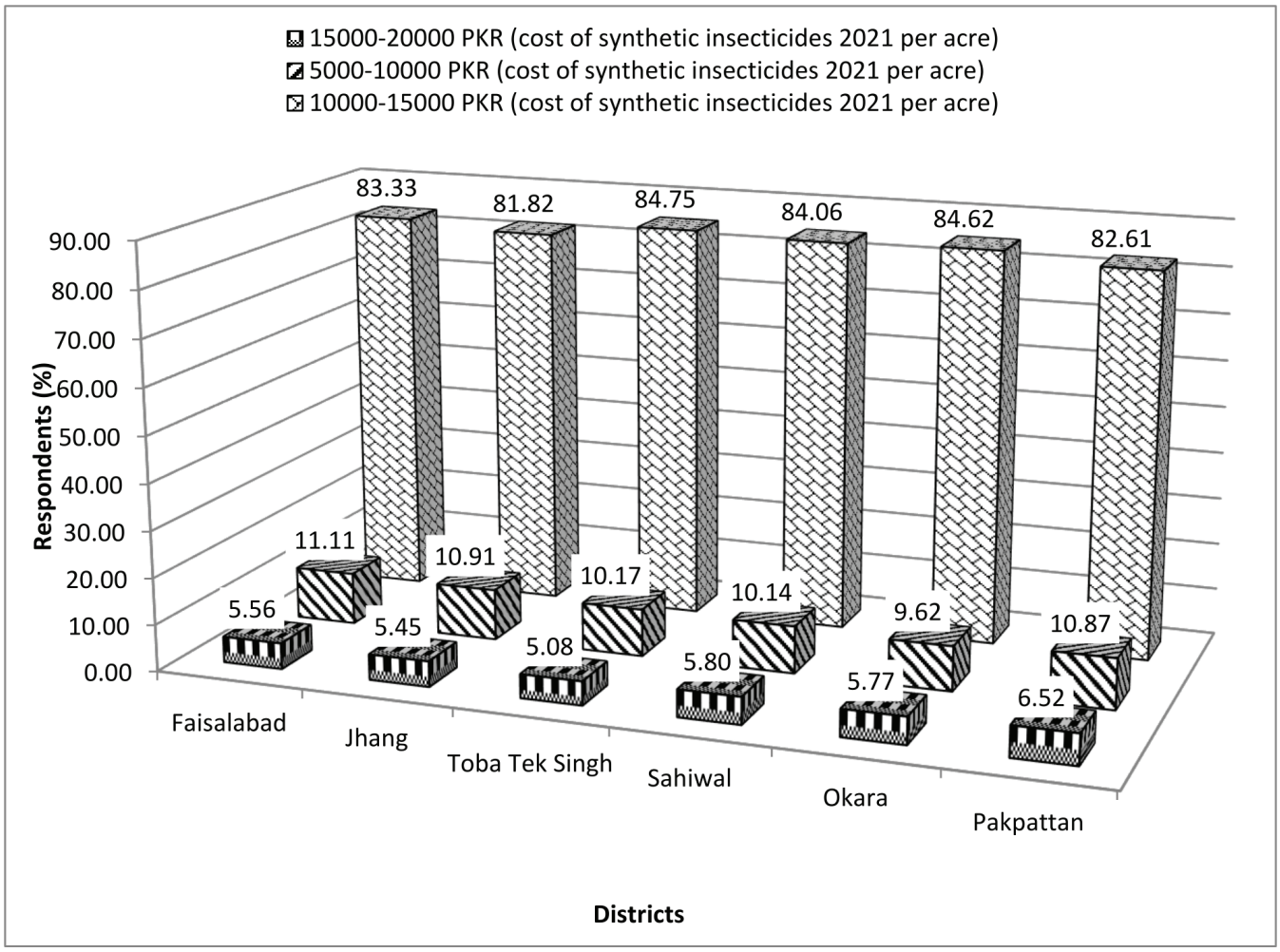


Figure 11: Responses of respondents regarding cost of sprays of synthetic insecticides on cotton crop during previous (2021) year

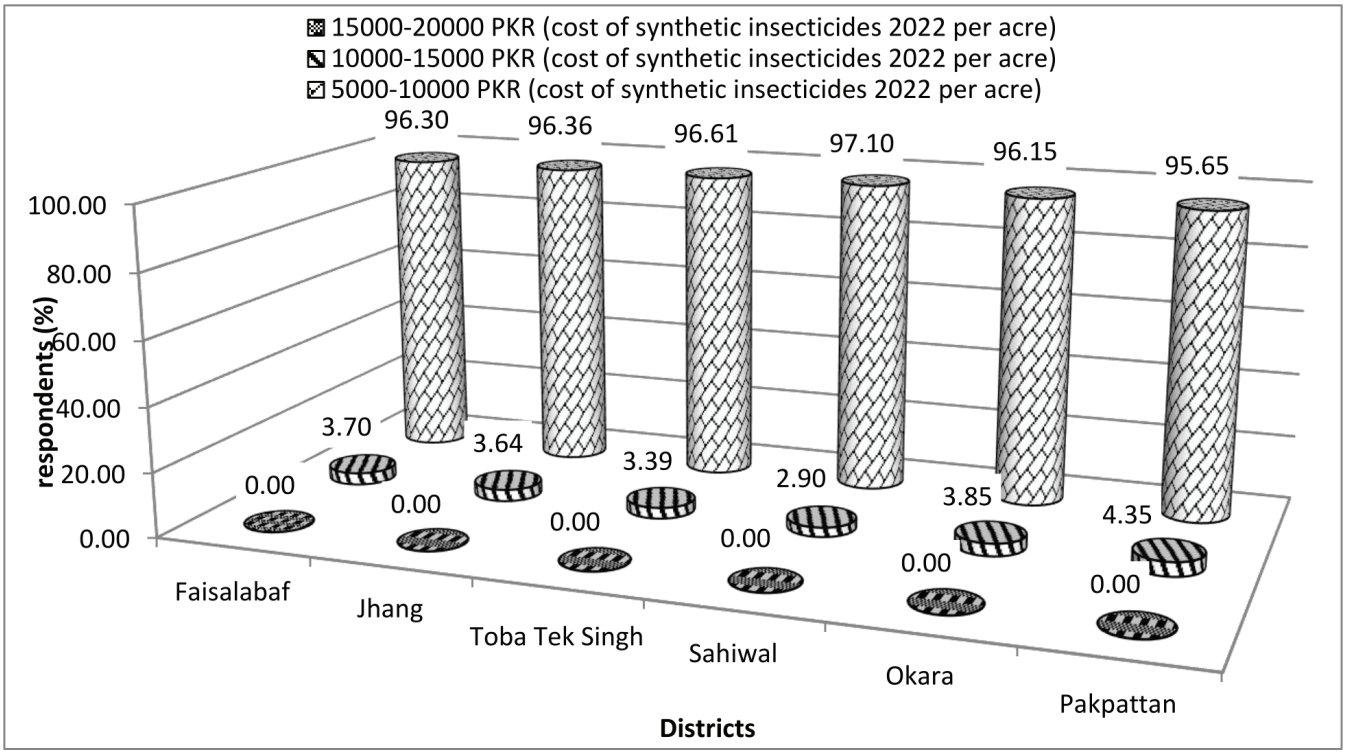


Figure 12: Responses of respondents regarding cost of sprays of synthetic insecticides on cotton crop during current (2022) year

Knowledge of respondents about bioagents/friendly insect fauna (natural enemies)

The respondents were asked about the situation of natural enemies in the cotton field during previous year (2021) when first sprayed was not delayed and biopesticides were not sprayed on cotton in comparison with the current year (2022) when the respondents delayed first spray as well as sprayed biopesticides on cotton. An encouraging response of the respondents about the presence of natural enemies (friendly insect fauna) during current year was observed. In the previous year (2021), the higher percentage of respondents (95.65-97.10%) declared their responses in "No" while only the minimum percentage of respondents (2.90-4.35%) declared their responses in "Yes" about the presence of natural enemies (friendly insect fauna) in cotton crop (Figure 13). Unlikely, in the current year (2022), the higher percentage of respondents (90.38-92.73%) declared their responses in "Yes" while only the minimum percentage of respondents (7.27-9.26%) declared their responses in "No" about the presence of natural enemies (friendly insect fauna) in cotton crop (Figure 14).

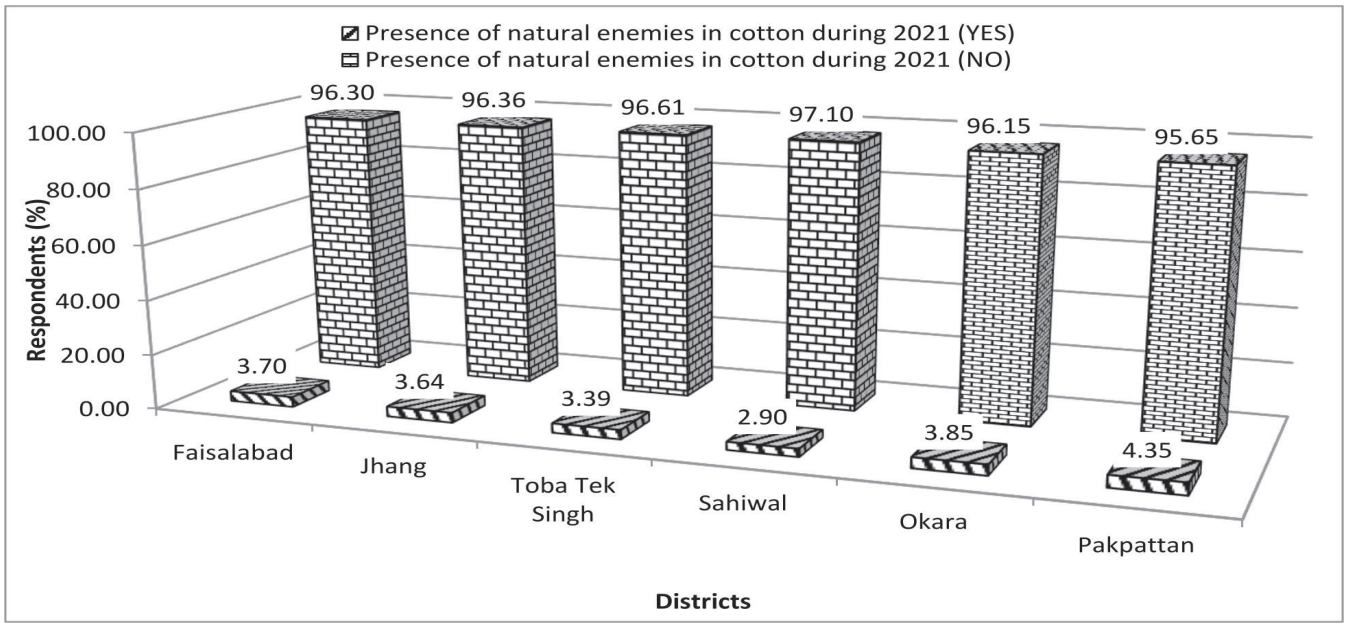


Figure 13: Responses of the respondents about presence of natural enemies in cotton during year 2021

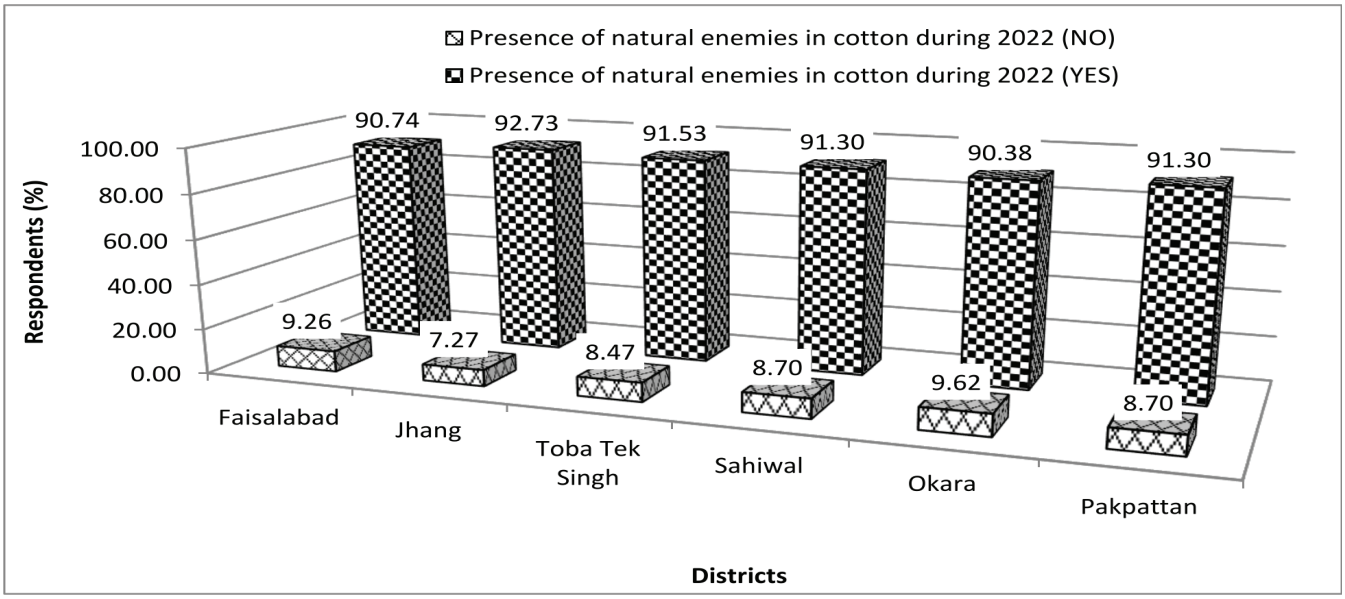


Figure 14: Responses of the respondents about presence of natural enemies in cotton during year 2022

Responses of respondents about most devastating factors for cotton crop

Cotton production depends on so many factors which individually and/or cumulatively result in significant decline in cotton production and quality. The respondents were asked about the most devastating and harmful factor(s) which had caused drastic decline in cotton productivity in Pakistan currently or in the past. The respondents were given different options including pesticides, seeds, weather/climate, biopesticides and any other factors responsible for reduced cotton productivity in Pakistan. The results of the survey data depicted that respondents highlighted the pesticides, seeds and weather/climate as major and prominent factors; while biopesticides and any others as minor factors responsible for decline in cotton productivity in Pakistan. About 71.19-77.78%, 67.80-74.07% and 64.41-71.01% respondents highlighted poor quality and unregistered seeds, unfavorable and unusual harsh weather/climate and ineffective pesticides as major factors responsible for decline in cotton productivity in Pakistan. According to these respondents, these major factors had resulted in the flare up of insect pests specially whitefly and pink bollworm in cotton crop. Unlikely, about 0.0-2.9% and 1.45-4.35% respondents highlighted biopesticdes and other minor factors responsible for decline in cotton productivity in Pakistan (Figure 15).

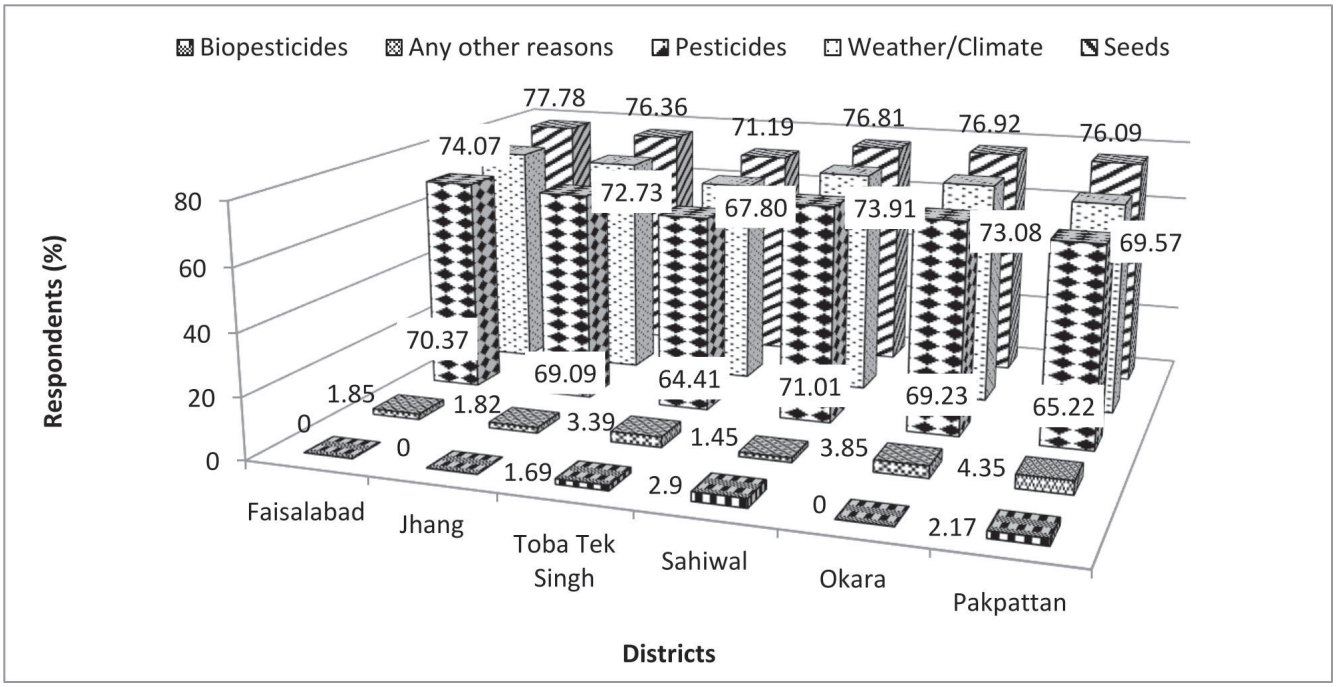


Figure 15: Responses of the respondents about the most harmful factors for cotton productivity

Responses of respondents about positive effects Biopesticides

The biopesticides are considered ecofriendly and have positive effects on the components of eco-system. These don't have harmful and negative impacts on the ecosystem. The use of biopesticides on cotton poses harmful impacts on insect pests but don't impose any harmful/negative impacts on non-target fauna and flora of cotton. The respondents of different districts of Sahiwal and Faisalabad divisions were interviewed to collect their viewpoint on the positive effects of biopesticides through questionnaire. The maximum percentage of respondents (69.23-93.22%) nodded in "Yes" when they were asked if they agreed on the positive effects of biopesticides. The percentage of respondents, who positively agreed on the positive effects of biopesticides, was found maximum in Toba Tek Sigh followed by Faisalabad, Sahiwal, Jhang, Pakpattan and Okara districts. The percentage of respondents, who disagreed on the positive effects of biopesticides, ranged between 6.78-30.77%, being higher in Okara followed by Pakpattan, Jhang, Sahiwal, Faisalabad and Toba Tek Sigh districts (Figure 16).

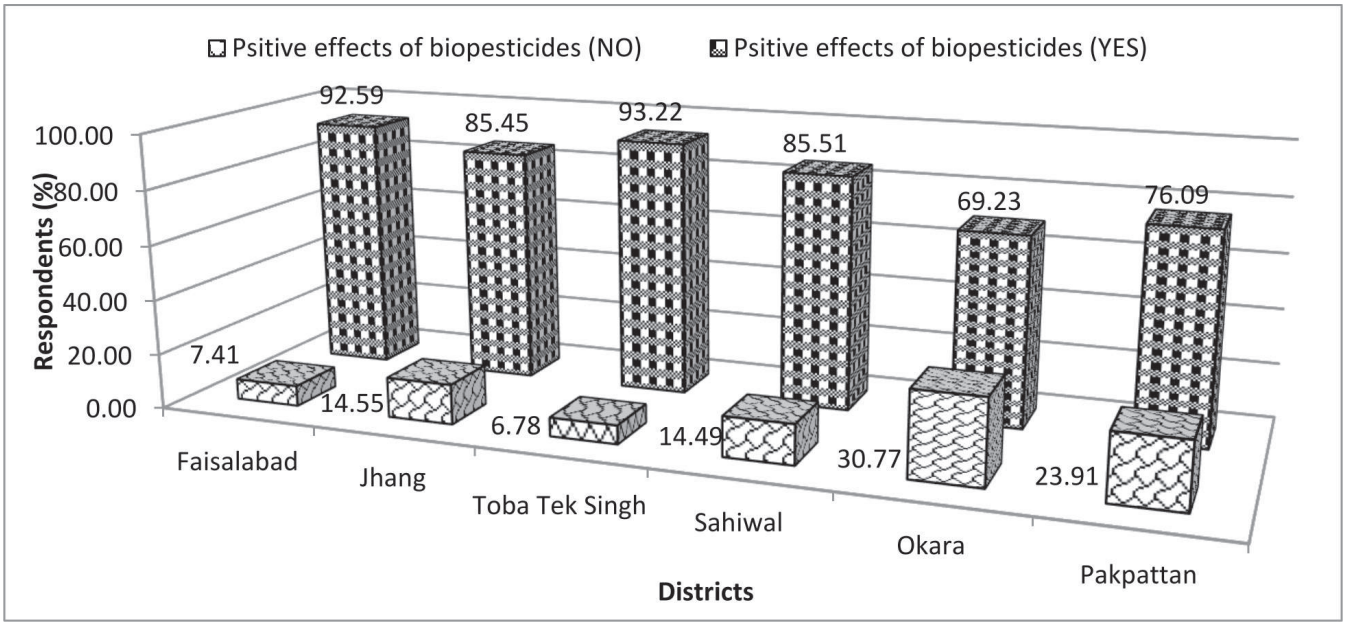


Figure 16: Responses of the respondents about positive effects of biopesticides in cotton agroecosys tem

Responses of respondents about adaptation of IPM model next year

IPM is considered as a comprehensive and holistic program for production and protection of any crop including cotton. The respondents of different districts of Sahiwal and Faisalabad divisions were interviewed and they were asked if they would adopt demonstrated IPM model next year or not on the basis of their previous experience. The maximum percentage of respondents (78.26-100%) nodded in "Yes" when they were asked if they would adopt demonstrated IPM model next year. The percentage of respondents, who positively agreed on adopting IPM model next year, was found maximum (100.0%) in Faisalabad and Jhang followed by Toba Tek Singh (96.61% respondents), Sahiwal (92.75% respondents), Okara (88.46% respondents) and Pakpattan (78.26% respondents) districts. The percentage of respondents, who denied to adopt IPM model next year, ranged between 3.39-21.74%, being higher in Pakpattan (21.74% respondents) followed by Okara (11.54% respondents) Sahiwal (7.25% respondents) and Toba Tek Sigh (3.39% respondents) districts. None of the respondents in Faisalabad and Jhang districts denied adopting IPM model next year (Figure 17).

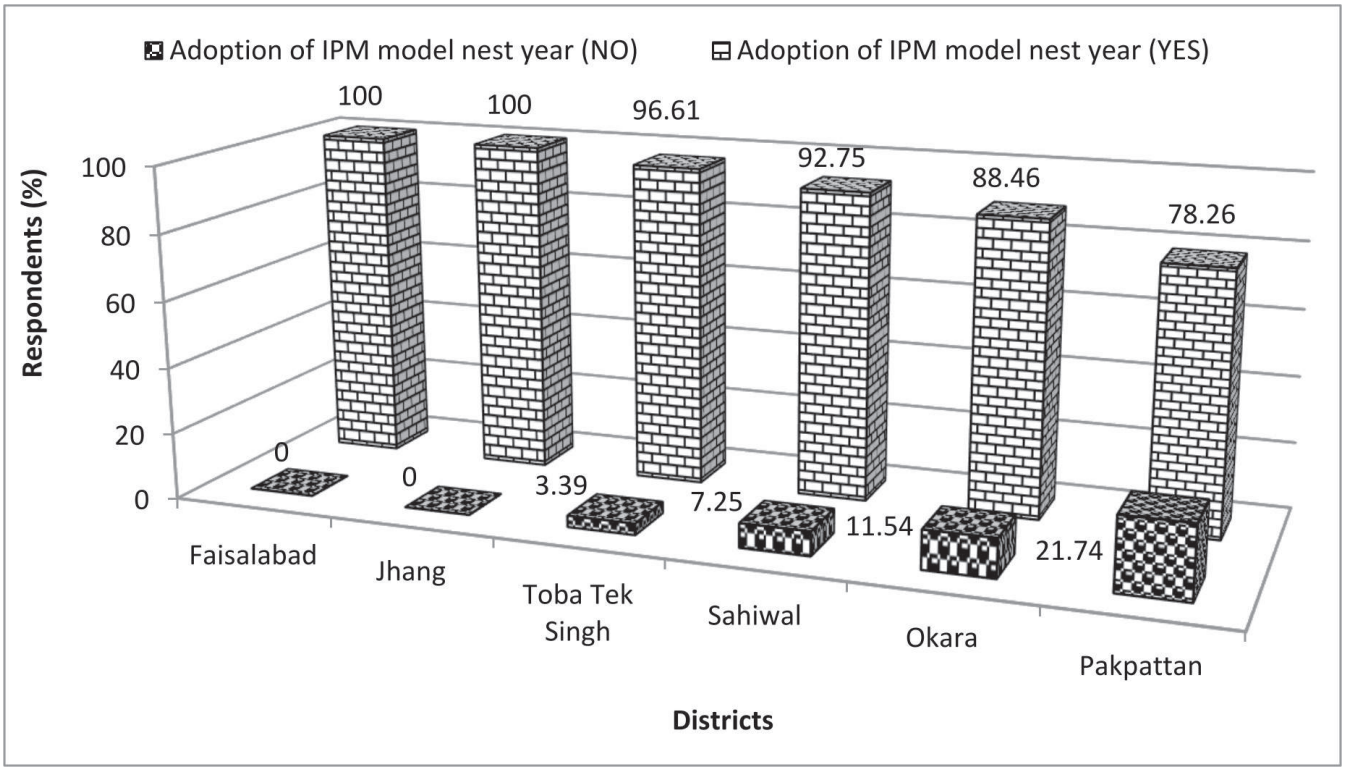


Figure 17: Responses of the respondents about adoption of IPM model next year

Knowledge of respondents about applications and cost of fertilizers

The farmers interviewed during survey about the types of fertilizers they used to apply in cotton crop for enhancing their cotton production. The responses of the respondents of selected districts of Faisalabad and Sahiwal divisions indicated that they used different types of fertilizers in cotton crops for improving its vigour, more increasing flower/fruit setting and ultimately enhancing its production. The overall responses of the respondents demonstrate that Urea (95-98.75% respondents) and DAP (88.55-91.56% respondents) were the major fertilizers applied to cotton followed by nitrophos (45.34-60.11% respondents), CAN gawara (21.56-33.12% respondents), ammonium sulphate (9.11-15.65% respondents) and Potassium (8.45-14.565 respondents). The percentage of respondents, who applies Sulphur, Zinc, Boron, SSP and other fertilizers in cotton for enhancing its productivity, were less (0.0-8.56% respondents) (Figure 18).

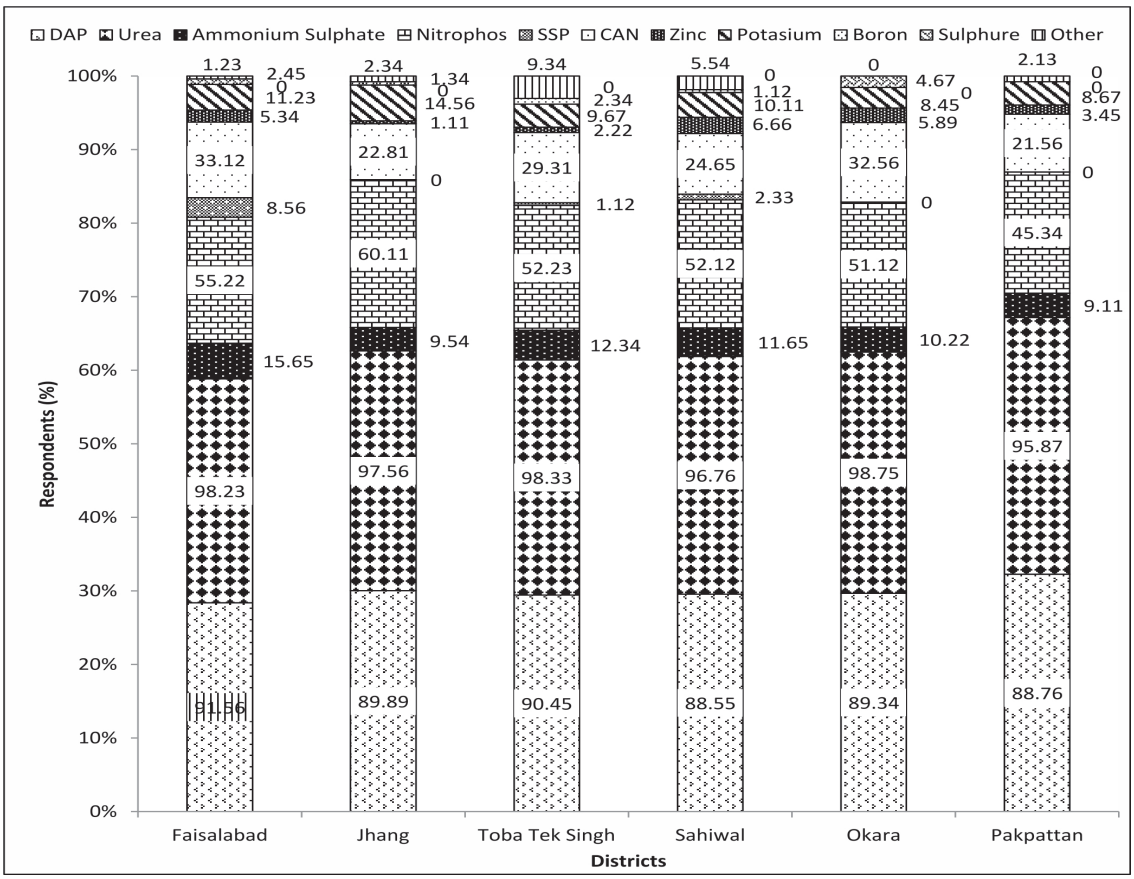


Figure 18: Responses of the respondents about the use of different types of fertilizers

A variable response of the respondents about the cost of fertilizers used on cotton was recorded during the survey. According to the responses, the respondents were categorized in four group on the basis of their responses about the costs of fertilizers i.e., 15000-20000, 20000-25000, 25000-30000, 30000-35000 and 35000-40000 Rs. (per acre). The maximum respondents (46.43-56.25%) replied that the per acre cost of fertilizers, they used on cotton, ranged between 20000-25000 Rs. About 16.67-21.43% respondents were those who mentioned the per acre cost of fertilizers in the range of 25000-30000 Rs. in their responses. About 11.11-14.29% respondents responded that their cost of fertilizers per acre on cotton was in the range of 20000-25000 Rs. The percentage respondents, who mentioned cost of fertilizers in the range of 30000-35000 Rs. (per acre), were about 6.25-10.71%. However, very low percentage of respondents (3.45-9.52%) replied that cost of fertilizers per acre on their cotton was 20000-25000 Rs. (Figure 19).

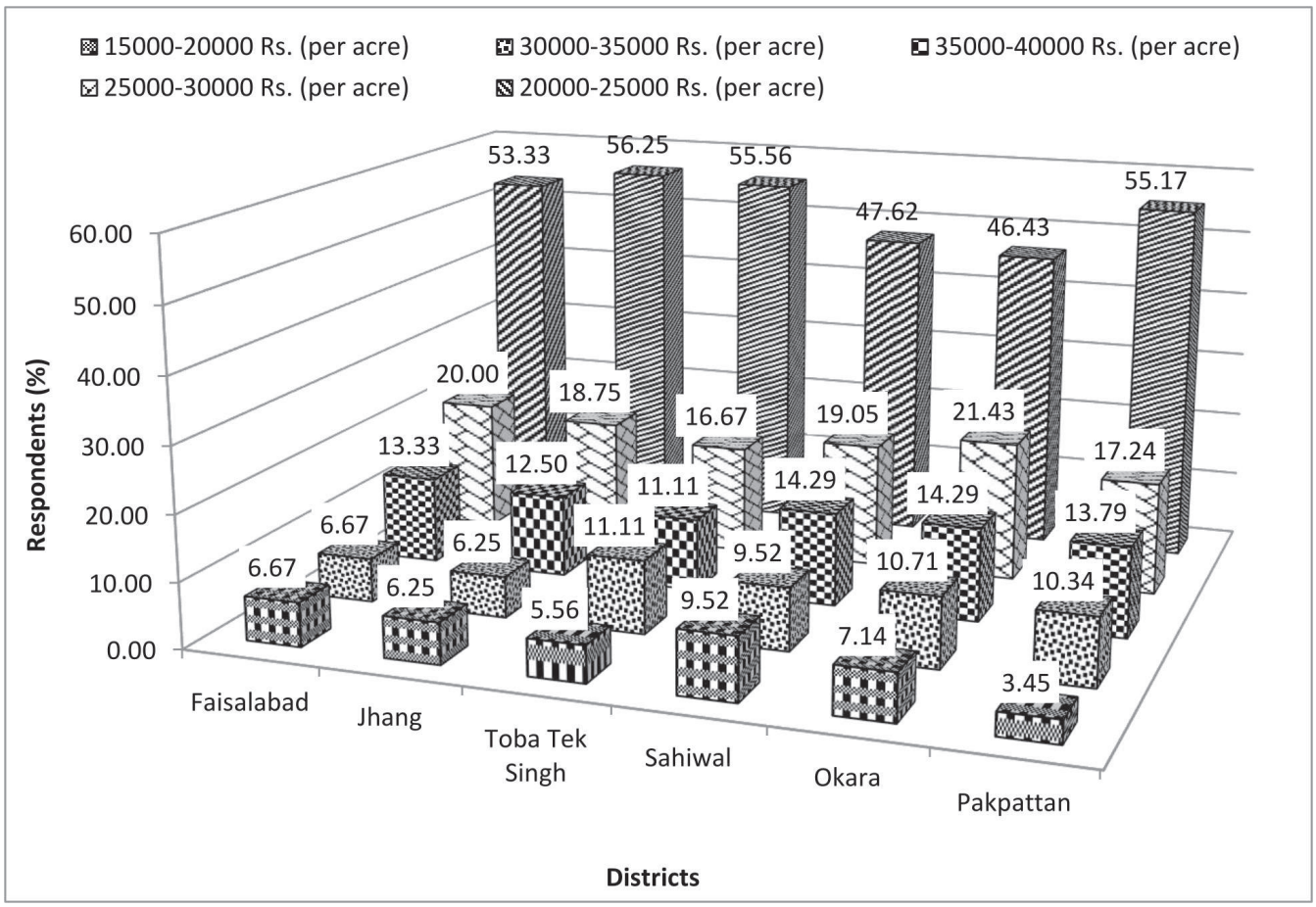


Figure 19: Responses of the respondents about the cost of fertilizers used on cotton

Recommendations

- No farmer is willing to have his or her son or daughter be farmer in next generation. So there is a need to advertise the agriculture and introduce it as major contents of our primary, middle and high school in addition to college level.
- IPM blocks monitoring staff is from all other majors or expertise except entomology so it shall be carefully to deploy the relevant personal for basic data collection.
- There is yet a strong need to interact with the progressive farmers who are basically the role model for local fellow or small farmers in adapting the biopesticides.
- There shall be a market for biopesticides available as well the manufacturer to implement the use of biopesticides.
- Research based advisory for the use of biopesticides is vital.
- Correct use of nozzle and spray machine is crucial for the use of biopesticides.
- Fellow farmer seed trade shall be banned to promote and bring the confidence of farming community in cotton growing areas.
- Authentic seed with any company be available timely and on time for farmers.

- The results of yield yet to be assessed for different introduced varieties during these visits.
- There is need to develop the new agronomic practices for the newly introduced varieties.
- There is strong need to public the use of biopesticides and then the significance of biocontrol agents that ultimately will lead to conserve and together with the biopesticides use is additional tool to keep the population at reduced levels.
- Fellow farmers will follow only if the proper dose rate is available through dealers.
- On Cotton might need a different chemical to control whitefly and other sucking pests to one need to control bollworms.
- The agrochemical industry should stop selling chemical pesticides that are formulated to mix in water as rain can wash the spray deposits off plants so the pesticide ultimately pollutes the local streams and rivers.
- The move should be to develop ULV sprays which require a formulation that is for example formulated in a botanical oil +? to stick on foliage and applied at <5litres per hectare.

Acknowledgement

We thank the Government of Punjab Agriculture Department for their assistance in IPM blocks location finding and to hold interviews and field visits in the respective regions. The survey reporting team is also highly thankful to Vice Chancellor of University of Agriculture Faisalabad for the provision of transport during the whole fields' survey.

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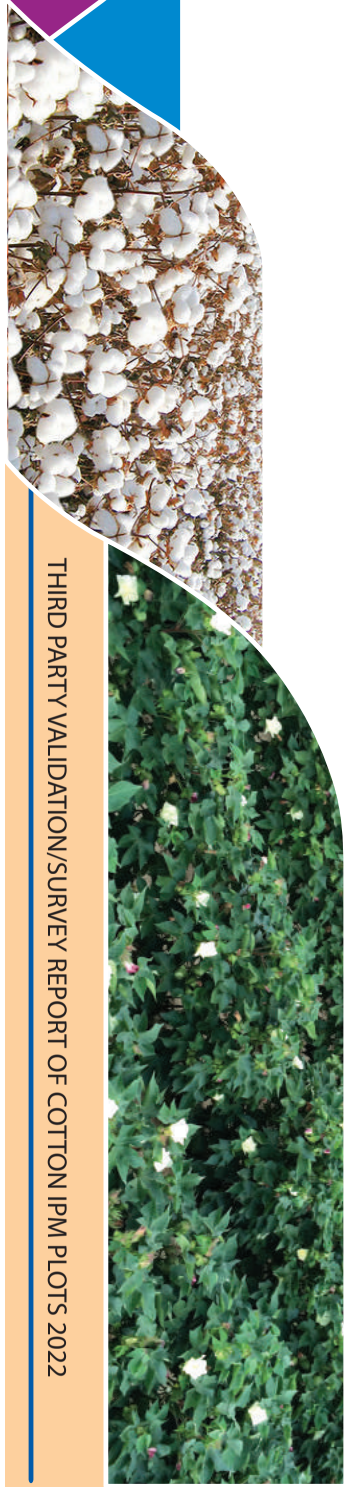
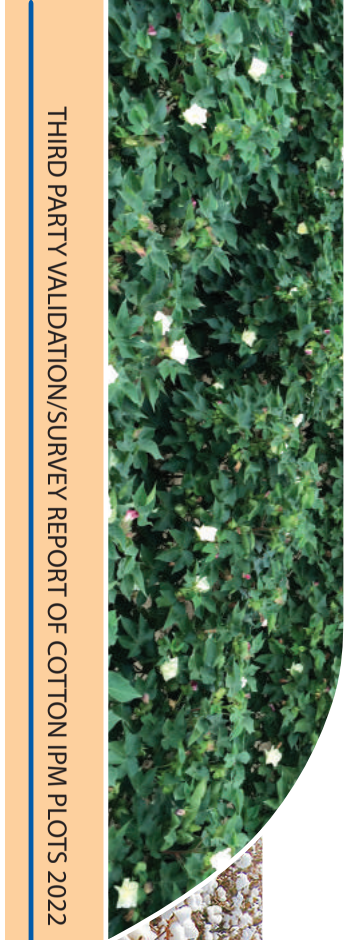
Appendix-1: details of ipm plots in faisalabad and sahiwal division

SN	DISTRICT	TEHSIL	MARKAZ	UC	NAME OF FARMER	FARMER AD-DRESS	CELL NO	CNIC NO	SUPER VISOR NAME	DESIGNATION	CELL NO	Size of D-Plots (Acres)	Coordinatesof D-plots	Name of Variety Sown	Directon of Sowing	Date of Sowing (DD-MM-YYYY)
1	Jhang	Jhang	Jhang Sadar	Pakay wala	Muhammad Aslam Parvez	Adda Pakky Wala to Link Chinot Road	0344-4754600	33202-4388475-1	Mrs. Rehana Rohi	AO. Ext. Jhang West	0340-1752366	5	72.33087 31.37078	CKC-3	East West	4/20/2022
2	Jhang	Jhang	Jhang Sadar	Ashaba	Taha Gilani	Kot Sai Singh	0333-6727970	33202-7239149-5	Mrs. Rehana Rohi	AO. Ext. Jhang West	0340-1752366	5	72.33479 31.25217	CKC-3	North South	4/15/2022
3	Jhang	Shor Kot	Shorkot	Bhango	Nawazish Ali Khan	Moza Bhngo Sharki	0333-6761097	33203-1349831-7	Muhammad Sar-war	AO.Ext. Shorkot	0301-7377752	5	304953.2 N 720658.3E	CKC-3	North South	4/2/2022
4	Jhang	Shor Kot	Waryam wala	Chian Wala	Ch.Tahir Naveed	Moza Chian Wala	0345-1308116	33203-4346650-9	Mrs.Sidra Hanif	AO.Ext Waryam wala	0332-6271046	5	30.993868 72.290134	CKC-3	North South	01/04/022

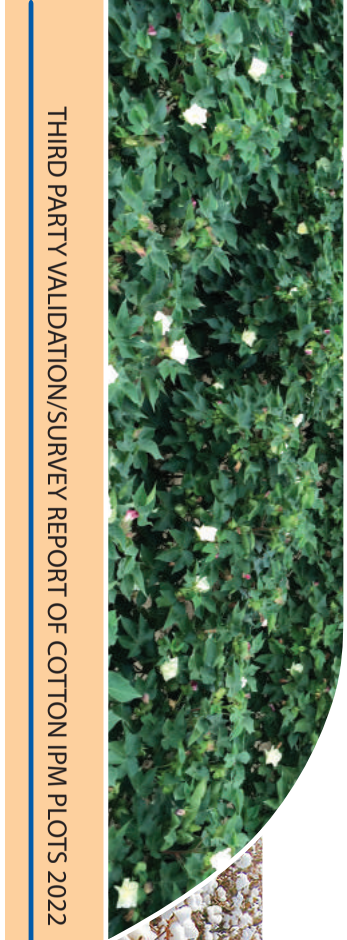
SN	DISTRICT	TEHSIL	MARKAZ	UC	NAME OF FARMER	FARMER ADDRESS	CELL NO	CNIC NO	SUPER VISOR NAME	DESIGNATION	CELL NO	Size of D-Plots (Acres)	Coordinatesof D-plots	Name of Variety Sown	Directon of Sowing	Date of Sowing (DD-MM-YYYY)
5	Jhang	A.P.Sial	A.P.Sial	Peer Abdul Rehman	Munawar Hussain	Peer Abdul Rehman	0305-7764408	33203-0374607-9	Mr.Muhammad Shahid	AO. Tech.A.P.Sial	0301-6558602	5	71.78133 30.74073	CKC-3	East West	4/5/2022
6	Jhang	A.P.Sial	A.P.Sial	2/2-L	Abdul Raoof	2/2L	0302-8661544	33203-2839335-7	Muhammad Noor Chan	AO. Ext. G.M.Raja	0300-5588374	5	71.90835 30.89574	CKC-3	North South	3/20/2022
7	T.T.Singh	TT Singh	Rajana	183/GB	M Abdullah S/O M Arif	182/GB	0346-4875082	33303-2204556-9	M. Shakeel Arshad	AO (Ext) Rajana	0307-4852068	4	30.95669 72.64708	CKC 3	East West	3/28/2022
8	T.T.Singh	TT Singh	Chutiana	344/GB	M. Iftekhar Hussain S/o M. Aslam	318/GB	0342-5977318	33303-3296592-7	Zeeshan Ubaid	AO (Ext) Chutiana	0300-8347347	3	30.84986 72.39015	CKC 3	North South	3/8/2022
9	T.T.Singh	Pir Mahal	Pir Mahal	330/GB	Sajjad Zafar S/O Zafar Iqbal	322/GB	0302-7253500	33303-2134461-1	M. Tariq	AO (Ext) Pirmahal	0302-5622861	1	30.76146 72.36357	CKC 3	North South	4/2/2022



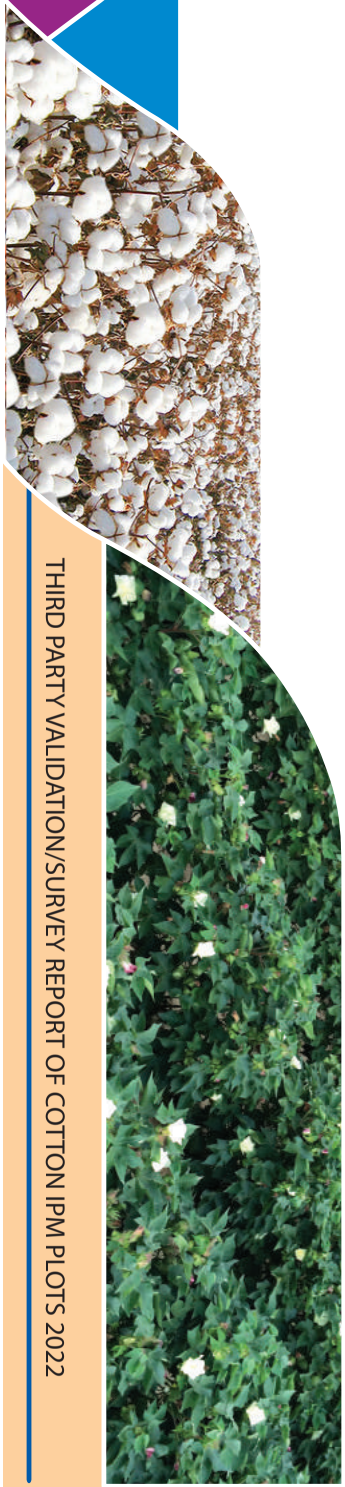


SN	DISTRICT	TEHSIL	MARKAZ	UC	NAME OF FARMER	FARMER ADDRESS	CELL NO	CNIC NO	SUPER VISOR NAME	DESIGNATION	CELL NO	Size of D-Plots (Acres)	Coordinatesof D-plots	Name of Variety Sown	Directon of Sowing	Date of Sowing (DD-MM-YYYY)
10	T.T.Singh	Pir Mahal	Pir Mahal	Plot C	Zaid Ashraf S/O M. Ashraf	Plot C	0341-7821589	33303-6572307-1	M. Tariq	AO (Ext) Pirmahal	0302-5622861	3	30.75573 72.36116	CKC 3	North South	4/9/2022
11	T.T.Singh	Gojra	Mongi Banglow	180/GB	M Rafique S/O Abdul Sattar	180/GB	0345-8283180	33301-2114580-7	Yassir Hussain	AO (Ext) Mongi Banglow	0347-8502716	3	30.99948 72.69253	CKC 3	North South	4/10/2022
12	T.T.Singh	Gojra	Gojra	423/JB	Javed Iqbal S/O M. Husain	358/JB	0341-7726402	33301-7783539-5	Zarqa Shakeel	AO (Ext) Gojra	0341-9815328	3	31.19661 72.57656	CKC 1	East West	4/15/2022
13	Faisalabad	Samundri	Samundri	175 GB	M. Shahid s/o Abdul Ghaffar	177 GB	0300-5628548	33105-7679294-3	Dr. Naeem	(AO) Samundri	0305-7435365	5	31.086 73.074	CKC-3	North South	02.04.2022
14	Faisalabad	Samundri	45 GB	225 GB	Khalid Mehmood s/o Mubarak Ali	49 GB	0346-5286128	33105-0343657-5	Dr. Amir	(AO) 45 GB	0300-7282286	5	31.079832 72.735036	CKC-3	North South	15.04.2022

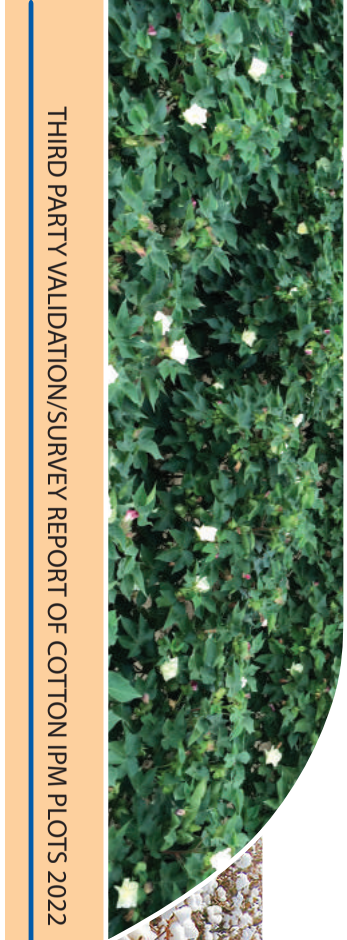
SN	DISTRICT	TEHSIL	MARKAZ	UC	NAME OF FARMER	FARMER ADDRESS	CELL NO	CNIC NO	SUPER VISOR NAME	DESIGNATION	CELL NO	Size of D-Plots (Acres)	Coordinatesof D-plots	Name of Variety Sown	Directon of Sowing	Date of Sowing (DD-MM-YYYY)
15	Faisalabad	Tandlianwala	Tandlianwala	411 GB	Ali Ahmad Shah s/o Ghulam Murtaza Shah	411 GB	0344-9175411	33106-5587135-3	Muhammad Shafiq	(AO) Tandlianwala	0333-8371462	5	30.989790 73.171448	CKC-3	North South	01.04.2022
16	Faisalabad	Tandlianwala	Garh	Kilianwala	Asghar Ali s/o Abdul Ghani	458 GB	0333-7329412	33106-7438906-5	Muhammad Awais	(AO) Garh	0343-0798397	5	30.85548 72.91105	CKC-3	North South	01.04.2022
17	Sahiwal	Sahiwal	Sahiwal Saddar	78/5L	Rao Mubashar s/o Mahboob Khan	81/5L	0344-4839206	36502-8804227-3	Pervaiz Akhtar	AO (Ext) Sahiwal	0302-9815216	6	30.61673N 73.18807E	CKC-1	North South	4/5/2022
18	Sahiwal	Sahiwal	Kamir	114/9L	Malik Ramzan s/o Shair Muhammad	107/9L	0300-9696524	36502-0731100-03	Tanvir Afzal	FA UC 114/9L	0345-9286314	6	30.58557N 73.09548E	CKC-3	North South	3/15/2022



SN	19	20	21	22
DISTRICT	Sahiwal	Sahiwal	Okara	Okara
TEHSIL	Chichawatni	Chichawatni	Okara	Okara
MARKAZ	Chichawatni	Ghaziabad	Shahbore	Shahbore
UC	36/12L	18/11L	52/2.L	32/2.L
NAME OF FARMER	M Ruman Aslam S/O M Aslam	Muhammad Anwar S/O Muhammad Hanif	Rana Naseer Ahmad	Rao Muhammad Akhtar
FARMER ADDRESS	36/12L	34/12L	52/2.L	31/2.L
CELL NO	0300-9406668	0341-7621505	0343-4687003	0315-2153131
CNIC NO	36501-1721182-7	36501-1819608-5	35302-6013393-1	35302-6125429-1
SUPER VISOR NAME	Ahmad Saad	M. Taimoor Manzoor	Farrukh Zahid	Farrukh Zahid
DESIGNATION	AO (Ext) Chichawatni	AO (Ext) Ghaziabad	AO (Ext.) Markaz Okara.	AO (Ext.) Markaz Okara.
CELL NO	0300-7608790	0317-6428470	0345-4519980	0345-4519980
Size of D-Plots (Acres)	5	5	4	3
Coordinatesof D-plots	30.53561N 72.74585E	30.500832N 72.722899E	30.77733 73.48285	30.74528 73.56220
Name of Variety Sown	CKC 3	BS-15	IUB-13	BS-15
Directon of Sowing	North South	North South	North South	North South
Date of Sowing (DD-MM-YYYY)	13/4/2022	12/4/2022	02.04.2022	08.04.2022



SN	23	24	25	26
DISTRICT	Okara	Okara	Okara	Okara
TEHSIL	Renala Khurd	Renala Khurd	Depalpur	Depalpur
MARKAZ	Akhtarabad	Akhtarabad	Depalpur	Depalpur
UC	33/1.AL	9/1.AL	Soba Ram	Soba Ram
NAME OF FARMER	Raja Asghar	Muhammad Aleem	Safdar Ali	Ch. Muhammad Farooq
FARMER ADDRESS	34/1.AL	7/1.AL	Chak 40/D	Chak 40/D
CELL NO	0300-6972327	0343-6706607	0301-7349918	0305-9592914
CNIC NO	35303-8047935-7	35303-2065342-7	35301-1881090-9	35303-2097172-5
SUPER VISOR NAME	Muhammad Ajmal,	Muhammad Ajmal	Muhammad Afzaal Ahmad	Muhammad Afzaal Ahmad
DESIGNATION	AO (Ext.) Markaz Akhtarabad	AO (Ext.) Markaz Akhtarabad	AO (Ext.) Markaz Depalpur.	AO (Ext.) Markaz Depalpur.
CELL NO	0306-5482791	0306-5482791	0300-4930335	0300-4930335
Size of D-Plots (Acres)	5	2.5	3	3
Coordinatesof D-plots	30.88218 73.69406	30.95269 73.68324	30.73711 73.57233	30.73609 73.57585
Name of Variety Sown	CKC 3	Niab	CKC 1	Silver Queen
Directon of Sowing	East West	East West	North South	North South
Date of Sowing (DD-MM-YYYY)	10.04.2022	25.04.2022	12.04.2022	04.03.2022



SN	DISTRICT	TEHSIL	MARKAZ	UC	NAME OF FARMER	FARMER ADDRESS	CELL NO	CNIC NO	SUPER VISOR NAME	DESIGNATION	CELL NO	Size of D-Plots (Acres)	Coordinatesof D-plots	Name of Variety Sown	Directon of Sowing	Date of Sowing (DD-MM-YYYY)
27	Pakpattan	Arifwala	Qabula	Machi Singh	Khursheed Ahmad S/O Saraj Deen	Chowk Chak Kalay pathan, Arifwala.	0313-6503015	36401-2272560-9	Hassan Mehmood	Field Assistant	0306-6373398	3	30.17277 73.12427	CKC-3	North South	13/03/2022
28	Pakpattan	Arifwala	34 EB	Muhammad Razzaq S/O Muhammad Fazal	Chak No. 38/EB, Arifwala.	0305-2856841	36401-4935582-7	Muhammad Akhtar	Field Assistant	0307-6918907	3	30.40180 73.03832	CKC-3	1-acre N-S 2-acres E-W	15/03/2020
29	Pakpattan	Pakpattan	Dhawna	Choudhary Babar Ali S/O Fazal Din	Chak Moza Mall, Pakpattan	0302-7254982	36401-5282812-5	Ghulam Fareed	Field Assistant	0304-7404077	4	30.6531 73.4869	CKC-5	East West	4/2/2022
30	Pakpattan	Pakpattan	Pakpattan	Jagga Baloach	Rana Munsoob Ali S/O Rana Ilyas	Kund Maleky	0300-6917623	36502-4251389-1	Dr. Azhar	AO (Ext) Pakpattan	0304-3033725	12	30.28978 73.47060	CKC-3	North South	4/1/2022