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STUDY OF THE FARMERS' AWARENESS AND ADOPTION OF INTEGRATED PEST MANAGEMENT FOR COTTON IN KHAIRPUR SINDH

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ABSTRACT

The indiscriminate use of pesticide, in addition to the health hazards, increased the cost of production. Considering the situation, various research organizations including Agricultural Research Institutes and Nuclear Institute of Agriculture recommended alternative techniques to control insect pests and diseases. Government and non-government institutes are involved in pursuing the farmers to reduce the use of pesticide and to adopt sustainable measures such as Integrated Pest Management (IPM) practices. However, very little efforts are made to understand the level of farmers' knowledge and adoption and barriers which impede the rate of adoption. Therefore, the present study sought to identify and describe farmers' knowledge, adoption, and barriers related to the adoption of IPM. The study employed a survey method selecting randomly 104 farmers who were enrolled and trained in an IPM series Farmers Field Schools (FFS) and 104 farmers who were not enrolled however exposed to IPM programs in Khairpur district of Sindh. The results show that trained farmers were following most of IPM practices as they have a good knowledge of these practices. Laborious work and unavailability of pure inputs were perceived as barriers in the adoption IPM.

Key words: Adoption of innovation, farmers field schools, IPM.

INTRODUCTION

The area, production, and yield per hectare of cotton of Sindh province are presented Table1 which shows the fluctuation during the last 10years. During the post February 1980 period, pesticide consumption increased from 906 metric tons in 1980 to 5519 metric tons in 1992. Tariq (2002) reported that during last two decades, there was substantial increase in the use of pesticides not only in volume, battalion value. Its

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use increased by about 70 times (of which about 80% was used on the cotton crop), while cotton yield increased only two-folds. The pesticide value exceeded Rs12-14 billions, which added to the cost of production.

Table 1. Area, production and yield of cotton in Sindh.

Year	Area in "000"	Production in "000"	Yield per hectare in kg
1998-99	630.2	2134.1	576
1999-2000	633.5	2377.4	638
2000-01	523.3	2141.1	696
2001-02	547.4	2443.2	759
2002-03	542.6	2411.8	756
2003-04	561.4	2242.8	680
2004-05	635.1	3016.7	808
2005-06	637.1	2648.0	707
2006-07	570.1	2398.2	716
2007-08	607.0	2536.0	711

Source: Government of Pakistan, 2009

There are number of reasons for fluctuation in cotton production and insect/pest damage is the major one. There are various kinds of insect pests which attack on cotton crop. In addition, with the increasing use of pesticides, the insect pest complex is considerably changed. Since 1980, many minor insect pests became major pests and new insect pests are appeared on cotton. The changes in insect pests are presented in Table 2. American Bollworm, Aphids and Tea mites were not original pests of cotton in Pakistan but became as a result of large-scale and indiscriminate use of pesticides. Due to indiscriminate use of pesticide, the pest of cotton flared up late in the season and did the considerable loss to cotton (Government of Sindh, 2003).

Table 2. Changes in insect pests of cotton since 1980 to 2002

Year 1980	Year 2002
Jassid	Jassid
White Fly	White Fly
Thrips	Thrips
Spotted Bollworm	Spotted Bollworm
Pink Bollworm	Pink Bollworm
Pink Bollworm	Pink Bollworm
	Aphids
	American Bollworm
	Tea Mites
	Beet Armyworm
	Mealy Bug

(Government of Sindh, 2003)

The details of the damages of production due to the insect pests' infestation during 1992-93 to 2004-05 are presented in Table 3 which indicates that the loss of production due to insect-pest infestation varies

and heavy loss was reported during the year 1998-99. Mealy bug causes severe damage to cotton production during the year 2004-05 (Ahmed, 2006).

Table 3. Production loss due to insect-pests during1992-93 to 2004-05

Year	Loss in Production "000" Bales
1992-93	250
1993-94	1650
1994-95	2500
1995-96	2000
1996-97	2700
1997-98	2800
1998-99	3050
1999-2000	500
2000-01	1000
2001-02	1250
2002-03	1300
2003-04	2400
2004-05	2525

Ahmed (2006)

Chemical control program in cotton crop has actually increased the pest related problems, disturbed the Agro-ecosystem and killed the non-targeted and environment friendly organisms such as parasites, predators and birds. Indiscriminate and misuse of pesticides has led to tremendous economic losses and hazard to human health. Consumption of pesticides in Pakistan has increased in many folds (*i.e.* from 501 tones in 1981 to 15322 tones in 2001), without significant gains in yield of cotton. From 1981 to 2005, the import of pesticides has increased upto 100 times. The detail of import of pesticides since 1981 to 2005 is given in Table 4.

Results of a study (Khan & Ahmed, 2003) indicated that almost every second household has reported pesticides related sickness. At least 2 persons per village or from 200 households hospitalized due to the nature of acute poisoning. Now pesticides are being used in suicidal deaths at an alarming rate (8 to 10 suicidal deaths within a radius of 20 villages). Most of the cotton pickers used no cautions such as gloves, shoes, and face cover during picking in Khairpur Mirs. Women pick cotton even when they become pregnant or are at the stage of breast-feeding. Health hazards to women cotton pickers show that 2.2 million women got sick from their exposure to pesticides use on cotton and colossal economic losses Rs. 105 million estimated for the treatment of human health (Khan & Ahmed, 2003).

During the last decade, it is observed that indiscriminate usage of pesticides has created many problems for farmers. High expenditure on

pesticides, health hazards, elimination of helpful insects and harmful insects were developed resultantly through improper pesticides usage. Viewing such a critical situation, the development of integrated pest management technologies are recommended by various agricultural research organizations in Pakistan.

Table 4. Import of pesticides in Pakistan since 1981 to 2005.

Year	a.i.m tones	Value (million Rs.)	Year	a.i.m tones	Value (million Rs.)
1981	501	125	1995	7645	9178
1985	2593	1780	1996	7325	8794
1986	3247	2359	1997	11209	9904
1987	3517	2774	1998	10394	9960
1988	3093	2301	1999	10107	9684
1989	3797	3208	2000	15322	4971
1990	4665	3990	2001	15548	5165
1991	4972	4804	2002	15433	5080
1992	5519	5991	2003	15345	5065
1993	4919	4804	2004	15142	5001
1994	6183	7423	2005	15567	5265

Ahmed (2006)

The national IPM program was one of major Government attempts to introduce Integrated Pest Management in the country during the years 2001-2004 and 2004-2009 in various crops and fruits including cotton crop. A unique model of extension “Farmer Field School” was introduced in the country. The program during the years 2001-2004 trained a total of 425 IPM facilitators (majority of them belonged to agricultural extension staff) researchers, and farmers. A total of 525 crop season long FFS were conducted in Punjab, Sindh, and Baluchistan. About 13000 farmers attended these schools. The national IPM program provided an opportunity to the farmers to be self-decision makers. The program used capacity development activities, enhancement workshops and farmers’ congress, workshop.

Various impact assessment studies (Khan, et. al., 2004: Khan, et. al. 2004: Ooi, et. al. 2005.) were carried out to show the program’s effectiveness on various aspects including pesticide consumption, cost of production, pesticide import and agro-ecological changes. However, it also had been hypothesized that the long-term impact of the national IPM would occur over a period of time based on the involvement in the agricultural and rural development activities. However, little has been done to describe and assess the long term impact of the program on participants knowledge about IPM, problem solving skills, and changes farmers, extension workers, and researchers have made in their attitude and behavior.

The use of pesticide is continued in Pakistan. Researchers suggest that extension workers must inform, motivate, and train the farmers about IPM technologies. IPM uses different methods to control pest including biological, cultural, mechanical, physical, and chemical methods and also promote the use of disease resistant varieties. Recognizing the need to save farmers from economic and health hazards, government of Pakistan has launched an IPM program with the help of various organizations including FAO. The program is being run in various districts of Sindh province. Efforts are being made to assess the effectiveness of these programs yet there is a need to know whether farmers are getting benefits from these IPM series programs and are willing to adopt the IPM as an alternative way to control insect pests and diseases. Therefore, this study was designed to know the level of awareness and adoption of IPM practices in cotton crop. The objectives were focus (a) to identify and compare farmers' perception regarding effectiveness of information sources involved in disseminating IPM practices, (b) determine and compare farmers' level of awareness and adoption of IPM technology on cotton and (c) identify the problems/constraints faced by farmers regarding IPM adoption.

METHODOLOGY

The research work was carried out by a structured survey method. The population of this study comprised of farmers who were enrolled and trained in a series of IPM programs at Khairpur District and farmers who were not enrolled but exposed to such programs. A sample of 104 farmers out of 150 from enrolled and trained group and 104 cotton growing farmers who were not enrolled however exposed to IPM training programs were taken on random basis by using McCall (1980) table of "determining sample size from a given population" (Degree of Accuracy = ± 0.05, Confidence Level = 95%). A self-report questionnaire was used. The questionnaire included quarries on the area under cotton crop, sources of information and their effectiveness in adoption of IPM technologies. In addition, various IPM practices for cotton were included after the consultation with the Directorate of IPM, Sindh. The questionnaire was sent to a panel of reviewers for suggestions and after the incorporation of suggestions, the questionnaire was administered. Personal interviews were conducted during the year 2007-2008. Farmers were asked to record their responses on Likert-type scales for sources of information, awareness and adoption of IPM practices and barriers they have faced during adoption of IPM at their fields. Data gathered were tabulated and analyzed using SPSS (PC) program.

RESULTS AND DISCUSSIONS

Demographic information

The demographic characteristics of the sampled farmers are presented in Tables 5 and 6. The maximum age of the sampled farmers was 66 years. On average, farmers had 19 years of farming experience. The maximum landholding was 65 acres and the maximum area under cotton cultivation was 63 acres (Table 5).

Table 5. Demographic characteristics (n = 208)

Characteristics	Minimum	Maximum	Mean
Age	18	66	41.05
Farming experience (in years)	5	45	18.90
Total land holding (in acres)	7	65	15.85
Area under cotton cultivation (in acres)	7	63	11.56

A largest number (48.08%) of the farmers are in the owner category. The educational level of farmers was good with 18.27% of the respondents had above intermediate level of education. A majority (51.92%) of the farmers were relying on both canal and tube well irrigation (Table 6).

Table 6. Tenancy status, educational level, and sources of irrigation

Characteristics	IPM Trained Farmers (n = 104)		Exposed Farmers (n = 104)		Total (a + b) (n = 208)	
	F	%	F	%	F	%
Tenancy status						
Owner	80	76.92	20	19.23	100	48.08
Owner cum cultivator	8	7.70	62	59.62	70	33.65
Tenant	16	15.38	22	21.15	38	18.27
Educational level						
Illiterate	24	23.08	16	15.38	40	19.23
Primary	14	13.46	18	17.31	32	15.38
Middle	16	15.38	10	9.62	26	12.50
Matric	10	9.62	24	23.08	17	16.35
Intermediate	20	19.23	18	17.31	38	18.27
Above	20	19.23	18	17.31	38	18.27
Sources of irrigation						
Canal only	40	38.46	50	48.07	90	43.27
Tube well only	8	7.69	10	9.62	18	8.65
Both	56	53.85	44	42.31	100	48.08

Farmers were asked to assess the effectiveness of sources of information involved in disseminating IPM practices. Responses were recorded on a five point Likert-type scale where 1 stands for “not sure”, 2 for “not at all”, 3 for “to some extent”, 4 for “to a larger extent” and 5 for “to a greater extent”. T-tests were applied (Table 7) which show that there was a significant difference at 0.05 probability level between

trained and exposed farmers regarding effectiveness of information sources on television, extension worker, research worker, subject matter specialist (SMS), neighboring farmers and NGO workers.

Table 7. T-Test for effectiveness of information sources.

Sources	Category of farmers	N	Mean	S.D.	Mean difference	T-value	Sig.
Radio	Trained	104	4.78	0.10	0.43	14.33	0.23
	Exposed	104	4.35	0.23			
TV	Trained	104	4.40	0.93	1.03	8.58	0.01*
	Exposed	104	3.37	1.45			
Extension worker	Trained	104	4.68	0.20	1.61	12.98	0.001**
	Exposed	104	3.07	1.11			
Research worker	Trained	104	4.75	0.15	1.28	17.77	0.001**
	Exposed	104	3.47	1.04			
SMS	Trained	104	4.60	0.00	2.07	9.65	0.001**
	Exposed	104	2.93	1.17			
FFS	Trained	104	4.95	0.12	0.10	4.76	0.078
	Exposed	104	4.85	0.31			
Neighboring farmers	Trained	104	4.90	0.31	0.70	19.44	0.001**
	Exposed	104	4.20	0.66			
Contact farmers	Trained	104	3.60	0.50	0.23	4.89	0.073
	Exposed	104	3.37	0.47			
NGO Worker	Trained	104	3.80	0.55	1.53	19.87	0.001**
	Exposed	104	2.27	0.98			

Scale: *1 = Not sure, 2 = Not at all, 3 = to some extent, 4 = to a larger extent, and 5 = to a greater extent

In order to determine and compare the level of awareness and adoption of IPM technology, various IPM practices were identified with the help of IPM cell, Agricultural Research Institute, at Tandojam and farmers were asked to identify their level of awareness and adoption of these identified IPM practices. Results are presented in Tables 8 and 9.Significant differences existed between trained and exposed farmers in the awareness of most of IPM practices, such as awareness of the ETL/EIL position, Trichograma card, Chrysopa card, pheromone strip, Oriours spp:, Dragon fly, Wasps, Ants, Amplioma, Mistery bug, and Assassin bug.

Table 9 indicates that there is a significant difference between trained and exposed farmers on the adoption of Trichograma cards, Chrysoperla cards, Sex Pheromone trap / card, Neem oil, Neem leaf, Pheromone strip, Oriours spp: Dragon fly, Wasps, Amplioma, Mystery bug, Assassin bug.

Farmers were asked to provide information regarding problems they have faced during the adoption of IPM practices. Results presented in Table 10 show that all trained farmers perceived that IPM is a laborious work.

Table: 8.T-Test for awareness of IPM practices for cotton

IPM practices	Category of farmers	N	Mean	S.D.	Mean differ-ence	T-value	Sig.
Pest scouting	Trained	104	4.67	0.15	0.91	75.83	0.40
	Exposed	104	3.76	0.10			
ETL/EIL position of insect pest	Trained	104	4.65	0.00	1.18	15.52	0.01*
	Exposed	104	3.47	1.11			
Trichograma card	Trained	104	4.90	0.31	3.70	105.71	0.001**
	Exposed	104	1.20	0.41			
Chrysopa card	Trained	104	4.90	0.31	3.70	105.71	0.001**
	Exposed	104	1.20	0.41			
Sex pheromone trap / card	Trained	104	4.65	0.00	3.58	143.20	0.001**
	Exposed	104	1.07	0.37			
Light trap method	Trained	104	1.57	.17	-057	- 7.03	0.10
	Exposed	104	1.00	0.00			
Neem oil	Trained	104	2.97	0.32	0.50	4.71	0.03*
	Exposed	104	2.47	1.20			
Neem leaf	Trained	104	3.00	0.26	0.07	0.86	0.75
	Exposed	104	2.93	1.14			
Neem seed (extraction)	Trained	104	1.13	0.51	-0.47	- 4.89	0.07
	Exposed	104	1.60	1.30			
Pheromone strip (BP Roap)	Trained	104	4.35	0.25	3.35	195.05	0.001**
	Exposed	104	1.00	0.00			
Oriours spp.	Trained	104	4.55	0.27	3.55	199.22	0.001**
	Exposed	104	1.00	0.00			
Dragonfly	Trained	104	4.58	0.28	3.58	188.42	0.001**
	Exposed	104	1.00	0.00			
Wasps	Trained	104	4.70	0.29	3.70	185.0	0.001**
	Exposed	104	1.00	0.00			
Ants	Trained	104	4.75	0.30	3.75	187.5	0.001**
	Exposed	104	1.00	0.00			
Amplioma	Trained	104	4.85	0.31	3.85	183.33	0.001**
	Exposed	104	1.00	0.00			
Mistery bug	Trained	104	4.78	0.30	3.78	189.0	0.001**
	Exposed	104	1.00	0.00			
Assesian bug	Trained	104	4.65	0.28	3.65	192.10	0.001**
	Exposed	104	1.00	0.00			

Means and SD are calculated using the scale: * 1 = Not at all, 2 = To some level, 3 = Moderate level, 4 = High Level, and 5 = Extremely High Level

Unavailability of inputs, inaccessibility from road, and fear of the adoption process as perceived by the trained farmers. Majority of exposed farmers

(67.30%) perceived that they are not familiar with the use of IPM practices that cause them to adopt IPM technologies.

Table 9. T-Test for adoption of IPM practices

IPM practices	Category of farmers	N	Mean	S.D.	Mean difference	T-value	Sig.
Pest scouting	Trained	104	4.79	0.00	0.27	5.19	0.22
	Exposed	104	4.52	0.75			
ETL/EIL position of insect pest	Trained	104	4.57	0.00	0.22	5.64	0.02*
	Exposed	104	4.35	0.57			
Trichograma card	Trained	104	4.51	0.00	3.18	61.15	0.001**
	Exposed	104	1.33	0.76			
Chrysopa card	Trained	104	4.53	0.00	3.20	61.53	0.001**
	Exposed	104	1.33	0.76			
Sex pheromone trap / card	Trained	104	1.00	0.22	3.55	236.53	0.001**
	Exposed	104	4.55	0.00			
Yellow cards	Trained	104	1.00	0.00	0.0	.50	0.55
	Exposed	104	1.00	0.00			
Light trap method	Trained	104	1.00	0.00	-0.13	-1.43	0.15
	Exposed	104	1.13	0.51			
Neem oil	Trained	104	2.93	0.37	-0.84	-16.80	0.001**
	Exposed	104	3.77	0.63			
Neem leaf	Trained	104	2.93	0.37	-0.84	-16.80	0.001**
	Exposed	104	3.77	0.63			
Neem seed (extraction)	Trained	104	1.60	0.93	-0.13	-1.20	0.064
	Exposed	104	1.73	1.26			
Pheromone strip (BP Roap)	Trained	104	1.00	0.00	-	-	0.001**
	Exposed	104	1.00	0.00			
Oriours spp	Trained	104	4.65	0.00	3.65	192.10	0.001**
	Exposed	104	1.00	0.00			
Dragonfly	Trained	104	4.63	0.00	3.63	201.66	0.001**
	Exposed	104	1.00	0.00			
Wasps	Trained	104	4.75	0.00	3.75	187.50	0.001**
	Exposed	104	1.00	0.00			
Ants	Trained	104	4.77	0.00	3.77	188.50	0.001**
	Exposed	104	1.00	0.00			
Amplioma	Trained	104	4.80	0.00	3.80	180.95	0.001**
	Exposed	104	1.00	0.00			
Mistery bug	Trained	104	4.70	0.00	3.70	185.0	0.001**
	Exposed	104	1.00	0.00			
Assassin bug	Trained	104	4.83	0.00	3.83	182.38	0.001**
	Un-trained	104	1.00	0.00			

Scale: * 1 = Not at all, 2 = Sometimes, 3 = Often, 4 = Almost Always, and 5 = Always

Table 10. Problems faced by farmers in adoption of IPM Technology

Problems	Trained farmers						Exposed farmers					
	Not at all		To some extent		To a great extent		Not at all		To some extent		To a great extent	
	F	%	F	%	F	%	F	%	F	%	F	%
Expensive	102	98.1	2	1.9	-	-	73	71.2	30	28.8	1	1.0
Financial constraints	100	96.2	4	3.8	-	-	78	75.0	25	24.0	1	1.0
Laborious	20	19.2	25	24.0	59	56.7	64	61.5	19	18.3	21	20.9
Not familiar with pesticides	71	68.3	15	14.4	18	17.3	77	74.0	17	16.3	10	9.6
Not familiar with the use of IPM practices	68	65.4	17	16.3	19	18.3	7	6.7	27	26.0	70	67.3
Lack of water sources & facilities	12	11.5	54	51.9	38	36.5	80	86.5	10	9.6	14	13.5
Small farm area	16	15.38	12	11.5	76	73.1	58	55.8	28	27.0	18	17.3
Inaccessibility from road	12	11.5	35	33.7	57	54.8	64	61.5	23	22.1	17	16.3
Un-availability of inputs	25	24.0	45	43.4	34	32.7	70	67.3	30	28.8	4	3.9
Others do not adopt	10	9.6	28	26.9	66	63.5	90	86.5	8	7.7	6	5.8
Ineffective inputs	94	90.4	4	3.9	6	5.8	46	44.2	27	26.0	31	29.8
Effect of IPM practices to human & crop health	95	91.3	9	8.7	-	-	69	66.3	22	21.3	13	12.5

CONCLUSION

Proper adoption of technology is one of the important aspects in increasing per acre yield. Adoption of IPM technology is very necessary in this contemporary age, where WTO imposing new regulations on agricultural commodities. Pakistan is a developing country, which has to compete in international markets for trade. However, this is not possible unless “rate of adoption” of sustainable agricultural practices is increased among farming communities. Previous efforts are lacking in understanding why farmers do not adopt sustainable practices.

Therefore, this study was conducted to know the level of awareness and adoption of IPM practices. The researchers randomly selected 104 enrolled and trained farmers and 104 not enrolled but exposed to IPM trained farmers. The epitomize of the study is that trained farmers (those who were enrolled in a series of farmer's field school for receiving IPM recommended practices) were more inclined to use IPM practices in their field than of exposed farmers. Respondents perceived that Radio, Extension Worker, Research Worker, SMS, and FFS were the most effective sources of information. Awareness and adoption level of trained farmers was more than the un-trained farmers. Therefore, the present study recommends that the Government of Pakistan should continue the FFS concept since it proves as an effective way of communicating IPM/sustainable agricultural practices among farming communities. The circle of IPM training must be expanded to those who have not received the benefits of IPM training and these farmers should be involved through "farmers' field school." Other studies must be conducted in other districts of Sindh province so as to validate and update the findings of present study.

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