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Study of diffusion and adoption of Male Annihilation Technique

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ABSTRACT

The Nuclear Institute of Agriculture (NIA) with the collaboration of the International Atomic Energy Agency (IAEA) has introduced "Male Annihilation Technique" (MAT) to control the fruit fly. MAT is economical, non-polluting, non-hazardous, environment friendly, less laborious technology that fulfills the demands of WTO for exporting agricultural commodities. Despite all these advantages offered by MAT, it has failed to reach at the maximum level of adoption among the growers of Pakistan particularly of Sindh province. Therefore, the researchers studied and identified barriers in the rate of adoption of MAT. The study also identified the information sources that have created trust among farmers resulting in the dissemination of MAT on a larger scale.

Key words: *Male Annihilation Technique; Agriculture Extension; Diffusion/Adoption*

INTRODUCTION

Pakistan possesses such a variety of soil and climate where all kinds of field and horticultural crops can be grown. Among horticultural crops, fruits are of immense importance because of its economic value and return. Fruits are also important due to their nutritional value. In Pakistan, the total area under fruit cultivation is 672.4 thousand hectares with the yield of approximately 5891.7 thousand tones out of which only 259.9 thousand tones of fruits was exported which is worth of 4575 million rupees (Anonymous, 2001). In Sindh and particularly in Hyderabad, fruits such as Mango, Banana, Guava, Sapota, papaya, Jujube and many other fleshy fruits are cultivated on larger scale. However due to insect pests and diseases, farmers sustain heavy economic losses. In Pakistan rather worldwide, the most destructive pest among other is fruit fly.

The major hosts of fruit flies are Guava, Mango, Jujube, Sapota, and vegetables. About 4500 species of fruit flies are distributed throughout the tropical, sub-tropical and temperate regions of the World (Hardy, 1988). Almost 800 species of fruit flies are reported from oriental regions, including 300 species from South and South East Asia. (Singh, 1988). The melon fruit fly (***Dacus cucurbitae***) normally causes 20 to 75% damage to melon production, where as about 80% of guava fruit in market is infested by oriental fruit fly (***Dacus dorsalis***). High infestation of guava has resulted in abandoning production of this popular fruit crop in southern Pakistan and export of this fruit has declined by about 50% (Kafi, 1986).

To forestall further infestation, the MAT was introduced in Sindh. The Male Annihilation Technique (MAT) is a fruit fly control method that removes male insects, thus reducing the male population, by distributing an appropriate amount of male attractant combined with poison in the entire target area continuously for a given length of time. This reduces the insect's chances of mating, and the females produce very few progeny. As a result, the wild population in the target area declines and the insects are eradicated in the end. The male attractant for the oriental fruit fly is methyl-eugenol. Fiberboard squares that have been soaked in lure-toxicant, a mixture of an attractant (methyl-eugenol) and an insecticide (BRP) are distributed manually in targeted areas.

The rate of adoption of MAT is slow as farmers are still relying on pesticide use. Rate of adoption is determined by many factors. According to Rogers (1995), perceived attributes of an innovation

are one of the most important explanations of the rate of adoption of an innovation. From 49-87% of the variance in the rate of adoption is explained by five attributes, which are as under:

1. Perceived Attributes of Innovations, i.e. Relative advantage, Compatibility, Complexity, Trailability, and Observability

In addition to these five perceived attributes of an innovation, other variables also affect the rate of adoption of an innovation (Rogers, 1995) which are as follows:

2. Types of innovation-decision
3. Communication channels
4. Nature of the social system
5. Extent of change agent's promotion efforts

Agricultural extension in Pakistan is involved in disseminating agricultural practices to farmers through various means including taluka extension agents. One of the strength in using taluka extension agents is that he/she personally contact with the farmers at their fields and help them to solve their farm problems. If the problem is sophisticated, taluka extension agents bring that problem back to research station for its solutions. Thus the role of taluka extension agents is like a bridge between research and farmers (Khan, 1997).

With the introduction of insecticides, entomologists were very optimistic and assertive in advocating that they found an everlasting solution against insect pests. But in recent past, the scientists have encountered a new growing concern related to the indiscriminate use of pesticides. The pesticide application is not only polluting the environment but also disturbing the natural eco-system of beneficial insects. The chemical control of fruit flies is not very effective because maggots (harmful stage of fruit fly i.e. larvae) live inside the fruit. Therefore, any insecticide that may be applied both in the forms of dust and spray destroys them at a very modicum rate because it has not the capacity to go inside the fruit and kill larvae (Qureshi, 1983).

Considering such constraints which are associated with the use of insecticides as far as the control of fruit fly is concerned, the entomologists of NIA (Nuclear Institute of Agriculture), Tando Jam have introduced a new technology with the collaboration of IAEA (International Atomic Energy Agency) to control fruit fly successfully, named as "Male Annihilation Technique" (MAT). MAT was introduced way back in mid 80^{s} and has a reputation that it is economically cheaper (74% less than insecticidal control).

Lack of knowledge is considered one of the most important attributes of learning of an innovation. Knowledge of an innovation and its use can help farmers to increase farm income. Knowledge can be transferred by various means. Agricultural extension uses three common approaches to technology transfer i.e., Individual method (face to face, telephonic call, farm visit etc), Group method (Demonstration plots, group meetings etc), and Mass method (Electronic and print media etc). Other factors which impede the rate of adoption according to Supe (1987) are characteristics of innovation (economic cost, consistency with values, complexity etc), characteristics of adopters (age, education, income, use of information sourcs etc), and constraints of a system (values and norms, authority system, feudalism etc).

Little efforts have been made to understand the causes of slow rate of adoption and very few studies focused on the barriers associated with the slow rate of adoption of modern agricultural practices in Pakistan (Saleem, 1990; Jalvi, 1996). The knowledge gap invoked researcher to undertake the study which determines the farmers' level of knowledge regarding the use of MAT and identify barriers affecting its rate of adoption in District Hyderabad, Sindh.

This research will help officials (policy makers), implementers (agriculture extension, NIA etc) and adopters (farmers) and will also be beneficial for organizations working in agricultural sector such as Non-Government Organizations (NGOs) and Farmers Organizations (FOs).

Objectives of the Study

Following objectives were set forth for the study:

1. To determine the perceptions of farmers and NIA's scientists regarding the attributes related to MAT,
2. To determine the level of knowledge of farmers regarding the use of MAT,
3. The determine the use of information sources and trust of farmers and NIA's scientists place on information sources involved in dissemination of MAT, and
4. To identify the barriers in the adoption of MAT as perceived by farmers.

Methodology

Hyderabad district is well known area in cultivating a variety of fruits and this study was limited to Guava, Mango and Jujube fruits. The population consisted of farmers who received technical assistance from NIA for the use of MAT and entomologists who were involved in diffusing MAT to the farmers. There were 416 farmers in the vicinity of Hyderabad district who used MAT on their holdings (NIA records). Among them, 60 farmers were taken as sample for research using McCall (1980) table with the 90% confidence level. All four (4) entomologists of NIA were also interviewed which makes the total sample of 64. Both the farmers and the entomologists of NIA were personally interviewed from July to September 2005 through a structured questionnaire. The response rate was 100% since the farmers who were randomly selected from the list provided by NIA were in touch with NIA for further assistance on various issues concerning agriculture productivity. The collected data were analyzed by using descriptive statistics.

RESULTS AND DISCUSSION

1. Demographic Information

The data in Table-1 show that majority of farmers (50%) and NIA scientists (75%) belonged to the age group of 41-60 years. About 22% of the farmers received graduate level of education whereas only 13.3% of farmers were illiterate. All NIA's scientists received post-graduate level of education. Majority of farmers (56.7%) had 16 and above years of farming experience and 28.3% of farmers had 11-15 years of farming experience. Seventy-five percent of NIA's scientists had more than16 years of professional experience.

Table 1: *Demographic Information of the Respondents*

Demographic Characteristics		**Farmers (n = 60)**		**NIA Scientists (n = 04)**	
		Frequency	**Percentage**	**Frequency**	**Percentage**
Age in Years	Up to 40	1	1.7	0	0.0
	41-60	30	50.0	3	75.0
	61 and above	02	3.3	1	25.0
Education	Illiterate	08	13.3	0	0.0
	Primary	11	18.3	0	0.0
	Secondary	09	15.0	0	0.0
	Higher	12	20.0	0	0.0
	Graduate	07	11.7	0	0.0
	Above	13	21.7	04	100.0
Experience in Years	1-5	06	10.0	0	0.0
	6-10	03	5.0	1	25.0
	11-15	17	28.3	0	0.0
	16 and above	34	56.7	3	75.0

2. Attributes related to the MAT

According to Rogers (1995), perceived attributes of an innovation are one of the most important explanations of the rate of adoption of an innovation. From 49-87% of the variance in the rate of adoption is explained by five attributes which were included in the study and results are presented in Tables 2 to 6 (Appendix). Both farmers and NIA scientists perceived that the MAT has relative advantages over other technologies because it is compatible, simple to use, can be used on trial basis, and the results are observable.

3. Farmers' Level of Knowledge

The knowledge level of farmers regarding the use of different techniques involved in MAT was inquired and the replies are presented in Table 7.

Table 7: *Perception of farmers regarding the use of recommended practices associated with the use of MAT (n = 60)*

Practices/Techniques	Recommended		Not-Recommended	
	f	%	f	%
No of Traps per acre	10	16.7	50	83.3
Height of Traps	18	30.0	42	70.0
Color of Traps	60	100.0	0	0.0
Preparation of Solution	59	98.3	01	1.7
Canopy of Plant	17	28.3	43	71.7
Cleaning of Traps	18	30.0	42	70.0
Dispose off Killed Flies	36	60.0	24	40.0

Results indicated that not all practices were followed as recommended by the NIA scientists for the use of MAT. Only color of traps practice was adopted completely by all farmers and 98.3% farmers prepared recommended solution. Number of traps were not followed according to the recommendation (83.3% did not use the recommended number of traps). Seventy percent did not follow the recommended height of the traps.

4. Sources of Information

Farmers were asked to rank the information sources they have used to adopt the MAT. According to the results presented in Table 8, farmers placed Entomologist of NIA at rank 1 (mean = 3.78), Neighbor or Friend at rank 2 (mean = 3.12), and Family members at rank 3 (mean = 2.78). Taluka Extension agents were ranked at 10 (mean = 1.08). The reason that farmers placed NIA at rank 1 was the fact that the MAT has been introduced and diffused by NIA scientists themselves as stated by NIA scientists. The role of taluka extension agents is limited here, however, may be the fact that the NIA scientists involved themselves to disseminate that technology to the farmers directly.

Table 8: *Farmer's ranking of the use of information sources in the diffusion of MAT (n=60)*

Sources		Mean*	SD	Rank
1.	Advertising Circular, Label etc	1.02	0.13	12
2.	Agriculture Supplier	1.07	0.41	11
3.	Banker or Lender	1.00	0.00	13
4.	Taluka Extension Agent	1.08	0.46	10
5.	Print Media	1.20	0.58	7
6.	Entomologists of NIA	3.78	1.24	1
7.	Family Members	2.78	1.32	3
8.	Farm Business Management Instructors	1.45	0.85	5
9.	Agriculture Teacher	1.10	0.30	9
10.	Electronic Media	1.17	0.46	8
11.	Paid Agriculture Consultant	1.10	0.35	10
12.	Professional Agriculture Literature	1.67	1.17	4
13.	Neighbor or Friend	3.12	1.14	2
14.	University Extension specialists	1.35	0.66	6

Note. * Mean based on scale of 1=never, 2=seldom, 3=often, 4=almost always, and 5=always

Another aspect of the study was to collect the information regarding the "Trust" farmers placed on the information sources involved in dissemination of MAT. In this regard, farmers trusted Entomologist of NIA as the most reliable source of information regarding MAT (mean = 4.65, rank = 1). Family members were placed on second with mean score of 4.07 followed by the Neighbor or Friend with mean score of 3.73 and was ranked third. Taluka Extension agents were again ranked ninth with the mean score of 2.22. Results are presented in Table-9.

Table 9: *Trust of Farmers on Information Sources used in the adoption of MAT (n=60)*

Possible Sources	Mean*	SD	Rank
Advertising Circular, Label etc	2.25	1.17	8
Agriculture Supplier	1.95	0.89	11
Banker or Lender	1.18	0.72	14
Taluka Extension Agent	2.22	1.11	9
Print Media	2.63	1.26	5
Entomologists of NIA	4.65	0.84	1
Family Members	4.07	0.90	2
Farm Business Management Instructors	1.78	1.03	12
Agriculture Teacher	2.05	0.95	10
Electronic Media	3.25	1.32	4
Paid Agriculture Consultant	1.25	0.81	13
Professional Agriculture Literature	2.30	1.59	7
Neighbor or Friend	3.73	1.01	3
University Extension specialists	2.53	1.20	6

Note. * Mean based on scale of 1=little, 2=some, 3=much, 4=very much, and 5=an exceptional amount

Table 10: *Perception of NIA scientists regarding the use of information sources in the diffusion of MAT*

Sources	Mean*	SD	Rank
Advertising Circular, Label etc	1.75	.50	08
Agriculture Supplier	1.00	.00	12
Banker or Lender	1.00	.00	12
Taluka Extension Agent	1.25	.50	11
Print Media	2.50	.58	4
Entomologists of NIA	4.75	.50	1
Family Members	2.75	.50	3
Farm Business Management Instructors	2.25	1.50	7
Agriculture Teacher	1.50	1.00	10
Electronic Media	2.50	.58	4
Paid Agriculture Consultant	1.75	.96	9
Professional Agriculture Literature	2.50	1.29	5
Neighbor or Friend	3.25	.96	2
University Extension specialists	2.05	1.26	6

Note. * Mean based on scale of 1=never, 2=seldom, 3=often, 4=almost always, and 5=always

The Entomologists of NIA were asked to rank the information sources used for diffusion of MAT. Results in Table-10 revealed that like farmers, Entomologists of NIA, Neighbor or Friend, and Family members were ranked first, second, and third with mean score of 4.75, 3.25, and 2.75 respectively. Taluka Extension agents were ranked 11 (mean = 1.25).

Entomologists of NIA were asked to place trust on the information sources used for diffusion of MAT. Results in Table-11 reflect that respondents trust Entomologist of NIA as the most reliable source of information regarding diffusion of MAT (mean = 4.75). Electronic media were ranked

second with mean score of 4.50 and Print media were ranked third as the most reliable source of information regarding diffusion of MAT (mean = 3.50). Taluka Extension agents again did not find a place and were ranked 12th (mean = 1.25).

Table 11: *Trust of NIA scientists' on Information Sources used in the diffusion of MAT*

Sources	**Mean***	**SD**	**Rank**
Advertising Circular, Label etc	3.25	.96	05
Agriculture Supplier	3.0	2.16	08
Banker or Lender	2.50	2.34	10
Taluka Extension Agent	1.25	.50	13
Print Media	3.50	.58	3
Entomologists of NIA	4.75	.50	1
Family Members	3.25	.96	4
Farm Business Management Instructors	2.00	.82	11
Agriculture Teacher	2.00	.82	11
Electronic Media	4.50	.58	2
Paid Agriculture Consultant	3.00	1.15	7
Professional Agriculture Literature	3.00	.82	6
Neighbor or Friend	2.50	.58	9
University Extension specialists	3.00	.82	6

Note. * Mean based on scale of 1=little, 2=some, 3=much, 4=very much, and 5=an exceptional amount

5. Barriers affiliated with the adoption of MAT

Table 12: *Barriers faced by Farmers in adoption of MAT*

Barriers	Not at all		To some extent		To a greater extent	
	f	%	f	%	f	%
Expensive	52	86.67	08	13.33	00	00.00
Financial constraints	54	90.00	06	10.00	00	00.00
Laborious	50	83.34	05	08.33	05	08.33
Large farm area	20	33.33	25	41.67	15	15.00
Inaccessibility from road	29	48.34	23	38.33	08	13.33
Un-availability of inputs	40	66.67	12	20.00	08	13.33
Ineffective inputs	47	78.33	08	13.33	05	08.33
Effect of chemicals to human & crop	59	98.33	01	01.67	00	00.00
Afraid of loss	44	73.34	14	23.33	02	03.33

Farmers were asked to identify the barriers they have faced in the adoption of MAT. The responses were recorded on a Likert-type scale (1 = Not at all, 2 = To some extent, and 3 = To a greater extent). Reponses are presented in Table-12 which show that large farm area, inaccessibility from roads, and afraid of loss were perceived as barriers of adoption by a number of farmers.

CONCLUSIONS

MAT is a sustainable agricultural practice which can reduce the cost of production without damaging and disturbing the flora and fauna. The adoption of sustainable practice can help prevent health and economic damages to the farmers as well as preserving our natural balance and resulting in poverty alleviation from rural masses.

The results are promising and MAT has relative advantages over other technologies because it is compatible, simple to use, can be used on trial basis, and the results are observable (see Tables 2-6 in the Appendix). Farmers' level of knowledge regarding the use of different practices related to the MAT was however not satisfactory. The researchers found that the farmers used their own intuition in using MAT ignoring the recommendations of the NIA scientists (Table 7).

Lack of proper use of MAT can be viewed as the barrier of adoption of MAT by other fruit growers. Such practices should be avoided and the use of information sources must be made effective. Farmers and NIA scientists perceived that Entomologists of NIA were the better sources of information over others.

The use of information sources should be maximized by involving Taluka Extension Agents since they are in close contact with the farmers of their area. Mass media can also be utilized for the cost effectiveness. Large farm area, inaccessibility from roads, and afraid of loss were perceived as barriers of adoption for a number of farmers in the studied area.

RECOMMENDATIONS

Based on the findings of the study, following recommendations were made;

- NIA should involve Agriculture Extension for diffusion of MAT.
- Follow-up should be made to farmers' field for further assistance and clarification about the use of MAT.
- Seminars on a wider scale should be organized and the use of Mass media must be encouraged for mass adoption of MAT.
- Further studies may be carried out in other districts of Sindh Province of Pakistan as to validate and update the findings of the present study.

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Appendix

Table 2: *Relative Advantage*

Relative Advantage	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Worse	0	0.0	0	0.0
Somewhat Worse	0	0.0	0	0.0
Somewhat Better	9	15.0	1	25.0
Better	51	85.0	3	75.0
Do not Know	0	0.0	0	0.0

Table 3: *Compatibility*

Compatibilty	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Incompatible	0	0.0	0	0.0
Somewhat Incompatible	0	0.0	0	0.0
Somewhat Compatible	5	8.3	0	0.0
Compatible	54	90.0	4	100.0
Do not Know	1	1.7	0	0.0

Table 4: *Complexity*

Complexity	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Simple	56	93.3	4	100.0
Somewhat Simple	1	1.7	0	0.0
Somewhat Complex	1	1.7	0	0.0
Complex	02	3.3	0	0.0
Do not Know	0	0.0	0	0.0

Table 5: *Trialability*

Trialability	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Easy	53	88.3	3	75.0
Somewhat Easy	6	10.0	1	25.0
Somewhat Difficult	1	1.7	0	0.0
Difficult	0	0.0	0	0.0
Do not Know	0	0.0	0	0.0

Table 6: *Observability*

Observability	Farmers (n = 60)		NIA Scientists (n = 04)	
	f	%	f	%
Unobservable	0	0.0	0	0.0
Somewhat Unobservable	0	0.0	0	0.0
Somewhat Observable	10	16.7	0	0.0
Observable	50	83.3	4	100.0
Do not Know	0	0.0	0	0.0