Factors Influencing the Adoption of Biological Control of Rice stem borer (*Chilo Suppressalis*) in Talesh Region, Iran

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ABSTRACT

Among the agricultural crops, rice has had the largest share in pesticide use. Most of the crop losses are caused by the attack of *Chilo suppressalis*. The purpose of this study was to examine effective factors on adoption of biological control by farmers in Talesh region of Iran. A survey study was conducted using a stratified random sampling to collect data from farmers in the selected rural areas of Talesh. The sample population was 184 farmers. In this study, results showed that there was a significant difference between the two groups of adopters and non-adopters of biological control regarding variables of number of domestic animals, number of plows, farm workers and kinds of fertilizers in rice field. But, there were no significant relationship between other variables and adoption of biological control of rice stem borer *Chilo suppressalis*.

Keyword: Adoption; *Chilo suppressalis*; Farmers; Talesh Region; *Trichogramma spp*.

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INTRODUCTION

Pests and diseases destroy considerable proportion of rice crop every year. Among the agricultural crops, rice has had the largest share in pesticide use. Most of the losses are caused by the attack of *Chilo suppressalis* (Salami & Khaledi, 2001). Nowadays, pest management programs usually include a sort of biological control along with chemical control methods (Mahdavi & Fahimi, 2001). Integrated pest management should be implemented with modern farming technologies. It was also noted that environmental factors related to the maintenance of low density of *Chilo suppressalis* and possibly its total extinction in the future, must be considered in developing rice management strategy. This includes maintaining a balance between integrated pest management and conservation of the paddy ecosystem, also known as integrated biodiversity management (Kiritani, 1990; Kiritani, 2000). Trichogramma are natural enemies of the *Chilo suppressalis* that parasite the eggs of this moth (Pezeshki-Raad & Masaeli, 2003). During Recent years, there have been much efforts for biological control (use of Trichogramma) against *Chilo suppressalis*. But, local farmers were not interested in adopting integrated pest management. Therefore, the study of various key factors on adoption of this technology will help extension services and will significantly enhance the development of bio control. Karamidehkordi and Hashemi (2010) in a study in Zanjan province of Iran reported that the farmers hardly used non-chemical pest control methods (e.g. mechanical and biological techniques and natural enemies) and their awareness of using these methods was low. Although the farmers were to some extent aware of the side-effects of the excessive use of chemical fertilizers and pesticides, but they continued utilizing chemical inputs due to the lack of knowledge and little access to the alternative or sustainable techniques and facilities. The farmers had little access to private or public extension or research institutions to get information about biological control. It is suggested that the extension services facilitate the process of participatory research, especially using the farmer field school approach and provide the required chemical and non-chemical inputs in order to make information and inputs more available and accessible. This may improve the implementation of IPM projects effectively. The results of study by Salami and Khaledi (2001) showed that 81 percent of the rice farmers, who did not adopt biological technology for the pest control, used pesticide against the *Chilo suppressalis*, whereas this percentage for the adopter of the new technology was 53 percent. Furthermore comparing the consumption of pesticides in the two groups of farmers indicated that average consumption of pesticides for the adopter of new technology is 17.14 kilogram per hectare and 31.14 kilogram for the non-adopter.

The results of a research by Hosseini and Niknami (2001) showed that there was a significant statistical relationship between educational level, type of land ownership, easy access to Trichogramma, low cost of biological control, complexity of spraying, contact with extension agent and adopting Trichogramma. Pezeshki-Raad and Masaeli (2003) in a study found out that rate of adoption of integrated campaign to control rice stem borer among the farmers was moderate. Among the economic characteristics, there was a significant relationship between adoption of integrated campaign and area of land, amount of area under cultivation, degree of family cooperation in the agricultural activities, access to agricultural inputs, access to financial resources and yield of rice per hectare. The purpose of this was to examine effective factors on adoption of biological control by farmers in Talesh region of Iran.

MATHERIALS AND METHODS

This study was carried out by survey during July and August 2009 in Talesh, Rezvanshahr and Masal in Talesh region of Guilan province, near Caspian Sea in North of Iran (Figure 1).

The main instrument for collecting data was questionnaire. Target populations were farmers of Tavalesh region in North of Iran. Respondents who selected from rural area were categorized into adopters and non adopters of Biological Control agent for control *Chilo suppressalis*. The sample population was 184 farmers who were selected by random sample. It includes 33 adopters and 151 non adopters (Table 1).

In this study, dependent variable was adoption of Biological Control agent for control *Chilo suppressalis* among farmers of Talesh region. The dependent variable was dichotomized with a value 1 if a farmer was an adopter of biological control and 0 if non-adopter. Frequency, percent, mean and standard deviation were used for the descriptive analysis of data. Chi square, Mann-Whitney and t-test were used for inferential analysis of data by SPSS (16) software.

Table 1: Total sample size used in the study area

	Talesh	Masal	Rezvanshahr	Total
Adopters Sample Size	14	6	13	33
Non-adopters Sample Size	43	78	30	151
Total	57	84	43	184

Source: Survey Results, 2009

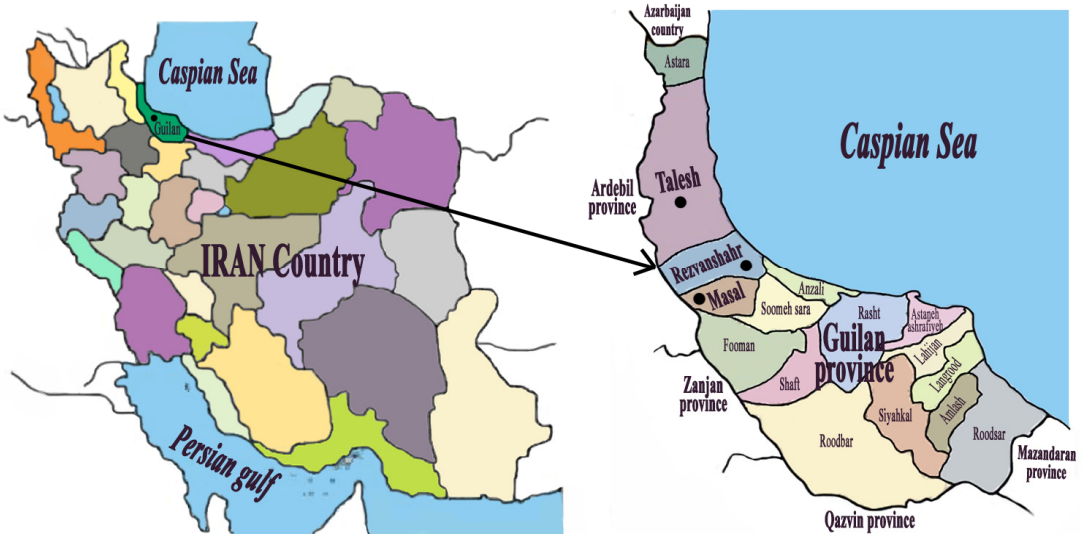

Fig. 1: Site of study

RESULTS AND DISCUSSION

The results of descriptive study indicated that average of farmland owned by adopter was 1.76 ha for adopters and 1.52 for non adopters (Table 2). The average yield of rice per year for adopters was 2.04 ton per hectare and 2.09 ton per hectare for non adopters.

Table 3 displays the results of farming characteristics of farmers. The average number of plows for adopters and non adopters was 2.63 and 2.84 respectively. Majority of non adopters (77.17percent) used chemical fertilizers while, 22 adopters used this type of chemical inputs.

In this study, the results showed that there was no significant relation between adoption of biocontrol and amount of farm ownership variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the amount of farm ownership variables (Table 6). These results are in agreement with those obtained by Adeogun (2008) and Joshi and Pandy (2005).

In this study, the results showed that there was no significant relation between adoption of biocontrol and farming system variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the farming system variables (Table 6). These results were not similar to Tabrayi and Hasan nejad (2009) and Rostami *et al*., (2008).

In this study, the results showed that there was a significant relation between adoption of biocontrol and farm labors variable (Table 4), and a significant difference between the two groups of adopters and non-adopters of biocontrol regarding the farm labors variables (Table 6). These results are in agreement with those obtained by Kohansal and others (2009).

In this study, the results indicated that there was no significant relation between adoption of biocontrol and accessibility to agriculture input variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the accessibility to agriculture input (Table 6). These results are not consistent with Rezvanfar and others (2000) and Darvish and others (2009).

In this study, the results revealed that there was no significant relation between adoption of biocontrol and accessibility to financial resources (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the accessibility to financial resources (Table 6). These results are not consistent with Darvish and others (2009) and Iravani and others (2006).

In this study, the results showed that there was no significant relation between adoption of biocontrol and yearly income from agricultural activities variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the yearly income from agricultural activities variables (Table 5). These results did not correspond to Darvish and others (2009).

In this study, the results showed that there was no significant relation between adoption of biocontrol and average yield of rice (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the average yield of rice variables (Table 5). These results did not correspond with Darban Astaneh and Irvani (2007).

In this study, the results showed that there was no significant relation between adoption of biocontrol and yearly expenditure in rice culture variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the yearly expenditure in rice culture variables (Table 5). In this study, the results showed that there was no significant relation between adoption of biocontrol and number of owned farm patches variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the number of owned farm patches variables (Table 5). These results were not similar to Kohansal and others (2009).

In this study, the results showed that there was a significant relation between adoption of biocontrol and number of domestic animals variable (Table 4), and a significant difference between the two groups of adopters and non-adopters of biocontrol regarding the number of domestic animals variables (Table 5). These results were similar to Darban Astaneh and Irvani (2007).

In this study, the results showed that there was a significant relation between adoption of biocontrol and number of plows variable (Table 4), and a significant difference between the two groups of adopters and non-adopters of biocontrol regarding the number of plows

variables (Table 5). These results are consistent with Noorhosseini Niyaki and Allahyari (2010).

In this study, the results showed that there was a significant relation between adoption of biocontrol and kinds of fertilizers in rice field variable (Table 4), and a significant difference between the two groups of adopters and non-adopters of biocontrol regarding the kinds of fertilizers in rice field variables (Table 6). These results were similar to Noorhosseini Niyaki and Allahyari (2010).

In this study, the results indicated that there was no significant relation between adoption of biocontrol and accessibility to water supply for irrigation variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the accessibility to water supply for irrigation variables (Table 6).

In this study, the results revealed that there was no significant relation between adoption of biocontrol and method of control weeds variable (Table 4), and no significant difference between the two groups of adopters and non-adopters of biocontrol regarding the method of control weeds variables (Table 6). These results are not consistent with Noorhosseini Niyaki and Radjabi (2010) and Noorhosseini Niyaki and Allahyari (2010).

Table 2: Economic characteristics of Farmers

Factors	Groups	Adopters		Non Adopters		Total	
		f	percent	f	percent	f	percent
Amount of farm ownership (per hectare)	<1	18	9.78	73	39.67	91	49.5
	1-3	12	6.52	69	37.5	81	44
	3-5	2	1.09	7	3.80	9	4.9
	5<	1	0.54	2	1.09	3	1.6
	Total	33	17.93	151	82.07	184	100
	Mean (Std. Deviation)	1.76 (1.45)		1.52 (1.18)		1.56 (1.23)	
Farming System	Ownership	30	16.30	144	78.26	174	94.6
	Sharing	3	1.63	6	3.26	9	4.9
	1 and 2	0	0	1	0.54	1	0.5
	Total	33	17.93	151	82.07	184	100
Farm labors	Family members	13	7.07	36	19.57	49	26.6
	Hired workers	10	5.43	33	17.93	43	23.4
	1 and 2	10	5.43	82	44.57	92	50
	Total	33	17.93	151	82.07	184	100
Accessibility to agriculture input (fertilizers, pesticides, machinery equipments, …)	Very little	1	0.54	6	3.26	7	3.8
	Little	10	5.43	25	13.59	35	19
	Intermediate	10	5.43	66	35.87	76	41.3
	Much	8	4.35	48	26.09	56	30.4
	Very much	4	2.17	6	3.26	10	5.4
	Total	33	17.93	151	82.07	184	100
Accessibility to financial resources/credits /investment	Very little	15	8.15	50	27.17	65	35.3
	Little	9	4.89	45	24.46	54	29.3
	Intermediate	6	3.26	42	22.83	48	26.1
	Much	1	0.54	12	6.52	13	7.1
	Very much	2	1.09	2	1.09	4	2.2
	Total	33	17.93	151	82.07	184	100
Yearly income from agricultural activities (Rls)	5000000>	1	0.54	14	7.61	15	8.2
	5000001-20000000	13	7.07	74	40.22	87	47.3
	20000001-35000000	6	3.26	21	11.41	27	14.7
	35000001-50000000	3	1.63	23	12.5	26	14.1
	50000001<	10	5.43	19	10.33	29	15.8
	Total	33	17.93	151	82.07	184	100
	Mean (Std. Deviation)	44636000 (50074200)		31705000 (37365100)		34024000 (40094700)	

Table 2: Economic characteristics of Farmers

Factors	Groups	Adopters		Non Adopters		Total	
		f	percent	f	percent	f	percent
Average yield of rice per year (ton per hectare)	1.5>	13	10.16	32	25	45	35.2
	1.5-2.5	12	9.38	43	33.59	55	43.0
	2.5-3.5	3	2.34	18	14.06	21	16.4
	3.5<	3	2.34	4	3.13	7	5.5
	Total	31	24.22	97	75.78	128	100
	Mean (Std. Deviation)	2.04 (1.008)		2.09 (0.82)		2.08 (0.86)	
Yearly expenditure in rice culture (Rls)	5000000>	11	5.98	42	22.83	53	28.8
	5000001-15000000	14	7.61	72	39.13	86	46.7
	15000001-25000000	3	1.63	23	12.5	26	14.1
	25000001<	5	2.71	14	7.61	19	10.3
	Total	33	17.93	151	82.07	184	100
	Mean (Std. Deviation)	12955000 (10851500)		12028000 (9371350)		12194000 (9628280)	
Number of owned farm patches	1	17	9.24	94	51.09	111	60.3
	2	9	4.89	38	20.65	47	25.5
	3	5	2.71	13	7.07	18	9.8
	4<	2	1.09	6	3.26	8	4.3
	Total	33	17.93	151	82.07	184	100
	Mean (Std. Deviation)	1.81 (1.13)		1.58 (1.02)		1.63 (1.4)	
Number of domestic animals	5>	23	12.5	129	70.11	152	82.6
	6-15	8	4.35	18	9.78	26	14.1
	16-25	0	0	3	1.63	3	1.6
	26-35	0	0	1	0.54	1	0.5
	36<	2	1.09	0	0	2	1.1
	Total	33	17.93	151	82.07	184	100
	Mean (Std. Deviation)	5.90 (10.59)		3.15 (4.41)		3.64 (6.06)	

Source: Survey Results , 2009

Table 3: Farming characteristics of farmers

Factors	Groups	Adopters		Non Adopters		Total	
		f	percent	f	percent	f	percent
Number of plows	2	13	7.07	26	14.13	39	21.2
	3	19	10.32	123	66.85	142	77.2
	4	1	0.54	2	1.09	3	1.6
	Total	33	17.93	151	82.07	184	100
	Mean (Std. Deviation)	2.63 (0.54)		2.84 (0.40)		2.80 (0.43)	
Kinds of fertilizers in rice field	Chemical Fertilizers	22	11.96	142	77.17	164	89.1
	Organic Fertilizers	1	0.54	1	0.54	2	1.1
	Chemical & Organic	10	5.43	8	4.35	18	9.8
	Total	33	17.93	151	82.07	184	100
Method of control weeds	Chemical control	0	0	1	0.54	1	0.5
	Mechanical & Cultural	1	0.54	3	1.63	4	2.2
	1 and 2	32	17.39	147	79.89	179	97.3
	Total	33	17.93	151	82.07	184	100
Accessibility to water supply for irrigation	Very Little	4	2.17	12	6.52	16	8.7
	Little	7	3.80	33	17.93	40	21.7
	Intermediate	7	3.80	38	20.65	45	24.5
	Much	13	7.07	64	34.78	77	41.8
	Very Much	2	1.09	4	2.17	6	3.3
	Total	33	17.93	151	82.07	184	100

Source: Survey Results , 2009

Table 4: Factors influencing the adoption of biological control using Chi-square test

Factors	Chi Square	Sig.
Amount of farm ownership	1.342^{ns}	0.719
Utilization System	1.725^{ns}	0.422
Farm workers	6.407*	0.041
Accessibility to agriculture input	7.747^{ns}	0.101
Accessibility to financial resources	5.911^{ns}	0.206
Yearly income from agricultural activities	8.279^{ns}	0.082
Average yield of rice per year	3.161^{ns}	0.367
Yearly expenditure in rice culture	2.076^{ns}	0.557
Number of owned farm patches	2.021^{ns}	0.568
Number of domestic animals	13.747**	0.008
Number of Plows	8.768*	0.012
Kinds of fertilizers in rice field	20.983**	0.000
Method of control weeds	0.355^{ns}	0.838
Accessibility to water supply for irrigation	1.745^{ns}	0.782

^{ns} Non significant, *significant at P<0.05, **significant at P<0.01
Source: Survey Results , 2009

Table 5: Comparison of adopters and non-adopters perception about biological control using t-test

Factors	t	Sig.
Amount of farm ownership	1.018^{ns}	0.310
Yearly income from agricultural activities	1.687^{ns}	0.093
Average yield of rice per year	0.249^{ns}	0.804
Yearly expenditure in rice farming	0.500^{ns}	0.618
Number of owned farm patches	1.137^{ns}	0.257
Number of domestic animals	2.398*	0.018
Number of plows	2.471*	0.014

^{ns} Non significant *significant at p<0.05
Source: Survey Results , 2009

Table 6: Comparison adopters and non-adopters perception of biological control using Mann-Whitney test

Factors	Z	Sig.
Farming system	1.006^{ns}	0.314
Farm labors	2.485*	0.013
Accessibility to agriculture input	0.395^{ns}	0.693
Accessibility to financial resources	1.227^{ns}	0.220
Kinds of fertilizers in rice field	4.568**	0.000
Method of control weeds	0.115^{ns}	0.908
Accessibility to irrigation water supply	0.103^{ns}	0.918

^{ns} Non significant *significant at p<0.05, **significant at P<0.01
Source: Survey Results, 2009

CONCLUSION

Based on the results of the study, the main important factors of adoption were number of domestic animals, number of plows, farm labors and kinds of fertilizers in rice field. It is recommended that the farmers should be trained and informed about biological control. It is also suggested that agricultural extension service should facilitate participatory research, especially by using farmer field school approach. Economic analyses of biological control programs are a valuable method which helps farmers to participate in the decision-making process for biological control programs (Jetter, 2005).

In Iran, like some of developing countries, there is not clear understanding about the new methods of biological controls and policymakers and researchers have difficulty in prioritizing the policies and strategies.

Government should explore ways to increase the participation of farmers in planning, implementing and evaluating programs related to biological control. This could speed up the adoption of this method and facilitate the exchange of ideas among various stakeholders.

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