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

**S. A. Noorhosseini [1]; M. S. Allahyari[1]*; M. S. Sabouri[2]**

*1: Department of Agricultural Management, College of Agriculture, Islamic Azad University, Rasht, Iran*
*2: Department of Agricultural Extension and Education, Islamic Azad University, Garmsar, Iran*

## 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*.

*** Corresponding Author Email**: Allahyari@iaurasht.ac.ir.

## 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

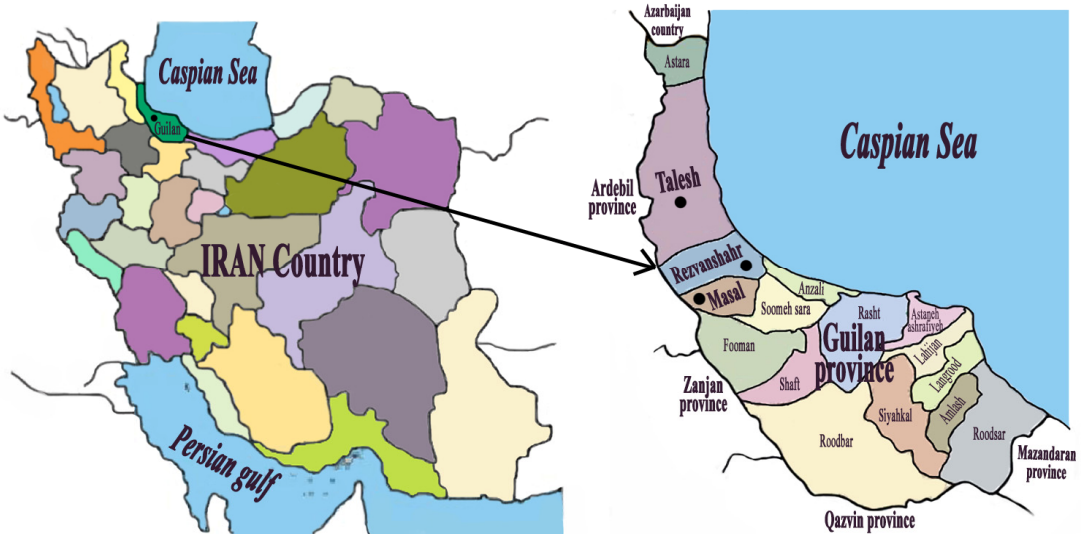


Fig. 1: Site of study

## 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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