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Full Length Research Paper

Social and economic factors for the adoption of biological control of *Bracon* parasitoid on corn *Caradrina* in Dezful Township, Khouzestan Province, Iran

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The purpose of this study was to analyze the social and economic factors involved in the adoption of the biological control of *Bracon* parasitoid on corn *Caradrina* in Dezful Township, Khouzestan province, Iran. The method of research was causal comparative. A random sample of corn farmers from Dezful Township of Khouzestan province, Iran (n=350) was selected for participation in this study. A questionnaire was developed to gather information regarding the adopted biological control of *Caradrina* by *Braconidae* in corn farms located in Dezful Township of Khouzestan province. The results of the *t*-test showed that there is a significant difference between level of education, income, crop yield, farm size, mechanization level and participation in extension classes by adopters and non-adopters of biological control. The Mann Whitney U test (MW) showed significant differences between farmers' awareness, attitude and access to information of adopters and non-adopters. Regression model indicated that the overall predictive power of the model (72.7%) is quite high, while the significant Chi square ($p<0.05$) is indicative of the strength of the joint effect of the covariates on the probability of adoption among farmers in the zone. The results also showed that the decision on the application of biological control is determined by the educational level, income, mechanization level, extension activities, biological control awareness, social participation, attitude toward biological control and access to information sources which have significant influence.

Key words: Adoption, *Caradrina, Braconidae,* corn farmers.

INTRODUCTION

Farmers' adoption of biological control package depends on many factors, such as their technical skill and socio-economic conditions as well as psychological and cultural factors, etc (Singh et al., 2008).

Based on the results from the research conducted by Ommani (2011), farmers have a favorable attitude toward biological control of the pest. According to the obtained relationship between the variables, extension and education classes in the field of biological control, emphasis on training needs must be considered, and necessary background to develop technical knowledge and skills of farmers should be provided.

The purpose of this study was to analyze the social and economic factors involved in adopting the biological control, *Bracon* parasitoid on corn *Caradrina* in Dezful Township, Khouzestan Province, Iran.

MATERIALS AND METHODS

The method of research was correlative causal comparative. A random sample of Dezful Township corn farmers of Khouzestan province, Iran (n=350) was selected for participation in the study. A questionnaire was developed to gather information regarding the adopted biological control of *Caradrina* by *Braconidae* in corn farms Dezful township of Khouzestan province. The questionnaire was pilot tested in Shoushtar Township. Questionnaire reliability was estimated by calculating Cronbach's alpha. The reliability value obtained was 0.85. Data collected were analyzed using the Statistical Package for the Social Sciences (SPSS). Appropriate

Table 1. Personal, social and economic characteristics of corn farmers.

Variable	Frequency	Percent	Cumulative percent
Income (Million Rials)			
10-100	241	68.9	68.9
100-200	79	22.6	91.4
200-300	18	5.1	96.6
300-400	9	2.6	99.1
400-500	3	0.9	100
Social participation			
Low	19.14	19.14	67
Moderate	83.14	64.00	224
high	100.00	16.86	59
Age			
20-35	111	31.7	31.7
36-50	196	56	87.7
51-65	40	11.4	99.1
66-80	3	0.9	100

Table 2. Adoption of biological control *Bracon* parasitoid of corn *Caradrina.*

Groups	Frequency	Percent
Adopters	84	24
Non-adopters	266	76
Total	350	100

statistical procedures for description (frequencies, percentages, means and standard deviations) were used. This study was carried out by survey between July and August 2010.

RESULTS

Demographic profile

The first section of the questionnaire described farmers' demographic profile in Dezful Township, Khouzestan Province of Iran. From the questionnaire, approximately 56% of respondents were between 36 and 50 years of age and 31.7% of them were between 22 and 35 years of age (Table 1). Most respondents (46.6%) reported work experience of 1 to 15 years and a vast majority of them were male (89.04%).

With reference to the frequency of the respondents' social participation, 64% of the farmers had moderate level. About 32% of the corn farmers had reached primary school level. Based on the results of this study, the income of 68.9% of the corn farmers was between ten to one hundred million Rials in a year (Table 1).

Adoption behavior

The dependent variable of the research was adoption of biological control *Bracon* parasitoid of corn *Caradrina* in Dezful Township, Khouzestan Province, Iran. The dependent variable was dichotomized with a value 1 if a farmer was an adopter of biological control and 0 if a non-adopter. Based on the results, 24% of corn farmers were adopter of biological control (Table 2).

Social and economic factors for the adoption of biological control *Bracon* parasitoid of corn *Caradrina*

In order to find out the social and economic factors affecting the adoption of biological control *Bracon* Parasitoid of Corn *Caradrina*, two groups of farmers were compared.

Causal comparative study

For the comparison of adopter and non-adopter characteristics, a *t*-test and Mann-Whitney test (MW) were used. The results of the *t*-test showed that there was a significant difference between level of education, income, crop yield, farm size, mechanization level and extension classes for adopters and non adopters of

Table 3. Comparisons between adopters and non-adopters of biological control of *Caradrina* by *Braconidae* with respect to interval variables.

Variable	*Adopter	Non-Adopter	Test	p-value
Age (Year)	48	53	T=0.98	1.087
Work experience	30	35	T=1.02	0.845
Level of education (year)	10	5	T=6.98	0.000**
Income (Million Rial)	98.7	46.4	T=7.89	0.000**
Extension classes (number)	13	3	T=8.56	0.000**
Farm size (hectare)	11.5	2.6	T=9.07	0.000**
Mechanization level	76.9	34.7	T=7.66	0.000**
Biological control awareness[1]	54.4	32.8	U=4.71	0.000**
Social participation	23.5	14.7	U=5.76	0.000**
Attitude toward biological control [2]	61.8	32.6	U=5.01	0.000**
Access to information sources	29.3	18.5	U=3.68	0.000**

*p < 0.05; **p < 0.01. Biological control awareness[1]: 0 = None; 1 = Very low; 2 = Low; 3 = Average; 4 = High; 5 = Very High. Attitude towards biological control[2]: 1 = Strongly disagree, 2 = Disagree, 3 = Unsure, 4 = Agree, 5 = Strongly agree. * Group.

Table 4. Logistic regression analysis.

Regression	B	Z	Odd ratio	Significance
Mechanization level	0.164	0.356	1.872	0.000
Awareness	0.171	0.678	3.165	0.000
Social participation	0.341	0.598	2.987	0.000
Level of education	0.493	0.834	3.426	0.000
Income	0.213	0.673	2.968	0.000
Extension activity	0.301	0.745	2.915	0.000
Attitude toward biological control	0.291	0.653	2.872	0.000
Access to information sources	0.301	0.782	2.569	0.000

biological control. The Mann Whitney U test showed significant difference between farmers' awareness, attitude, and access to information of adopters and non-adopters (Table 3).

Logistic regression analysis

Table 4 shows the result for logistic regression analysis.

$$\text{logit}(Y) = natural\log(odds) = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta X. \quad (1)$$

$$\pi = Probability(Y = \text{outcome of interest} \mid X = x \text{ a specific value of } X) = \frac{e^{\alpha+\beta x}}{1+e^{\alpha+\beta x}}, \quad (2)$$

$$\text{logit}(Y) = \ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 X_1 + \beta_2 X_2. \quad (3)$$

Therefore,

$$\pi = \text{Probability}\,(Y = outcome\ of\ interest \mid X_1 = x_1, X_2 = x_2 = \frac{e^{\alpha+\beta_1 X_1+\beta_2 X_2}}{1+e^{\alpha+\beta_1 X_1+\beta_2 X_2}}, \quad (4)$$

The results of the Logit likelihood Regression model indicated that the overall predictive power of the model (72.7%) is quite high, while the significant Chi square (p <

0.05) is indicative of the strength of the joint effect of the covariates on the probability of adoption among farmers in the zone. The results also showed that the decision on the application of biological control is determined by education level, income, mechanization level, extension activities, biological control awareness, social participation, attitude toward biological control and access to information sources which have significant influence. Also, the Wald indicating the relative contribution of individual variable to the probability of adoption of biological control showed that the level of education (3.426) was one of the most important factors for determining the choice of application of biological control (Table 4).

$$\text{Ln (odd ratio)}=2.965+0.164X1+0.171X2+0.341X3+0.493X4+0.213X5+0.301X6+0.291X7+0.301X8$$

$$\text{Probability} = \frac{e^{2.965+0.164X1+0.171X2+0.341X3+0.493X4+0.213X5+0.301X6+0.291X7+0.301X8}}{1+e^{2.965+0.164X1+0.171X2+0.341X3+0.493X4+0.213X5+0.301X6+0.291X7+0.301X8}}$$

DISCUSSION

According to the results of this study, there was a significant difference between the level of education, income, crop yield, farm size, mechanization level and extension classes for adopters and non adopters of biological control. The Mann Whitney U test (MW)showed significant difference between farmers' awareness, attitude, and access to information of adopters and non-adopters.

According to Niyaki et al. (2010), the most important factors of adoption of biological control include educational level, family size, experience in rice culture and rate of participation in educational-extension activities.

Singh et al. (2008) showed that technological awareness through formal crop-specific Integrated Pest Management (IPM) training provided by farmers' field schools is extremely important for the wider adoption of IPM in the study area. Hence, investment in IPM education through these programs will have a long-term beneficial impact.

The regression model indicated that the overall predictive power of the model (72.7%) is quite high, while the significant Chi square ($p < 0.05$) is indicative of the strength of the joint effect of the covariates on the probability of adoption among farmers in the zone. The results also showed that the decision on the application of biological control is determined by educational level, income, mechanization level, extension activities, biological control awareness, social participation, attitude toward biological control and access to information sources which have significant influence. Also, the Wald indicating the relative contribution of individual variable to the probability of the adoption of biological control showed that the level of education (3.426) was one of the most important factors for determining the choice of application of biological control. Cullen et al. (2008) noted that farmers must perceive biological pest control innovations to have economic advantages at an acceptable level of risk when compared to the relatively simple conventional agrochemical control methods. The key finding of this paper is that biological control innovations must be developed in a manner which gives consideration to the realities at the farm level.

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