



Financial Comparison of Management Methods of Rice Blast Disease in Langerood County, Iran

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Abstract

The objective of the present study was to financially compare chemical and agricultural management methods of rice blast disease, as a prevalent disease in paddy fields of Langerood in Guilan Province, Iran. Thirty-three rice experts and 373 paddy farmers were selected by random sampling procedures. Data were collected by a research made questionnaire and were analyzed by SPSS. Benefit Cost Ratio (BCR) was utilized for analysis to recognize the most efficient disease management method. Given the costs in 2012 and the evaluation of economic variables of chemical disease management procedures in paddy fields per acre, it became evident that agricultural disease management methods can replace the chemical ones financially. Furthermore, the comparison of farmers' demographic, economic and agricultural characteristics by Chi-squared test among agronomic method and chemical method users showed no significant relationship between paddy farmers' gender, age and farming experience, but there was a significant relationship between cultivation area and management method at the 0.05 significant level. However, there was a significant correlation between disease management methods and the size of the area under cultivation. Furthermore, there were significant differences between experts and farmers' professional viewpoints in their preferences of disease management methods. While experts insist on an integrated application of chemical and agricultural procedures, most farmers apply chemical disease management methods.

Keywords:

Rice blast, Financial comparison, Agriculture management, Chemical management

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INTRODUCTION

Rice blast disease is one of the most prevalent fungal diseases in rice fields. This fungus has been reported in more than 85 countries which grow rice in a commercial scale. The disease can attack the rice fields in transplantation, tillering and clustering phases. Various studies have focused on the issue. Nevertheless disease is still considered as the most unpredictable and detrimental pestilence of rice fields (Padasht-Dehkayee, 1999).

In Iran, the disease was first recognized in 1966 in the paddy fields. Due to this disease, irregular spots appear on the leaves of rice seedlings and shrubs. Then, rice leaves start shrinking at tillering phase of cultivation resulting in the annihilation of rice shrubs. Cluster contamination causes consequential damages to the rice fields which results in sudden deterioration of the number and the quality of clusters and the weight of cluster kernels (Okhovat *et al.*, 1990).

The economic significance of rice can be seen in the fact that it is a main regional source of food. Approximately 80 percent of worldwide rice is produced in small domestic fields, whose objective is to maintain economic subsistence of rural families. Eighty percent of paddy farmers live in poor economic conditions. In Iran, agriculture plays a key role in utilization of social justice, economic variables, food supply, job opportunities and environmental preservations and therefore, should be paid attention to efficiently (Najafi Khotbeh Sarraii, 2011).

Today, sustainable agriculture is emphasized in most countries. Such agriculture emphasizes on farmers' benefits and facilitates preservative procedures for soil, water and other natural resources. Soil fertility, promotion of a healthy society and utilization of opportunities for future generations are some of the components of sustainable agriculture (Allahyari, 2012). In order to facilitate the realization of sustainable agriculture, three key factors should be taken into consideration: environment conservation, proper social conditions and economic profitability, should be taken into consideration. Economic success should be achieved without harming soil, water resources, natural landscapes and

native flora. In most cases, water and soil resources are over-exploited due to the lack of professional knowledge and discernment. Therefore, intensive farming is considered one of the major threats to soil stability (Karimi, 2002).

Today, food supply has become one of the serious challenges for governments and according to a statistical report of the United Nations, millions of people annually die of hunger and malnutrition since only one out of three is financially capable of providing food for him/her qualitatively and quantitatively. One reason behind such devastating observation can be the fact that the level of food production in countries with considerable population growth decreases significantly. World population is projected to reach eight billion by 2025. Today, hunger has become a social challenge whose implications can be politically observed in countries suffering from starvation. Such a threat negatively affects the economics of countries whose agricultural methods have remained traditional for years and therefore, cannot cultivate their lands efficiently. Such technical backwardness in agriculture will make these countries incapable of providing sufficient food for their growing populations (Pajuhandeh, 2013).

One of the most effective disease management procedures of rice blast is agricultural management and rotation. Water preservation is another procedure in paddy fields. The possibility of the emergence of rice blast is considerably high in fields with low water levels. Finally, it should be noted that the utilization of high-quality healthy seeds is of utmost importance so that soil contamination can be prevented (Tebeest *et al.*, 2007).

A number of researchers have proposed a number of chemical and biological management procedures (Shaymala and Sivakumaar, 2012). Chemical management procedure is another method for the management of rice blast fungus. For instance, Tricyclazole fungicide is proposed by a number of agriculture researchers (Peterson, 1990).

The side effects of pesticides compounds were economically evaluated in cotton fields of Pakistan's Punjab Province. The results revealed the detrimental effects of pesticides compounds. Therefore, preventive procedures should be im-

plemented (Azeem Khan *et al.*, 2002).

In order to evaluate the economics of various methods of implementation of methyl bromide in disinfection of soil resources of greenhouse strawberries, partial budgeting of Benefit Cost Ratio (BCR) of various methods was analyzed. The results showed that the utilization of methyl bromide was economically justifiable. Furthermore, it should be noted that agricultural efficiencies of chemical compounds were not similar in all regions and therefore, in some regions, the utilization of Chloropicrin was more efficient than methyl bromide and acquired more than \$1670 efficiency per acre (Sydorovych *et al.*, 2006).

The application of fungicides on diseases of root vegetables in preservative fields was economically evaluated in Egypt. The results indicated that new fungicide compounds mitigated the level of rhizomatous decay of greenhouse cucumber, tomato and pepper as compared to conventional pesticides and facilitated the level of BCR. Such boost in BCR level facilitated agricultural revenues of cucumber, tomato and pepper fields up to 68.8, 98.5 and 45.8 %, respectively and reduced expenses up to 42.5, 54.5 and 35.3, respectively (El-Mougy *et al.*, 2013).

In peanut fields of Nigeria, economic evaluation of management procedures against weed growth was administered during the cultivation seasons of 2010 and 2011 to estimate their efficiency levels. It was found that the best agricultural treatment of fields was the procedure in which rice straws were implanted at the depth of 10 cm. After cultivating a bundle of weeded rice clusters in six weeks, this method was considered to be economically justifiable. Furthermore, the level of utilization of pesticide was reduced considerably (Etejere *et al.*, 2013).

In another study, various irrigation and cultivation methods were economically evaluated in potato fields (Soleimanipoor *et al.*, 2010). Three methods of sprinkling irrigation, tape irrigation and furrow irrigation were evaluated technically and economically. At the beginning and ending of the growth periods, the level of water consumption was estimated. The ultimate results of the study depicted that in the sprinkling method, BCR index acquired higher statistical

rate than other two methods proving the superiority of sprinkling irrigation in the studied region so that BCR was estimated to be 50-60% in this method.

Economic and technical variables of chemical and biological management of *Bemisia tabaci* were analyzed in cotton fields of Fars Province. According to the findings of this study, production sectors, the level of consumed pesticides and their spraying frequency per acre significantly influenced the overall efficiency level of field cultivation of the region. Furthermore, considering annual cotton price and consumption of four liters of pesticides per acre, the application of biological management instead of chemical procedures was proposed due to its technical and economic justifications (Zare *et al.*, 2007).

Hasani Moghaddam *et al.* (2007) analyzed the efficiency of management variables in disease management of rice diseases in rice fields of Mazandaran Province. Data were collected by interviews and questionnaire. The results revealed that efficient cultivation of agriculture fields of both >2-acre and <2-acre farms were affected by less extensive application of fungicides and more extensive application of pesticides. After surveying social, economic, physical and administrative variables in pesticide waste correlatively, it became apparent that there were correlations between the number of cultivated fields, the size of each cultivated fields, the amount of applied chemical fertilizers and farmer's behavioral characteristics in pesticide wastage. Finally, this research indicated that economic, social and technical variables affected mean management costs of rice diseases. Furthermore, in order to economically measure the level of consumption of pesticides as compared to the BCR rate of the fields, a systematic spraying mechanism with variable parameters was applied in corn fields. The results indicated considerable reduction in the level of consumed pesticides in average, intense and low grass fields. BCR rate was reduced to less than 1 indicating that the mechanism was economically justifiable. Furthermore, this rate depicted that BCR rate would be diminished statistically with the increase in weed coverage (Safi-Yari *et al.*, 2011).

In another research, the most economical and efficient method against canker *Rhizoctonia* disease of potato was evaluated (Hasani Moghadam *et al.*, 2012). Technical analyses of seedling, flowering, post-flowering and harvest phases were administered. After recognizing BCR rate as an economic index, it was depicted that all the implemented disease management methods could be economically justified.

In another study, in another study, disease management methods against *Chilo suppressalis* of rice were economically evaluated. The results indicated no correlation between farmers' personal, agricultural, and economic characteristics and the biological-chemical management method. However, there was significant difference between rice plantation experience, agricultural experience, and age (Javadpoor, 2013).

The main objectives of the present study were to analyze the most efficient management method of rice blast disease, to survey farmers' opinions on present management methods of rice blast, to study farmers and agriculture experts' professional opinions, and to analyze farmers' personal and economic characteristics in relation with application of biological and chemical management methods.

MATERIALS AND METHODS

The present study was administered in Langerood County during the growing seasons of 2013 and 2014. Data were collected by a questionnaire and field survey, and were analyzed by SPSS Software Package.

The questionnaire was composed of nine sections: respondents' demographic information, farming system characteristics, paddy farmers' economic attributes, knowledge of rice blast management, paddy farmers' social collaboration, farmers' educational-extension activities, paddy farmers' technical knowledge, and awareness of environmental impacts of rice blast management.

Statistical population was comprised of 33 experts of the Organization of Agriculture Jihad and 13,000 active farmers of this county. Research sample was selected through administration of random sampling methods and Cochran's for-

mula. So, 373 individuals were selected as research sample, and 367 questionnaires were considered as verified sources of research data. Research questions covered issues such as disease management methods of rice blast, production rate per acre, costs of biological and chemical management, the amount of applied pesticide, and harvest expenses, and proposed a number of research hypotheses.

Data analysis was administered by SPSS software application, and variance analysis and descriptive and inferential statistics were carried out by mean rates. At the first step of data analysis, descriptive statistics were used, in which the features of the sample were studied including the tables of frequency distribution, percentage, cumulative frequency, central tendency measures like mean, median and mode, and standard deviation as dispersion measure. Also, the means of two groups – users of agronomic methods and the users of chemical methods – were compared by Chi-square test. In addition, data collected by questionnaire and from plant protection databank of Guilan Province were used for economic assessment of agronomic management method as compared to chemical method. Then, the economically best management method was determined by BCR.

RESULTS AND DISCUSSION

Analysis of demographic data indicated that participants' average age was 55.5 years (SD = 9.98). Respondents were mostly male (97.2%). With respect to participants' academic degree, high school and diploma had the highest frequency of 30.5%, and academic degrees had the lowest frequency of 14.2%. Analyzing participants' dialects, Gilaki dialect had the highest frequency level of 89.3%. Among participants, 60.75% of families had three members. In terms of job experience, 11-20 years of experience had the highest frequency level (34.75%). In the research, mean job experience in rice fields was 27.32 years (SD = 13.33). Study of participants' agricultural characteristics indicated that the highest and lowest frequency levels of area of rice fields were less than one acre (with 68.39%) and more than three acres (with 1.36%),

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Table 1: Characteristics of farmers farming systems in Langerood (n= 367)

Variable	Group	Frequency	Percent	Cumulative percent
Total area of land	≤ 1 acre	251	68.39	68.39
	1.1- 3 ha	111	30.25	98.64
	≥ 3 acres	5	736	100
Land leveling	Land logged	267	66.8	66.8
	No leveling Caspian	133	33.3	100
Varieties of rice	Khazar	1	0.30	0.3
	Hashemi	333	83.3	83.6
	Ali Kazemi	29	7.3	90.9
	Jamshid joo	37	9.1	100

respectively. Furthermore, most participants (more than 66.8%) believed that their rice fields had been leveled. Being planted in 83.3% of farms, cultivar Hashemi was ranked the first among all cultivars (Table 1).

Analysis of economic characteristics showed that mean rice yield was less than one tons per acre with the frequency of 63.8% and more than three tons per acre with the frequency of 2.91% . The highest frequency level of participants' income was recognized to be 1,000,001-50,000,000 IRR¹ (with 44.97%). The lowest frequency level of participants' income was recognized to be less than 10,000,000 IRR (with 1.59%). 26.5% of participants utilized bank credits to support their agricultural activities.

Furthermore, most participants predicted that they would sell their product between 60,001 to 70,000 IRR in 2014 (Table 2).

Also, the study of disease management knowledge of rice blast indicated that more than 80.3% of participants utilized chemical methods for rice blast management (Figure 1).

Participants' personal, agricultural and economic characteristics (divided into two groups, one utilizing chemical and the other agricultural methods) were comparatively analyzed by Chi-square test. The results showed no correlation between gender, age, job experience, and the method chosen by farmers. However, there was significant correlation between disease management procedures and the size of the area

Table 2: Farmers' economic characteristics

Variable	Group	Frequency	Percent	Cumulative percent
Average yield per hectare (t)	≤ 1 tons	228	60.32	60.32
	1-1.3 tons	139	36.77	97.09
	≥ 3 tons	11	2.91	100
Annual income of rice growing (IRR)	≤ 10000000 IRR	6	1.59	1.59
	10000001-50000000 IRR	167	44.18	45.77
	50000001-100000000 IRR	170	44.97	90.74
	≥ 100000000 IRR	35	9.26	100
The average price of what (IRR)	≤ 60000 IRR	166	41.5	41.5
	60001 -70000 IRR	225	56.25	97.75
	≥ 70000 IRR	9	2.25	100
The need for banking facilities	Needed	106	26.45	26.5
	Not required	294	73.5	100

¹ \$1 = 31,979 IRR

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Table 3: Comparison of the characteristics of farming and agriculture groups using chi-square test

Variable	Group	Number	Chi-square	p-value
Sex	Crop	309	0.981	0.322
	Chemical	58		
Curry rice history	Crop	309	4.069	0.131
	Chemical	58		
Cultivation	Crop	309	10.290**	0.006
	Chemical	58		
Group	Expert	33	144.464**	0.000
	Farmer	367		

**p<0.01

under cultivation. Furthermore, there were significant differences between experts and farmers' professional viewpoints about disease management procedures (Table 3). The results indicated that high costs of chemical management practices in cultivation season make agricultural management methods more economical (Tables 4 and 5). It was found that more than 62% of participants had social influence in their communities as farmers, and when it came to social collaboration, their level of collaboration was more than 76% (n = 280). In terms of educational activities and courses, more than 64% of participants

acquired medium level willingness to participate in such activities. Most participants (56%) had high technical efficiency rate. 87% of participants (n = 318) showed high level of environmental knowledge (Table 6).

The comparison of farmers' personal, economic, and agricultural characteristics and their applications of chemical and/or agricultural management practices indicated no correlation between pest management practice and some variables including family size, farmers' performance level and annual income rates. However, there was significant correlation between disease man-

Table 4: Calculation of the costs (in IRR) of chemical and agricultural controls

Method	Plowing	Nitrogen fertilizers	Potash fertilizers	Herbicides	Chemical pesticides	Total
Crop Control	8261000	2669100	1600420	1605390	0	14135910
Chemical Control	8261000	2669100	1600420	1605390	2779000	16914910

Table 5: Economical comparison of chemical and agricultural controls based on the ratio of benefits to costs

Factor	Price	The ratio of benefits to costs
The annual income from rice farming (IRR)	63515600	-
The cost of field control (IRR)	14135910	4.49
The cost of chemical control (IRR)	16914910	3.76

Table 6: Social penetrability of farmers' social accountability, participation, extension, technical knowledge and familiarity with environmental risks of pesticide application

Level	Percent				
	Social penetrability	Community involvement	Extension	Technical knowledge	Understanding environmental risks
Weak	7.40	3.00	12.5	0.00	0.00
Average	22.9	13.1	13.4	6.30	4.40
Good	38.3	76.3	63.8	37.3	9.00
excellent	100	7.60	15.3	56.4	86.6

agement procedures and farm area. In an economic evaluation of disease management methods of *Chilo suppressalis* in paddy fields, Javadpoor (2013) indicated no correlation between family size, farmers' performance level and annual income rates and their utilization of either chemical or agricultural management methods. In the present study, there was significant correlation between the area of cultivation and the type of disease management method and therefore, it was in direct discordance with Javadpoor (2013)'s study.

The estimation of latent costs of chemical management methods is complicated because they inflict ineluctable damage to ecosystem and mankind in long-term periods. If true costs of the application of chemical management procedures were tallied, one could realize their severe impact on ecosystem and mankind. Yusefina Pasha *et al.* (2012) studied various management methods of weeds in rice fields. They concluded that double weeding mechanism was economically more justifiable than chemical management methods, for they cause lower ecological contamination and financial expenditures. In bestowing priority to an agricultural management method, that study is in direct agreement with the present study.

In a study on detrimental effects of pesticides on cotton fields, Azeem Khan *et al.* (2002) concluded that the application of agricultural preventives was preferable to the application of chemical pesticides. By such an implementation, expenditures can be cut considerably and farmers can spend more on sanitary maintenance, agricultural recycling and research activities. Etejere *et al.* (2013) economically analyzed weeds management methods in peanut fields. They also confirmed the priority of agricultural method over chemical procedures, in that they proposed manual weeding procedures over chemical and mechanical manipulations. Zare *et al.* (2007) economically analyzed chemical and biological management methods of *Bemisia tabaci* and believed that if proper biological elements were utilized against this fungus, its population and detrimental impacts could be reduced considerably. Moreover, the substitution of biological measures for chemical

pesticides would preserve ecosystem from nefarious contamination. It was worth mentioning that if biological management was administered efficiently, the quality level of agricultural products would be facilitated. With such qualitative outcome, farmers can justify higher expenditure rates of biological management procedures. El-Mougy *et al.* (2013) utilized new fungicides against diseases of root vegetables and concluded that the application of these fungicides facilitated biological control and reduced financial characteristics of agricultural fields.

As mentioned earlier, participants had a good level of social collaboration. Consultation about the problems of the village in village meetings was considered an instance of farmers' active role in the social interactions of their community. Most participants acquire medium level educational activities. Therefore, educational courses should facilitate farmers' level of actuation in learning new management methods against rice blasts. In the time of the research, these courses acquired no significant priority for participants.

Participants' level of technical knowledge in administration of rice blast was high. Technical knowledge of participants in application of preventive measures of weeds for rice blast control, plow protocols in fall and thorough stemming procedures had low efficiency. Farmers' level of ecological awareness had high efficiency rate. According to the research findings, it was indicated that farmers already knew that utilization of chemical management methods would increase prevalence rate of incurable diseases and annihilate possible natural antagonists against rice blasts in ecology. Furthermore, they were aware of this general premise that through facilitation of their educational activities, they should welcome utilization of biological methods instead of chemical procedures; especially in those regions that this substitution acquires no extra expenditure and maintains ecological priorities. Since farmers acquired high level technical efficiency, a local understanding of agricultural mechanisms should be realized so that indigenous experience could

be recognized in learning processes of newcomers and inexperienced farmers of rice fields. Furthermore, in order to control rice blast disease, a true understanding of fungal growth and their activation seasons should be recognized. Due to low level of initiation of preventive measures against rice blast, it was incumbent to facilitate farmers' awareness towards such measures through holding proper educational courses.

According to the economical analyses, the development of biological methods instead of chemical procedures should be constantly promoted and monitored by officials of the Organization of Agriculture Jihad.

CONCLUSION

The present study was administered in Langerood County. It is recommended to study rice producing provinces in Iran more comprehensively so that the devastating issue of rice blast can be tackled multifariously. Furthermore, the present study should be compared with those studies which have already been administered in Mazandaran Province. It was recommended that ecological consequences of the application of chemical pesticides against rice blasts in Guilan Province should be studied and that the challenges of the development of the biological management of rice blast should be analyzed.

Since the present study was administered in a specific time frame, it was not possible to use Net Present Value (NPV) rate, Return on Investment rate and Profitability Index for the research samples and population. Therefore, it is suggested that the present study is administered during four seasons of a year so that the level of devastating consequences of utilization of chemical pesticides can be measured accurately. Furthermore, financial economy of both chemical and biological management methods should be analyzed and compared. Considering the importance of the application of biological management procedure, it is suggested that this procedure is thoroughly studied and compared with agricultural and chemical management methods.

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