

The Implementation of Integrated Pest Management Technology in Red Chili Farming (Case Study of Dukuh Dempok Village, Wuluhan District, Jember Regency)

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The Implementation of Integrated Pest Management Technology in Red Chili Farming (Case Study of Dukuh Dempok Village, Wuluhan District, Jember Regency)

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Abstract. The use of chemical pesticides among farmers has been indicated in excessive amounts. Excessive use of chemical pesticides for a long time was hazardous to environment and human health. This study aims to determine the level of farmers knowledge to the implementation of integrated pest management (IPM) technology, the perception and behaviour of farmers in the implementation of IPM technology and the correlation between knowledge and perception to farmers behaviour in the implementation of IPM technology. The research was conducted in the Dukuh Dempok Village, Wuluhan District, Jember Regency in April – August 2019. The number of respondents are 30 samples selected by purposive sampling. Data were analyzed with nonparametric statistical using Spearman Correlation. The results showed that almost the farmers had a medium level of knowledge, and almost the farmers had a neutral perception. Level of farmers knowledge and farmers perception were positively correlated to the behaviour of farmers in implementation on IPM technology.

1.Introduction

Wuluhan District is a center of red chilli cultivation in Jember Regency. Based on data from Statistics Indonesia, the area of red chili harvest in Wuluhan in 2016 reached 261 hectares with production¹ reaching 16,496 quintals. This amount¹ of production reaches more than 29% of the total production of red chili in Jember Regency [1]. One of the centers of red chili production in the District of Wuluhan is the Dukuh Dempok Village. Farmers in Dempuh Dempok village continue to cultivate red chilli in the plant season from April to September each year. In general, the production of red chilli in Dukuh Dempok Village continues to fluctuate. This fluctuating amount of production can lead to unstable market prices, which makes farmer suffer losses.

The fluctuations in red chili production faced by farmers in Dukuh Dempok village are caused by several factors, including an environment condition, high pest infestation and excessive use of pesticides. Environment condition will influence plant growth, plant development and susceptibility to pests. The usual action taken by farmers when there is a high pest attack is the continuous application of pesticides which will have an impact on pest resistance to pesticides.

Integrated Pest Management (IPM) is agricultural management that aims to minimize pest attacks naturally and at the same time, reduce the danger of chemical pesticides on humans, plants and the environment. The expected results from IPM technology are knowledge enhancement and decision making skills by farmers. It is also expected to reduce the use of pesticides, increase production and ultimately increase economic benefits [2].



Some example of the application of the IPM technology is utilizing natural enemies and biological pesticides in farming activities. The application of *Beauveria bassiana* as bio pesticides, design of refugia area, and application of *Trichoderma* as bio-fertilizers are among the concept of integrated pest management that can be applied to chili farming. The biological control method with *Beauveria bassiana* and Refugia biological agents on chili plants, as well as the application of *Trichoderma* is expected to be able to maintain the stability of chili production in the Wuluhan District.

Moreover, there is a need for natural enemies to fight the whitefly and trips population. Refugia which is planted around the chili planting area or on land boundaries can function as a micro habitat for predators or natural enemies of whitefly or trips. Planting refugia can increase the population of predators and parasitoids which have decreased due to excessive application of pesticides. Based on the results of the study, the population of natural enemies or predatory insects in areas planted with refugia is greater than land that is not planted with refugia [3]. Refugia plant as biological control also has the role of repellent and mask (camouflage), and physical barrier. *Trichoderma* bio-fertilizer functions as a biofungicide that is antagonistic to other fungi. *Trichoderma* has high antagonistic power and can remove toxins, so that it can inhibit or even kill other pathogens.

Integrated pest management technology still encounters many obstacles to be applied by farmers. This is because integrated pest management requires a long time and expensive. Farmers are faced with the reality that farming is part of the work to earn income and they don't want to lose profits.

2. Research Methods

The study was conducted in the Gawok sub-village, Dukuh Dempok Village, Wuluhan District, Jember Regency. The respondent farmer was a participant in the socialization and training on integrated pest control in red chilli cultivation. This type of research is a survey study using a questionnaire to determine the level of knowledge, perceptions, and behavior of farmers in integrated pest control in red chilli cultivation.

Instruments to measure the level of knowledge of farmers are arranged in the form of knowledge tests with the Guttman scale, namely statements with two alternative choices of true and false (true value = 1, and false = 0). Instruments to measure farmers perceptions in integrated pest control are prepared in the form of statements with Likert scale guidelines related to farmers opinions. Alternative responses are expressed in scores between 1-5. The instrument to measure farmers behavior was arranged in the form of a questionnaire guided by the Likert scale with a statement form with an alternative score of 1-5 [4].

Data were analyzed by descriptive analysis with the help of SPSS. Descriptive statistical analysis is used to describe the sample characteristics of each variable studied, including the maximum value, minimum value, average, mode, standard deviation and distribution table. The assessment of knowledge, perception and behaviour variables are arranged and grouped based on the lowest score if the answers are all wrong and the highest score if the answers are all appropriate. In this study the grouping was done in 3 categories, namely low, medium and high for level of knowledge dan farmers behaviour, and bad, neutral, and good for perceptions variable.

Bivariate statistical tests the Spearman correlation analysis method were also carried out using in this study. Data were analyzed by Spearman Correlation to determine the correlation between knowledge and perceptions to farmers behavior. Spearman correlation test is used to see the strength of the relationship between 2 variables that have an ordinal measurement scale, which is to see the strength of the relationship between the independent variable (knowledge and perception) with the dependent variable (farmers behavior in integrated pest control in the red chilli farming). The Spearman Correlation formula is as equation 1 [5]. The calculated Spearman correlation value is then compared with the Spearman Table. The decision is taken from this comparison if rho count > rho table, then H0 is rejected. If rho count < rho table, then H0 is accepted.

$$r_s = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)} \quad (1)$$

That :

rs = spearman / rho correlation

d = difference, or different between levels of each subject

n = number of samples

1-6 = constant numbers

Hypothesis testing for 2-way test

H0: $\rho = 0$ (no relationship between variables X and Y)

Ho: $\rho \neq 0$ (there is a relationship between variables X and Y)

3. Result and Discussion

Red chili farming has a high risk, both production and price. The risk of red chili production is very high due to high pest and plant disease attacks. An effort that can be used to overcome pests and diseases of the red chili plant is integrated pest management. Integrated Pest Management (IPM) is a conception or way of thinking about controlling plant pests with a multidisciplinary ecological approach to managing pest and disease populations.

3.1. Characteristics of Respondents

Characteristics of respondents such as age, land area, level of education, and farming experience affect the skills of farmers in managing their farm. Respondents in this study were farmers of red chili who participated in the socialization and training of IPM technology during April-September 2019 in Gawok sub-village, Dukuh Dero Village, Wuluhan District, Jember Regency. Respondents in the study amounted to 30 farmers. Respondent characteristics can be used to describe the background of the respondent. Many studies state that age, farm size, education, farm experience positive and highly influence the adoption behaviour of the farmers [6]. Respondent's characteristics in this research can be seen in table 1.

Table 1. Characteristic of Respondents

Variable	Amount (person)	Percentage (%)
Age (Years Old)		
1. 20 up to 40	12	40
2. 41 up to 60	18	60
Education Level (Years)		
1. 6	6	20
2. 9	6	20
3. 12	18	60
Land Area (Ha)		
1. < 0,5	22	73,33
2. > 0,5 up to 1,5	8	26,67
Farming Experience (Years)		
1. < 10	6	20
2. >10 up to 20	24	80
Land Ownership		
1. Own	5	16,67
2. Rent	25	83,33

Based on table 1 showed that the age of the farmers in this study ranged from 20 to 60 years old. The farmers in this research are in the productive age range. It means that the farmers had the physical ability in conducting farming activities. Characteristics of farmers in this research are also the education level. Most farmers (60%) have a high school level of education. The level of education of farmers will influence the farmers perception, behaviour, and the ability to use new technology.

According to other study, the adoption of information related to a particular technology was influenced by the level of education [7]. Other studies also stated that the success of basic training activities on participants' knowledge was influenced by the level of education they had [8].

The land is the most important production factor in farming system. The greater number of land area will also produce the greater product, and will affect to the costs and revenues obtained by farmers. So that the farmer's land area effects to the farmer's decision on cultivating the crop. Most farmers have a small land area, which is less than 0.5 Ha. Based on table 1, the results showed that the farmers experience in red chili farming was categorized high. Most farmers (80%) had farming experience more than 10 years and reach 20 years. It's mean that farmers have long experience in managing red chilli farming. The experience will affect the level of knowledge and farming activities. Land is the main input in agricultural production and also an asset for farmers. There are two common forms of agricultural land ownership that are owned land and rented land. Most farmers (83,33%) rent land for farming.

3.2. The Level of Farmers Knowledge

The farmers knowledge in this research referred to knowledge of various pests and plant diseases, and how to control them according to applying various control techniques that are integrated to prevent damage to plants and cause economic loss, prevent environmental and ecosystem damage. Based on the results of frequency distribution analysis, that most farmers have medium category (56.67%), the remaining 26.67% have low knowledge, and 16.67% have high knowledge of integrated pest management in red chilli farming. Most farmers already have understood the concept of IPM technology, i.e. crop rotation, the use of pesticides appropriately, and the use biopesticides in the management of red chilli farming. The level of knowledge the farmer in this research can be seen in table 2.

Table 2. The Level of Farmers Knowledge

Score Scale	Number of Farmers	Percentage (%)	Category
0-33	8	26,67	Low
34-67	17	56,67	Medium
68-100	5	16,67	High
Total	30	100	

Level of knowledge is the result that occurs after someone senses a certain object. Farmers' knowledge of the IPM technology will help farmers in controlling pests and plant diseases according to the procedure. In line with other study showed that after farmers participated in farmer field schools, their knowledge about biological agents and botanical pesticides increased [9].

3.3. The Level of Farmers Perception

The distribution of respondents according to the perception of integrated pest management shows that 66.67% of farmers have a neutral perception of IPM, 20% of farmers have a good perception and 13.33% have a bad perception. The level of farmers perception in this research can be seen in table 3.

Table 3. The Level of Farmers Perception

Score Scale	Number of Farmers	Percentage (%)	Category
0-33	4	13,33	Bad
34-67	20	66,67	Neutral
68-100	6	20	Good
Total	30	100	

Perception is a cognitive process used by someone to interpret and understand the surroundings. Farmers' perceptions of the IPM technology are seen from the benefits that can be obtained by the program and program requirements (easy or difficult). The more benefits obtained and the easier implemented will lead to a good perception among farmers. Other study stated that innovation will be easily accepted if it can increase production [10]. Farmers participating in the IPM technology have a neutral perception because they have not been able to see the benefits of the IPM technology on the sustainability of their red chilli farming.

3.4. The Level of Farmers Behavior

Farmer's behavior can be defined as everything done by humans and their movements can be observed by others. Based on the results of frequency distribution analysis, that most farmers have medium behavior (46.67%), 43.33% in the high behavior category, and the remaining 10% are in low behavior towards integrated pest management in the red chilli farming. A study on agricultural innovation showed that the technology can be applied if the perception of the farmers toward the benefits of the technology is positive [11].

Based on discussions with farmers, they are still doubts to fully implement the IPM technology. The use of chemical pesticides is still the first choice of farmers because the impact is fast and easy to obtain. According to farmers, the application of the integrated pest management requires a long time, not cheap, and have a long impact to be implemented. In line with the results of the study, stated that the farmers choose to use chemical pesticides because they have a faster deadly effect. In addition, chemical pesticides are easier to obtain, store and use and in certain conditions they are cheaper [12]. Others study also stated that farmers were well aware of the effects of pesticides with regards to the environment and human health but they are still dependent on chemical pesticides use [13]. The level of farmers behaviour in this research can be seen in table 4.

Table 4. The Level of Farmers Behavior

Score Scale	Number of Farmers	Percentage (%)	Category
0-33	3	10	Low
34-67	14	46,67	Medium
68-100	13	43,33	High
Total	30	100	

3.5. Spearman Correlation

Based on the results of research from various sources it was concluded that many factors can influence behavior that is the level of education, knowledge, perception, and others. Spearman correlation analysis results shows that there is a significant influence between farmers knowledge and farmers perceptions on farmer's behavior in the implementation of IPM programs. Spearman correlation analysis in this study can be seen in table 5.

Table 5. Spearman Correlation Test Results

Variable	Correlation Coefficient	Sig
Knowledge	0.587	0.000
Perception	0.367	0.000

Spearman correlation analysis shows that farmers knowledge in integrated pest control has a positive influence (0.587) on farmer's behavior. The amount of contribution to farmer's behavior is 0.587 so that it can be said that each increase in respondent's knowledge of 1 level will cause the behavior in pest control to increase by 0.587. Based on the description it can be said that the level of farmers' knowledge is positively correlated to the behavior of farmers in integrated pest management programs. This is relevant to the results of the study which states that farmers' knowledge influences the behavior

of farmers in using pesticides. Research shows the higher behavior of farmers will more wise in using pesticides [14].

The Spearman correlation test also shows that farmers perceptions influence the farmers behavior in integrated pest management (IPM) programs. The amount of contribution to farmer's behavior is 0.376, which means that every 1 level increase in farmers' perception will cause the behavior of farmers in integrated pest management to increase by 0.376. the better the farmers' perception of the IPM program will increase the behavior of farmers to implement the IPM program in their cultivation of red chili.

4. Conclusion

Level of knowledge of farmers in implementing integrated pest management (IPM) programs is in the medium category. The farmers already know about crop rotation, the use of pesticides as recommended, and the use of bio-pesticides. Farmers perception of integrated pest management is in the neutral category, which means farmers know the impact of pesticides on health and environmental sustainability but farmers still thinking that integrated pest management requires a long process and expensive costs. Farmers knowledge and perception are positively correlated to farmers behavior in integrated pest management technology.

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