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Empowerment of Farmer Group in Controlling *S.podoptera frugiperda* on Corn Using Entomopathogenic Fungi

Endang Warih Minarni[a)], Nurtiati, Nur Kholida Wulansari, Mutala'liah

Faculty of Agriculture, Jenderal Soedirman University, Banyumas, Indonesia

[a)]Corresponding author: endangwarihminarni@gmail.com

Abstract

Raden Farmer Group is one of the farmer groups in Pabuwaran, Purwokerto District, Banyumas Regency. This group faced the problem of encountering the attack of *S.podoptera* frugiperda on corn. This pest caused a detrimental loss in corn cultivation. The common control technique used to control this pest is by applying chemical insecticides. The use of this chemical insecticide causes negative effects on both the environment and human health. The offered solution to overcome this problem is technology transfer using entomopathogenic fungi, which is environmentally safe. Technology transfer was conducted through mentoring, education, and demonstration plots (demplots).

Evaluation was carried out by pre-test and post-test for each activity to find out how well the partners understood the presented materials. The improvement in skills was measured by assessing the entomopathogenic fungi-based bioinsecticide product that was successfully made in the training activity by the partners, the decrease in *S. frugiperda* attack intensity, and the increase in yields in demplot. The evaluation results showed: (a) improvement of the partner's knowledge and skills regarding *S. frugiperda* and its control technique using entomopathogenic fungi; (b) the results on demplot showed that the use of entomopathogenic fungi could replace the application of chemical insecticides to control *S. frugiperda.* (c) Farm analysis showed that the use of entomopathogenic fungi in corn cultivation was efficient and profitable for farmers.

Keywords: bioinsecticides; demonstration plot; entomopathogenic fungi; *S.podoptera frugiperda*

INTRODUCTION

The Raden Farmer Group is one of the farmer groups located in Pabuwaran Village, North Purwokerto District, Banyumas Regency, Central Java Province. The Raden Farmer Group, which is located in the southern part of Pabuwaran Village, covers the RW 05 and RW 06 areas. It was founded in 1990 with Group Register No. 33.02.740.005.1.001, including the advanced group class. The Raden Farmers Group is led by Mr. Narlim Mugiarso and has a total of 57 members, consisting of 30 active members and 27 passive members. Group meetings are held once a month, every third Thursday.

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Group business types include agricultural commodities consisting of food crops (rice and corn), vegetable/horticultural crops, processed food based on local agricultural products, and freshwater agriculture. The main problem being faced by the Raden farmer group is the attack by the armyworm *S.podoptera frugiperda*. The pest *S. frugiperda* is an invasive pest that originally came from America and has spread throughout the world (Georgen et al., 2016; Sharanabasappa et al., 2018; Shylesha et al., 2018; IPPC, 2018; Babu et al., 2019; IPPC, 2019; FAO, 2019).

The entry of the *S. frugiperda* pest into Indonesia was reported in July 2019 through the International Plant Protection Convention (IPPC). In a period of five months, this pest has spread to various districts on the islands of Sumatra, Java, Kalimantan, and Sulawesi, with an attack area reaching 4,357 hectares (ha). The presence of *S. frugiperda* in Indonesia threatens the stability of corn production. This pest adapts quickly to Indonesia and can damage corn plants in a short time. The most destructive phase of this corn pest is the larval or caterpillar phase (Nonci et al., 2019; Trisyono et al., 2019).

Minarni et al. (2020) reported that in several corn planting areas in Banyumas Regency, the pest *S. frugiperda* was found. Based on the results of the identification based on the symptoms of attack and the morphological characteristics of the existing larvae, it can be confirmed that the *S. frugiperda* pest has spread to the Banyumas Regency area. The pest population of *S. frugiperda* ranges from 0.24 to 1.26 larvae per plant, with an attack intensity ranging from 0.34 to 62.2%.

S. frugiperda larvae can be found during the vegetative stage up to the cob formation stage. During the vegetative stage, newly emerged larvae feed in groups, causing symptoms of elongated white spots on the leaves (Sharanabasappa et al., 2018; Trisyono et al., 2019), and eating the epidermis of the leaves, producing symptoms such as groups of pinholes, round ones that are elongated and form windows. In the next stage, where S. frugiperda eats, it is found to look like dry sawdust (Babu, et al., 2018).

Farmers generally control the *S. frugiperda* pest with synthetic chemical insecticides. However, in its application in the field, it causes many problems, such as resistance, resurgence, killing of natural enemies, second pest explosions, and environmental pollution. Biological control using natural enemies is the main component of integrated pest control (IPM), where biological control is an environmentally friendly alternative to pest control.

Entomopathogenic fungi are one of the potential biological agents for controlling the pest *S. frugiperda* and can be a relatively safer control alternative for both natural enemies, farmers, the products produced, and the surrounding environment.

According to the results of interviews with heads and members of farmer groups, factors that hinder increasing corn production in partner groups include: (a) the high intensity of *S. frugiperda* pest attacks; (b) farmers' dependence on the use of synthetic chemical pesticides in corn cultivation; (c) a lack of money; and (d) farmers' knowledge about healthy corn cultivation techniques.

The objectives of this research-based community service project were to: (1) increase farmers' knowledge of entomopathogenic fungi in the field; (2) increase farmers' skills regarding entomopathogenic fungi propagation; (3) increase farmers' skills regarding the application of entomopathogenic fungi to control pests; (4) increase the quantity and quality of healthy corn production; and (5) increase farmers' income through increasing the yield of their crops.

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METHOD

The community service strategy utilized for solving the problems that partners confront was technology transfer via mentorship, teaching, and demonstration plots.

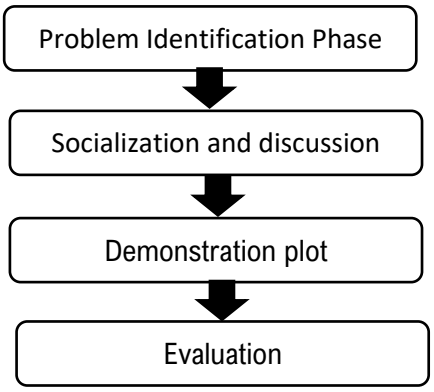

Figure 1. Methods of Implementation of Mentoring

Lecture and discussion approaches were employed as a medium for bidirectional interactive information delivery. This technique was a program start-up with the intention that partners have a solid understanding of managing *S. frugiperda* pests on maize plants with entomopathogenic fungus. Pre-test and post-test evaluation of learned information.

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The healthy cultivation of corn demonstration plot is controlled using simple, inexpensive, and accurate technology, so it is believed that the community would embrace its adoption. The demonstration plots were evaluated by comparing corn crop demonstration plots treated with synthetic chemical pesticides and entomopathogenic fungus. The following parameters were observed: the degree of *S.frugiperda* pest infestations, crop yields, and farming efficiency.

The degree of *S.frugiperda* pest infestations value is calculated using the formula proposed by the Directorate General of Food Crops (2018), namely:

$$I = \frac{\Sigma (ni \times vi)}{N \times Z} \times 100\% \quad (1)$$

Information :

I = Intensity of *S. frugiperda* attacks (%)
ni = Number of plant leaves attacked by *S. frugiperda* larva
vi = The scale of attack
Z = The highest scale value of specified attack category

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N = Number of plant leaves observed

Category of intensity of attack by *S. frugiperda* larva on corn leaves
Light : leaf damage 0-25%
Currently : leaf damage 26-50%
Heavy : leaf damage 51-85%
Puso : leaf damage >85%

Harvest yields and farming efficiency are calculated per demonstration plot area, namely 630 m2. Increased business efficiency is calculated by comparing the ratio of revenue to total costs between demonstration plots with applied technology and without service technology. Farming efficiency is calculated using the R/C formula.

$$\text{R/C ratio} = \frac{\text{Total Revenue}}{\text{Total cost}} \quad (2)$$

Criteria:
R/C > 1 : the farming is efficient
R/C<1 : the farming is not yet efficient
R/C= 1 : the farming reaches its break-even point

The higher the R/C value, the more efficient the farming. It is hoped that this activity can increase the R/C value.

This service activity is carried out using the oil drop pattern method, namely expanding from the pilot center to other areas, both around the pilot and other village areas. The partners will then be trained intensively through mentoring, and it is hoped that the partners will also be able to act as driving cadres in developing the use of entomopathogenic fungi to control the pest *S. frugiperda* in cultivating healthy corn plants.

RESULTS

The results of community service activities in the form of training, education, and mentoring cannot currently be seen in real terms. However, this activity can generally be said to be successful. This can be seen from the active role of the participants and the dynamic discussions during the training. Participants were very enthusiastic about asking questions regarding how to control *S.podoptera frugiperda* pests on corn plants with entomopathogenic fungi. Participants also play an active role in creating and maintaining corn plant demonstration plots, accompanied by a service team.

Based on the results of the pre-test and post-test, it is known that there has been an increase in knowledge. Mitra is of the opinion that the technology transfer that has been provided can open up insight into healthy corn cultivation. In general, participants' responses to this activity were positive. Training participants are interested in the material delivered and agree that the material presented is useful and constitutes a new innovation.

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Table 1. Activities that have been carried out in research-based service and the results achieved

Activity	Indicator	Target	Implementation	Achievement (%)
a. Counseling on healthy corn cultivation techniques with habitat management	Increased knowledge and skills	1 time	1 time	100
b. Introduction to the pest *S. frugiperda*	Increased knowledge and skills	1 time	1 time	100
c. Introduction to natural enemies of the pest *S. frugiperda*	Increased knowledge and skills	1 time	1 time	100
d. Exploration of fungal entomopathogenic genes from infected *S. frugiperda* larvae	Increased knowledge and skills	1 time	1 time	100
f. Application of propagated entomopathogenic fungi to the field	Increased knowledge and skills	2 time	2 time	100
g. Observation of the intensity of *S. frugiperda* attacks	Increased knowledge and skills	4 time	4 time	100
h. Harvest (land area 630 m2)	Increased production	523 kg	529 kg	100%
i. Average weight of corn fruit	Healthy corn fruit	Fruit weight is around 336 grams	Fruit weight is around 340 grams	100%

Table 1 shows all the activities that have been successfully achieved in this service. Indicators of the success of this activity can be determined by comparing the initial conditions before the activity and the achievements obtained after the activity. Based on Table 1, it is known that the implementation of the service received a good response from the community. This success is the result of collaboration between members of the farmer group and the team implementing this activity.

Partners hope that there will be a follow-up to this activity. Mitra hopes that the extension team will provide assistance in cultivating corn on a wider scale.

Farming analysis of sample plots shows an R/C value > 1, namely 1.228 in sample plots of synthetic chemical insecticides and 1.242 in sample plots of the application of entomopathogenic fungi. An R/C value > 1 indicates that the farming carried out on the two sample plots is efficient (Table 2).

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Table 2. Analysis of corn farming with control using synthetic chemical insecticides and entomopathogenic fungi (land area 630 m2)

No	Description	Insecticide	Fungal Entomopatogenic
A	Production (kg)	523	529
B	Price (Rp/kg)	2.500	2.500
C	Gross income	1.307.500	1.322.500
D	Variable Costs		
	Seed	80.000	80.000
	Fertilizer		
	- Manure	125.000	125.000
	-Urea	100.000	100.000
	-NPK	150.000	150.000
	-KCl	30.000	30.000
	-TSP	125.000	125.000
	Pesticide	50.000	50.000
	Labor		
	-TKDK	210.000	210.000
	-TKLK	70.000	70.000
	Total variable costs	940.000	940.000
E	Fixed cost		
	Land rental costs	125.000	125.000
	Total fixed costs	125.000	125.000
	Total variable + Fixed costs	1.065.000	1.065.000
F	Profit	242.500	257.500
G	R/C efficiency	1,228	1,242

The success of this activity is expected to motivate members of farmer groups to control pests using entomopathogenic fungi. Apart from reducing spending on insecticides, the corn produced is healthier to consume because it is free from synthetic insecticide residues.

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CONCLUSIONS AND RECOMMENDATIONS

From the implementation and evaluation of activities, it can be concluded that: (a) farmers' knowledge about the *S. frugiperda* pest and its control with entomapathogenic fungi has increased; (b) the results of the demonstration plot show that entomopathogenic fungi can replace synthetic chemical insecticides; (c) farming business analysis shows that cultivating corn using entomopathogenic fungi is efficient and profitable for farmers; (d) the technology transfer activities carried out received a positive response from members of the farmer group and went well and smoothly; (e) this service activity can encourage the mindset and action patterns of farmers in cultivating healthy corn.

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REFERENCES

Direktorat Perlindungan Tanaman Pangan. 2018. Petunjuk Teknis Pengamatan dan Pelaporan Organisme Pengganggu Tumbuhan dan Dampak Perubahan Iklim (OPT-DPI).

Babu, S.R., R.K. Kalyan, S. Joshi, C.M. Balai, M.K. Mahla and P. Rokadia. 2019. Report of an exotic invasive pest the fall armyworm, *Spodoptera frugiperda* (J.E. Smith) on maize in Southern Rajasthan. Journal of Entomology and Zoology Studies, 7(3): 1296-1300. https://www.entomoljournal.com/archives/2019/vol7issue3/PartV/7-3-42-160.pdf

FAO. 2019. Briefing note on FAO action on fall armyworm. Rome, Italy: FAO.6pp. http://www.fao.org/3/a-bs183e.pdf

Goergen,G , P. L. Kumar, S. B. Sankung, A. Togola, and M. Tamò. 2016. First report of outbreaks of the fall armyworm *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera, Noctuidae), a new alien invasive pest in West and Central Africa. Plos One, 0165632: 1 – 9. https://doi.org/10.1371/journal.pone.0165632.

IPPC. 2018. First detection of Fall Army Worm on the border of Thailand. IPPC Official Pest Report, No. THA-03/1. FAO: Rome, Italy. https://www.ippc.int/

IPPC. 2019. The Occurence of Fall Armyworm (*Spodoptera frugiperda*) in Indonesia. https://www.ippc.int/en/countries/indonesia/pestreports/2019/07/the- occurence-of-fall-armyworm-spodoptera-frugiperda-in-indonesia/

Minarni, E.W, A. Suyanto, Nurtiati dan A. Suroto. 2020. Penyebaran Hama Invasif Spodoptera frugiperda pada Tanaman Jagung dan Potensi Musuh Alaminya di Kabupaten Banyumas. Laporan Riset Peningkatan Kompetensi Universitas Jenderal Soedirman, Purwokerto.

Nonci,N., S.H. Kalqutny, H. Mirsam, A. Muis, M. Azrai dan M.Aqil. 2019. Pengenalan Fall Armyworm (Spodoptera frugiperda J.E. Smith) Hama Baru Tanaman Jagung di Indonesia. Kementerian Pertanian. Badan Penelitian dan Pengembangan Pertanian, Balai Penelitian Tanaman Serealia. Maros.

Prasanna, B.M., J. E. Huesing, R. Eddy and| V. M. Peschke. 2018. Fall Armyworm in Africa: A Guide for Integrated Pest Management. First edition. USAID and CIMMYT, Mexico.

https://doi.org/10.35568/abdimas.v6i4.4079
LPPM Universitas Muhammadiyah Tasikmalaya

Sharanabasappa, C.M. Kalleshwaraswamy and M.S. Maruthi. 2018. Biology of invasive fall army worm *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) on maize. Indian Journal of Entomology, 80(3). DOI : 10.5958/0974-8172.2018.00238.9

Shylesha, A.N., S.K. Jalali, G. Ankita, V. Richa, T. Venkatesan,and S. Pradeeksha et al. Studies on new invasive pest *Spodoptera frugiperda* (J. E. Smith) (Lepidoptera: Noctuidae) and its natural enemies. Journal of Biological Control. 2018; 32(3):145-151. DOI: 10.18311/jbc/2018/21707

Trisyono Y. A., Suputa, V. E. F. Aryuwandari, M. Hartaman and Jumari. 2019. Occurrence of heavy infestation by the fall armyworm *Spodoptera frugiperda*, a new alien invasive pest, in corn in Lampung Indonesia. Jurnal Perlindungan Tanaman Indonesia, 23 (1): 156–160. DOI: 10.22146/jpti.46455