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The Pesticides Use by Rice Farmers in Siak Regency

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ABSTRACT

Using chemical pesticides is still considered for rice farmers to be one of the most effective ways of pest control. The pesticide's chemical content is toxic and causes an increased risk for farmers and the environment if their use is not under applicable regulations. The limited knowledge of farmers about the application of Integrated Pest Management (IPM) and lack of discipline in the use of pesticides has triggered environmental damage, especially to the lowland rice ecosystem and human health. This study aims to determine the use of pesticides by rice farmers in the Siak Regency in controlling rice pests. The method used is a purposive sampling interview method using a questionnaire. The results showed that rice farmers had not implemented a pest control system based on the IPM principle, which did not consider the control threshold as a basis for pesticide use. Farmers are satisfied with the effectiveness of chemical pesticides in pest control, so they continue to use them in rice farming. The lack of Farmers' knowledge about IPM and its application can trigger farmers to increase the dosage and frequency of spraying if the chemical pesticides used cannot control the pest.

Keywords: *pesticide, rice pests, Integrated Pest Management*

1. INTRODUCTION

Increasing rice productivity can be increased by using superior varieties, quality seeds, efficient fertilization, and integrated pest control (IPM). The application of IPM is an effort to control pests by combining several control techniques such as crop cultivation, such as crop rotation, the use of resistant varieties, and the use of vegetable pesticides. The results of previous research stated that the application of IPM reduces the use of chemical pesticides by more than 50% without decreasing productivity (Maryono and Irham, 2001). The basic concept in IPM is the economic threshold, namely the use of chemical pesticides when a pest attack causes a loss of yield equal to the cost of control and other control techniques are no longer susceptible (Rola and Pingali, 1993). The concept of IPM, both ecological and technological in principle, is to limit the use of synthetic pesticides. Although IPM technology still uses economic thresholds as the basis to determine control with synthetic pesticides, ecological IPM completely rejects chemical control (Baehaki, 2009).

Pesticide use has been seen to be one of the best solutions for farmers in controlling pests. The results of research in Dramaga Subdistrict, Bogor Regency, West Java show that the satisfaction of farmers using pesticides is 79.14% refers to the highest proportion of farmer loyalty levels at the habitual buyer level of 41% (Mustikarini et al., 2014). Another study in Cianjur, Subang, and Tasikmalaya districts stated that 46.30% of farmers considered the choice of pesticides to be a determining factor in the decision to cultivate rice. The fact is presumably due to the characteristics of farmers who are familiar with the agricultural production process using pesticides (Thamrin, 2014). Other research in Siak Regency regarding the production efficiency of rice farmers participating in the Riau Makmur Food Operation (OPRM) shows that the use of pesticides is a dominant factor that significantly affects production (Ulfah et al., 2016). Data from the Riau Province Food Crops and Horticulture Department (2019) shows that pest control in Siak Regency mostly uses chemical control using chemical pesticides, which is 96.08%. Pests that attack rice plants in Siak Regency are rice stem borer, rats, white pests, brown planthoppers, black bugs, and rice stink bugs.

The behavior of farmers who are less disciplined in using pesticides, both in terms of type, dose, and frequency, can cause high pollution (Anshori and Prasetyono, 2016). The pesticide effects depend on its poisonous properties, the number of toxicants, and the duration of contamination. Research on residue levels at Padi Centers in Central Java reveals that pesticide use in paddy fields in Central Java tends to exceed the prescribed dosage and frequency of spraying, thus potentially leaving pesticide residues on agricultural land (Ardiwinata and Dedi, 2012). The continuous use of non-selective chemical pesticides to maintain plant productivity resulted in several types of pests becoming immune, then eliminating natural enemies and other useful insects (Arifin, 2012). The research results on the impact of pesticides on the environment and health have been reported commonly. The effects of chronic poisoning that occur in humans due to the consumption of pesticide residues are damage to the cells of the liver, kidneys, nervous system, immune system, and reproductive system (Badrudin and Jazilah, 2013). Insecticides are the dominant type used in which their effects on soil fauna are more varied. Pesticide residues are still below the Maximum Residue Limit; nonetheless, we have to be aware of their long-term use, especially their accumulative and biomagnification properties and toxicity to the environment, human health, and soil microorganisms (Ardiwinata and Dedi, 2012). Pesticides are not entirely on target, causing residues and negative impacts on soil, water, plants, and humans.

This study aimed to identify the use of pesticides by farmers in 4 central rice districts in Siak Regency. The detailed information obtained in this study is expected to support the government or stakeholders in making policies regarding the use of pesticides.

2. MATERIAL AND METHOD

The location was selected by purposive sampling based on the total rice production in Siak Regency. Based on rice production data from the Food Crops and Horticulture Office in Siak Regency (Table 1), four districts with the highest rice production, e.g., Bunga Raya, Sabak Auh, Sungai Mandau, and Sungai Apit.

Table 1. Rice Production in Siak Regency

No	District	Production(ton)
1	Bunga Raya	18.029
2	Sabak Auh	5.000
3	Sungai Mandau	3.974
4	Sungai Apit	2.576

Source: Food Crops and Horticulture Office of Siak Regency (2016)

The research was carried out from January to October 2019 using the Rapid Rural Appraisal (RRA) survey method by implementing interviews using a questionnaire toward 100 rice farmers as the respondents. Based on the data on the area of paddy fields in each sub-district, the number of respondent farmers was determined, as seen in Table 2.

Table 2. Number of Farmers / Respondents Samples Based on Rice Field Area

District	Village	Rice Field Area (Ha)	Farmers (people)
Bunga Raya	Kemuning Muda	504	10
	Bunga Raya	474	10
	Tuah Indrapura	395	8
	Jayapura	338	7
	Buantan Lestari	233	5
Sungai Apit	Teluk Lanus	673	14
	Harapan	55	1
	Sungai Apit	50	1
	Parit I/II	30	1
Sabak Auh	Belading	475	10
	Sungai Tengah	380	8
	Laksamana	350	7
Sungai Mandau	Muara Kelantan	373	7
	Muara Bungkal	326	7
	Lubuk Jering	180	4

Through discussions, the survey also collected formal and informal information from field agricultural extension officers and plant control organisms officers. The data were analyzed descriptively through explanations, tables, and graphics.

3. RESULT AND DISCUSSION

3.1 Types of pests in Siak Regency

The survey results showed that the pest species most often attacked rice plants in 4 sub-districts of Siak Regency. There are pest groups, e.g., the brown planthopper (*Nilaparvata lugens* Stal.), ricefield rat (*Rattus argentiventer* Rob and Kloss), black bugs (*Scotinophara coarctata* F.), white rice stem borer (*Scirpophaga innotata* Walker), rice stink bugs (*Leptocorisa acuta* F.) and golden apple snails (*Pomacea canaliculate* L.). The disease categories are blast caused by pathogens (*Pyricularia grisea*), leaf spot (*Helminthosporium oryzae*), bacterial leaf blight (*Xanthomonas oryzae*), and tungro (*Rice Tungro Bacilliform Virus*, *Rice Tungro Spherical Virus*). The weeds that were identified were cockspur grass (*Echinochloa colona*), nut grass (*Cyperus rotundus*), pickerelweed (*Monochorea vaginalis*), grasslike fimbry (*Fimbristylis miliacea*), and bermudagrass (*Cynodon dactylon*).

3.2 Types of Pesticides In 4 Districts in Siak Regency

The types of pesticides used by rice farmers from the questionnaire results are present in Table 3. Farmers use spray applications to use pesticides on insecticides, fungicides, herbicides, and bactericides. Also, other groups of pesticides are applied by fumigation and sprinkling, such as rodenticides to control rats and nematicides for nematodes.

Table 3 shows that insecticides and herbicides are the groups most widely used by farmers in rice cultivation because the attacks of pests are classified as intensive, and weeds are a problem in land preparation, so they are always applied every planting season.

Rice stem borer control technology is available and has been implemented by researchers, officers, and farmers, starting from using natural enemies and resistant varieties to applying insecticides, but it is still failing (Baehaki, 2013). The insecticides used include Furadan, Prevaton, and other insecticides with active ingredients dimehypo and fipronil. The insecticide with the active ingredient lambda-cyhalothrin under the brands Alika and Matador is also used by farmers in Siak Regency to control stem borer and other types of leaf borer larvae. Rat control in Siak District is generally carried out with "gropyokan" at the beginning of the growing season, fumigation with Tiran and Basmikus, and the use of rat poison bait. The control of brown planthoppers uses insecticidal active ingredients that have caused resistance or resuscitation of brown planthoppers, including cypermethrin, cyhalothrin, fipronil, and imidacloprid. The active ingredients of dinotefuran and pymetrozine are still effective because they have not been circulating for a long time, so it is suspected that resistance/resistance has not occurred yet. In Siak District, black bug attacks with mild to moderate intensity are controlled by intermittent irrigation arrangements, but severe attacks are carried out by spraying Regent and Plenum insecticides. When there is a population of black bugs in the nursery, the farmers control them by sprinkling an insecticide with the active ingredient carbofuran.

Table 3. Types of Pesticides Used by Rice Farmers in Siak Regency

Kecamatan	Jenis Pestisida (%)			
	Insektisida	Herbisida	Fungisida	Bakterisida
Bunga Raya	100	97,5	97,5	67,5
Sabak Auh	100	100	96	80
Sungai Apit	94,1	100	76.5	76,5
Sungai Mandau	100	100	100	38,8

Farmers who use insecticides, especially the dosage/concentration and inaccurate application methods, cause low efficacy. To effectively reduce the pest population, the application of insecticides is not excessive so that it does not cause pest explosion because the excessive use of synthetic chemical insecticides causes an explosion of pests (Minarni et al., 2018).

Types, brands, and active ingredients of pesticides used by rice farmers are presented in Table 4. Regulation of the Ministry of Agriculture of the Republic of Indonesia, Number 39 / Permentan / SR.330 / 7/2015 concerning Pesticide Registration, stipulates Paraquat Dichloride as a limited type of active pesticide in the field of management plants, e.g., pesticides that require special requirements and security tools beyond what is stated on the label. Paraquat dichloride is the active ingredient of herbicides from the pyridine group to control post-growth weeds. Farmers from the Gramoxon, Gramakuat, Supretox, and Zenus brands use the active ingredient in the four sub-districts. Regulation of the Minister of Agriculture No. 43/2019 concerning pesticide registration stipulates 31 active ingredients that are prohibited from being used for rice plants, including active ingredients such as acephate, chlorpyrifos, and profenofos, namely active ingredients in insecticides used by farmers in Siak Regency (Dafat, Starban, and Curacron).

Table 4. Types, Brands, and Active Ingredients of Pesticides Used by Rice Farmers in Siak Regency

Types	Brands and Active Ingredients
Insecticides (28 brands)	Abacel (Abamektin); Alika (Lamda Sihalotrin); Applaud (Buprofezin); Astertrin (Sipermetrin); Bajaj (Dimehipo); Bassa (BPMC/ Fenobukarb); Bestox (Alfa Sipermetrin); Curacron (Profenofos); Dafat (Asefat); Dagger (Imidakloprid); Darmabas (Karbamat: BPMC/ Fenobukarb); Decis (Deltametrin); Decis (deltametrin); Demolish (Abamektin); Furadan (Karbofuran); Glido (Abamektin); Manuver (Dimehipo); Marshal (Karbosulfan); Matador (Lamda Sihalotrin); Montaf (Dimehipo); Plenum (Pimetrozin); Prevaton (Klorantraniliprol); Regent (Fipronil); Spontan (Dimehipo); Stadium (Abamektin); Starban (Klorpirifos, Piretroid Sintetik); Starvidor (imidakloprid); Vertigo (sipermetrin)
Fungicides (17 brands)	Amistartop (Azoksistrobin, Difenokonazol); Antracol (Propineb); Danvil (Heksakonazol); Dense (Metil Tiofanat); Dithane (Mankozeb); Explore (Difenokonazol); Filia (Propikonazol Dan Trisoklazol); Fujiiwan (Isoprotiolan); Mankozeb (Mankozeb); Renzo (Difenokonazol); Score (Difenokonazol); Tandem (azoksistrobin dan difenokonazol); Throne (Propikonazol); Tillo (Metil Tiofanat); Topsida (Metil Tiofanat); Topsin (Metil Tiofanat); Zifllo (Ziram)
Herbicides (22 brands)	Aladin (2,4-D Dimetilamina); Ally (sulfonylurea); Basmilang (Isopropil Amina Glifosat); Best Up (IPA Glifosat); Cba (Klorotalonil); Clipper (Butil Siholatop); Eros Gold (Etil Pirazosulfuron, Pretilaklor); Gramaquat (Parakuat diklorida); Gramoxon (parakuat diklorida); Ken Up (isopropil amina glifosat); Lindomin (2,4-D Dimetil amina); Metsul (Metil Metsulfuron); Nominee (Bispiribak Sodium); Rapid (Metil Metsulfuron); Round Up (glifosat); Santamin (2,4-D dimetil amina); See Top (Iso Propil Amine); Sidamin (Dimetil Amina); Solusi (2,4-D Dimetil Amina); Supretox (Parakuat Diklorida); Tabas Natrium Bispiribak); Zenus (parakuat diklorida)
Bactericides (5 brands)	Batocin (Oksitetrasiklin); Hatake (Spora Bacillus Amyloliquefaciens); Nordox (Tembaga Oksida); Plantomycin (Streptomycin); Puanmur /Asam Kloro Bromo Iso Sianurik (CBIA)

3.3 Knowledge and Application of IPM

The study on the farmer's behavior using pesticides by surveying farmers' knowledge about IPM, the application of IPM, farmers' compliance in reading the directions for using pesticide products, and the farmer's compliance to follow the directions. The survey results as presented in Table 5.

Table 5. Percentage of Knowledge and Application of IPM and Compliance of Rice Farmers with the Directions for the use of Pesticides in Siak Regency

District	Knowledge of IPM	Application of IPM	Read the Directions	Follow the Directions
Bunga Raya	67,50	50,00	87,50	47,50
Sabak Auh	40,00	40,00	100,00	96,00
Sungai Apit	52,90	35,20	100,00	100,00
Sungai Mandau	16,70	11,10	100,00	27,80

The highest knowledge of farmers about IPM in Siak Regency respectively was in the Kecamatan Bunga Raya (67.50%), Sungai Apit (52.90%), Sabak Auh (40%), and Sungai Mandau (16.70%). The percentage of farmers in Bunga Raya who know IPM was higher than in other sub-districts because the IPM Farmer *Field School* or technical guidance on IPM has been provided by the local government in Bunga Raya frequently. The percentage of IPM application is below the percentage of IPM knowledge in each district because there are still farmers who have not applied IPM even though they already know it. The lowest percentage of IPM application was 11.10% by sample farmers in Sungai Mandau District, with the percentage of farmers who knew IPM also low, that is, 16.70%. This finding is because despite having vast paddy fields, Sungai Mandau is a new rice plant development area for rice in Siak Regency, so farmers have not participated in many activities regarding IPM that can increase knowledge about IPM and motivate farmers to apply it.

Farmers 'awareness and skills to read the instructions of use and comply with the directions for using pesticides are also necessary aside from farmers' knowledge about IPM so that the use at the farm level can be effective and efficient. Factors that influence farmers' attitudes and actions in using pesticides include the low awareness of farmers in implementing IPM, and farmers have the intention to apply IPM principles because of the support of cognitive aspects; nevertheless, their implementation is influenced by the surrounding situation so that their desire to behave according to the rules is hampered. In other words, the high level of knowledge does not have a significant correlation to the actions of farmers in using pesticides (Sulistiyono et al., 2008).

In Bunga Raya District, those who read the directions of use were 87.50%, while those who followed were 47.50%. This situation can be generated by the farmers' confidence who have years of farming experience determining the dosage of pesticides used without reading the directions of use listed on the pesticide packaging label. In contrast to farmers in Sungai Mandau District, 100% have the awareness to read the rules for using pesticides, but it is inversely proportional to the compliance to use pesticides following the directions of use of 27.80%. Before using pesticides, all sample farmers in the Sungai Mandau read the directions, but due to their lack of experience and knowledge in rice cultivation, these farmers had difficulty calculating and determining the appropriate spraying dosage according to the directions.

3.4 Satisfaction Level of Pesticide Use

The satisfaction factor in using pesticides is substantial to know because it affects farmers' sustainability of pesticide use. Farmers' satisfaction with the pesticides they use will direct farmer loyalty. Satisfaction will encourage consumers to repurchase products or services that have been used (Mustikarini et al., 2014). The percentage of farmers' satisfaction when using pesticides is present in Figure 1. More than 90% of respondents were satisfied with using chemical pesticides to control pests and diseases in rice. In Sabak Auh and Sungai Mandau Districts, 100% of respondents were satisfied, and only 7.90% in Bunga Raya and 5.88% in Sungai Apit expressed dissatisfaction. Some farmers who were dissatisfied with the use of pesticides cited the reason that the pesticides used were not effective or were not proven to control the pest attack on their rice crops.

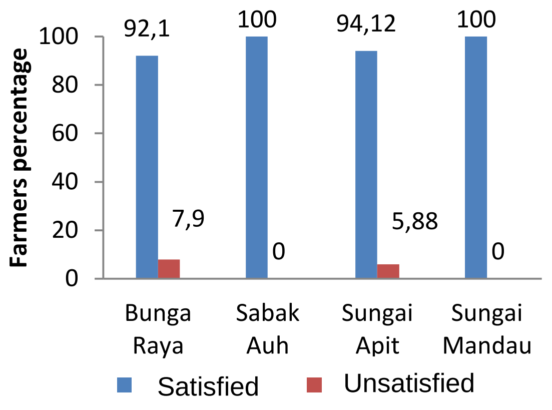

Figure 1. Satisfaction Level of Pesticide Use on Rice Farmers in Siak District

3.5. The Pesticides Use

A survey was also conducted to determine the reasons for using pesticides by the farmers, and the results are present in Figure 2. The most reason for using pesticides is due to pest attacks, the second is for prevention, the third is because of reasons recommended by field agricultural extension officers and plant control organisms officers, and the fourth is because of farmers' habits.

The reason farmers used pesticides was that they only saw the pest attack without taking into account or considering that the pest control threshold can cause harm to themselves and also negatively impact the environment. Generally, the behavior of farmers is guided by prevention rather than cure with the risk of crop failure.

Farmers have prevented pests and diseases by spraying or applying pesticides during soil cultivation where there have been no pest attacks (Ilham, 2008).

The reason for controlling pests by observing the control threshold was only found in Bunga Raya Subdistrict, as much as 2% of the sample farmers, while in other sub-districts, no one chose this reason even as the last priority reason. The control threshold is a momentary economic threshold for control, adjusted to the value of the price of grain at harvest so that the economic threshold is not a fixed price but is flexible (Baehaki, 2013). The low reason for this control threshold is that most sample farmers do not understand determining the control threshold for each pest.

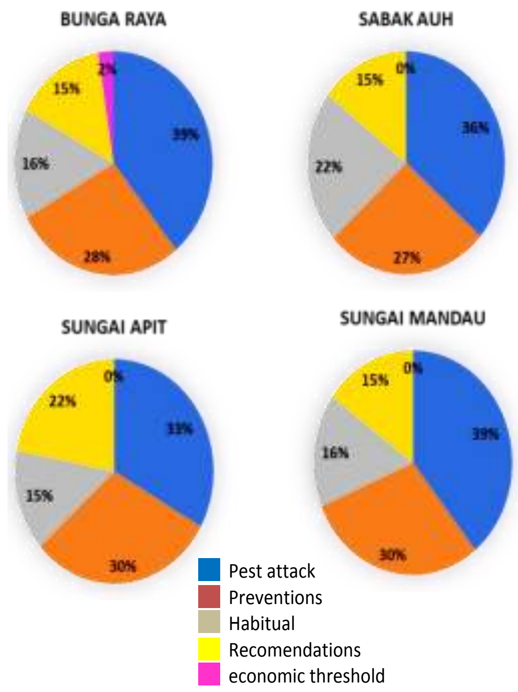

Figure2. Diagram of Percentage of Rice Farmers' Reasons for Using Pesticides in Siak District

The information collected from several sources in this study states that the reason for using pesticides is that the pest attack has passed the control threshold. The concept of economic thresholds as the basis for determining pest control with pesticides is very important to understand because it can reduce the use of pesticides by itself and ultimately increase farmers' income because the pest control process must go through monitoring or monitoring the presence of pests in the field and then determining control techniques with pesticides or recommended. Pest attacks that are still below the control threshold do not need to be controlled by using pesticides, thus reducing costs incurred by farmers.

The survey results also describe the time when rice farmers use pesticides, whether regularly during the growth of rice plants for a routine time, when there is a pest attack, or when it recommend by the field agricultural extension officers and plant control organisms officers (Figure 3). The survey results showed that only a small proportion of farmers used pesticides regularly (Figure 3), with a percentage in the Bunga Raya (32.50%), Sungai Mandau (10.53%), and Sungai Apit (5.53%) Subdistrict. The routine use of pesticides is related to the intensity of rice farming in the district.

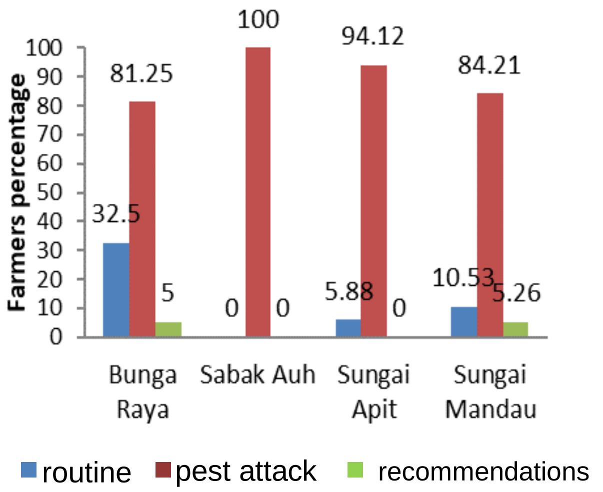

Figure 3. Time of Pesticides Use by Rice Farmers in Siak District

Farmers routinely use pesticides in Bunga Raya District because the intensity of rice cultivation is more intensive, which the farmers in this sub-district have already harvested three times a year or harvest five times in two years (Yusuf, 2020). Farmers sprayed once a week on average. This activity shows that farmers spray up to 9-12 times as long as the rice plants are in paddy fields. Given the high frequency of spraying, it is necessary to be aware of the residual effect it causes.

Rice farmers generally use pesticides when there is a pest attack; even farmers in Sabak Auh District 100% do this. This situation illustrates that farmers' knowledge about pesticides and their use is right if the pesticide application takes when the pest attack is above the control threshold. The role of pesticides in saving agricultural production from pests and plant diseases is still very large if it has exceeded the control or economic threshold (Ditjen PSP, 2018). The spraying pesticide whenever they see a pest attack allows a higher frequency of pesticide application than the spraying done routinely by farmers. The applications of pesticides based on the IPM concept should carry out based on the results of routine monitoring or observation because the presence of pests at a certain population level is not necessarily economically detrimental (Moekasan and Prabaningrum, 2011).

Figure 3 also informs that only a few farmers have applied pesticides based on field agricultural extension officers and plant control organisms' recommendations. The officer makes observations as initial information needed to prepare an operational plan for food crop protection, including an early warning, corrective action, improvement of observation activities, provision of control facilities, and preparation of a food crop protection program for the next period. (DG of Food Crops, 2018). The officers will provide advice or call for control with pesticides when they see severe pest attacks on whether there is information on pest attack outbreaks or early warnings in the surrounding area when other pest control techniques are deemed ineffective. Recommendations for the use of pesticides must pay attention to the five right on rules, namely at the right time, right on target, right on a dose, the right at method, and right on the type (Kurnia and Nurhasan, 2017). When the population of pests and disease attacks is still below the control threshold, the officers do not recommend control using pesticides. Farmers tend to use pesticides even if they are not or have not been recommended by the officers to prevent more severe attacks. IPM technology consists of two control activities, namely preventive controls and the use of pesticides (pesticide controls), and the pesticide use can be done if the first method has been used but has not given optimal results (Supriatna and Ikin, 2012).

Intensive counseling and mentoring by the officer be required to increase rice farmers' knowledge and skills in applying environmentally friendly pest and disease control technologies, given the negative impact of pesticide use. The unwise use of pesticides can harm humans and the environment. Therefore, education and training are necessary for farmers to use pesticides under IPM principles.

4. CONCLUSION

The use of pesticides by rice farmers consists of 4 types: insecticides, herbicides, fungicides, and bactericides with various brands and active ingredients. Farmers have not applied the IPM principle because they do not consider the control threshold as a basis for pesticide usage and based on the pests' presence and attack symptoms in rice fields.

REFERENCES

Anshori dan Prasetyono, 2016. Pestisida pada budidaya kedelai di Kabupaten Bantul D. I. Yogyakarta. Journal of Sustainable Agriculture 31 (1) : 38-44

Ardiwinata A.N dan D. Nursyamsi, 2012. Residu pestisida di sentra produksi padi di Jawa Tengah. Jurnal Pangan 21 (1) : 39-58

Arifin. M, 2012. Pengendalian hama terpadu pendekatan dalam mewujudkan pertanian organik rasional. Iptek Tanaman Pangan 7(2) : 98-107

Badrudin, U., dan S. Jazilah, 2013. Analisis residu pestisida pada tanaman bawang merah (Allium ascalonicum L.) di Kabupaten Brebes. Jurnal Ilmu Pengetahuan dan Teknologi 24 (1) : 75–86

Baehaki, S.E. 2013. Hama penggerek batang padi dan teknologi pengendalian. *J. IPTEK Tanaman Pangan* 8 (1) : 1-14

Baehaki. SE, 2009. Strategi pengendalian hama terpadu tanaman padi dalam perspektif praktek pertanian yang baik (Good Agricultural Practices). *Jurnal Pengembangan Inovasi Pertanian* 2(1) : 68-78.

Direktorat Jenderal Prasarana dan Sarana Pertanian, 2016. *Pestisida Pertanian dan Kehutanan*. Kementerian Pertanian. Jakarta

Ilham, N. 2008. Profil teknologi pada usahatani padi dan implikasinya terhadap peran pemerintah. *Analisis Kebijakan Pertanian* 6 (4) : 335-351.

Kurnia.A dan Nurhasan. 2017. Identifikasi potensi pencemaran residu pestisida di lahan pertanian Jawa Tengah. Universitas Negeri Surakarta. *Prosiding* 1(1) : 334 – 340

Maryono dan Irham, 2001. Usaha menurunkan penggunaan pestisida kimia dengan program pengendalian hama terpadu. *Jurnal Manusia dan Lingkungan* 8(l) : 30-36

Minarni. E.W., A. Suyanto, Kartini. 2018. Potensi parasitoid telur dalam mengendalikan wereng batang cokelat (*Nilaparvata lugens* Stal.) pasca ledakan populasi di Kabupaten Banyumas. *Jurnal Perlindungan Tanaman Indonesia* 22 (2) : 132–142

Moekasan, T.K., R.S Basuki, L. Prabaningrum. 2012. Penerapan ambang pengendalian organisme pengganggu tumbuhan pada budidaya bawang merah dalam upaya mengurangi penggunaan pestisida. *Jurnal Hortikultura* 22(1) : 47-56

Mustikarini F, Retnaningsih, M. Simanjuntak. 2014. Kepuasan dan loyalitas petani padi terhadap pestisida. Jurnal Ilmu Keluarga dan Konsumen 7(2) : 93– 102.

Rola, A.C dan P.L. Pingali, 1993. Pesticide, rice productivity, and farmers. *Health, an Economic Assessment*, World Resources Institute, IRRI.

Sulistiyono, L., S. Bunasor, Danang. 2008. Pengetahuan sikap dan tindakan petani bawang merah dalam penggunaan pestisida studi kasus di Kabupaten Nganjuk Provinsi Jawa Timur. *Jurnal Agroland* 15 (1) : 12-17

Thamrin, F.D. 2014. Model Perilaku Petani Padi Yang Berwawasan Lingkungan Untuk menjamin Kemandirian Pangan Kasus Jawa Barat. Tesis. IPB

Ulfah F., F Restuhadi dan Rosnita, 2016. Analisis efisiensi produksi petani padi peserta operasi pangan riau makmur di Kabupaten Siak. Jurnal Sorot 11(1): 61 -73