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OUTREACH AND TRAINING ON THE USE OF BOTANICAL PESTICIDES IN SUPPORT OF SUSTAINABLE AGRICULTURE IN SITUBONDO

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ABSTRACT

Botanical pesticides are natural chemical substances derived from plant sources such as leaves, flowers, roots, or seeds. These materials have the potential as more environmentally friendly and sustainable alternatives to chemical pesticides. In general, the residents of Mangaran Village, Mangaran District, Situbondo Regency work as farmers. In controlling pests and plant diseases, chemical pesticides are commonly used. The negative impact of chemical pesticide use is that pests become increasingly resistant to the applied pesticides, requiring stronger pesticides as the pests grow stronger. This results in an increasing amount of chemicals in the crops planted by farmers, which impacts the health of both farmers and consumers. The purpose of this outreach regarding botanical pesticides is to provide knowledge and insight related to the production of natural pesticides to control pests and plant diseases. The outreach and training activities received enthusiastic responses from farmers, with 26 farmers attending, each representing their respective hamlet. The results of this outreach are expected to be an initial step in encouraging farmers to begin considering the use and production of botanical pesticides independently.

Keywords: Chemistry, Botanical, Agriculture, Pesticide

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A. BACKGROUND

Agriculture is one of the primary sectors driving economic development in Indonesia (Tanzil et al., 2022). Situbondo Regency is one of the regencies in East Java Province with a relatively well-developed agricultural sector among the regions of the Besuki Residency. Agriculture is a sector whose output is difficult to predict due to environmental factors, which, if not well understood, can result in reduced yields or even crop failure.

However, economic development in agriculture still faces challenges, including environmental pollution, low quality of plant materials, attacks by plant pests and diseases, and pesticide residues on agricultural products that may endanger public health. The numerous negative impacts caused by the use of chemical pesticides have prompted the government to encourage farmers to use pesticides that are safe for the environment and public health (Suhartini et al., 2017).

This policy is an implementation of agriculture that is environmentally and health-conscious in sustainable development. Pest and disease attacks on plants can lead to a decline in the quality and quantity of agricultural products (Tuhuteru et al., 2019). Control and prevention of pest and disease attacks are generally conducted using synthetic chemical pesticides. The use of pesticides and synthetic chemical fertilizers negatively impacts both the environment and health.

One of the impacts of the massive use of chemical pesticides is the emergence of resistance. One alternative control method is the use of biopesticides or botanical pesticides in pest and disease management, which can yield optimal results and are relatively safe for living beings and the environment (Afifah et al., 2022). Excessive pesticide use can result in management failure through pest resurgence and secondary pest problems such as inherited resistance. Worldwide, more than 500 species of arthropod pests have developed resistance to one or more insecticides, while nearly 200 weed species are herbicide-resistant (Chandler et al., 2011). The presence of pests in cultivated plants should be addressed wisely. Plant pests are controlled integratively following the concept of Integrated Pest Management (IPM), with the use of chemical pesticides as the last option, considering the economic threshold in the field (Sutriadi et al., 2019).

Botanical pesticides are pesticides whose active ingredients come from plants or other organic materials with the efficacy to control pest and plant disease attacks. Botanical pesticides are natural chemicals derived from plant sources such as leaves,

flowers, roots, or seeds. These materials have the potential as more environmentally friendly and sustainable alternatives to chemical pesticides.

Based on the potential of natural pesticide plants available in Situbondo Regency, especially in Mangaran Village, it is necessary to enhance knowledge related to the production of natural pesticides to control pests and diseases in plants.

B. METHOD

1. Location and Time of Implementation

The flagship work program of KKN UMD 115 from the University of Jember focused on the agricultural sector, carrying the title "Sustainable Agricultural Harmony: Promoting the Use of Botanical Pesticides and Appropriate Technology in an Environmentally Friendly Agricultural Environment." This activity was held at the Mangaran Village Hall, Mangaran District, Situbondo Regency. The activity was conducted on August 12, 2023.

2. Activity Participants

The main target of the outreach and training activity on botanical pesticides was the farmers of Mangaran Village, Mangaran District, Situbondo Regency, totaling 27 people. The activity was also attended by the Village Government of Mangaran and Field Agricultural Extension Officers of Mangaran District.

3. Implementation

The community service method used in this activity referred to the Asset-Based Community Development (ABCD) approach. This approach emphasizes the identification, development, and optimization of local potentials and assets possessed by the village community. In the context of this activity, local materials such as neem leaves, sembukan leaves, rice washing water, and EM4—which are easily found in the local environment—were utilized as the main ingredients for making botanical pesticides. The activity was also carried out with active community participation through discussion sessions, Q&A, and hands-on practice. In the implementation process of the outreach and training on botanical pesticides to the farmers of Mangaran Village, several stages were carried out as follows: a) Observation, based on the information from the farmers and the Field Agricultural Extension Officers (PPL) of Mangaran Village, it was found that many farmers had not yet used botanical pesticides in their farming activities. b) The materials needed in the training for making botanical

pesticides were neem leaves, sembukan leaves, EM4 solution, molasses, and rice washing water. The required tools included jerry cans, stirrers, knives, cutting boards, funnels, and filters. c) Outreach, the participants received outreach materials delivered by the members of KKN UMD 115 and Field Agricultural Extension Officers of Mangaran Village, covering the definition of botanical pesticides, the benefits of using botanical pesticides, and the method of making botanical pesticides. d) Practice of Making Botanical Pesticides, after the participants understood the theory and the method of making botanical pesticides, they proceeded to the practical session. The participants were divided into 2 groups, each consisting of 13–14 people. The practical session was guided by two facilitators in each group.

4. Evaluation

Evaluation was carried out by observing the activeness of the participants in following the entire series of activities and also the enthusiasm of all participants who actively engaged.

C. RESULTS AND DISCUSSION

The activity carried out through the KKN UMD program took place in Mangaran Village, Mangaran District, Situbondo Regency. This activity involved the farmers of Mangaran Village in the introduction of the use of botanical pesticides among farmers. The activity process was supported by the village government and Field Agricultural Extension Officers, resulting in a smooth implementation process.

Figure 1. Socialization on the Use of Botanical Pesticides

The introduction of botanical pesticides was conducted through outreach and training for farmers. The outreach served as an introduction to farmers that pest control in plants can be carried out not only by using chemical pesticides but also by using botanical pesticides. Botanical pesticides are used to control pest attacks on plants and can have a positive impact on the environment (Hersanti, H., Santosa, E., & Dono, 2013). In addition to the outreach, a practice session on making botanical pesticides was also conducted. The presence of botanical pesticides is expected to be a new breakthrough for the farmers of Mangaran Village towards sustainable agriculture that can bring benefits to the community.

The materials needed for the use of botanical pesticides can be easily found in the community surroundings. The ingredients used in the making of botanical pesticides include neem leaves and sembukan leaves, rice washing water, EM4 (Effective Microorganism 4), and molasses or liquid palm sugar (Atifah et al., 2017). The tools used include knives, blenders, buckets, filters, funnels, and jerry cans. The method of making botanical pesticides is quite easy to follow, prepare the mentioned tools and materials, chop neem leaves and sembukan leaves, prepare a bucket/basin, pour 5 liters of rice washing water, add 440 ml of molasses, add 220 ml of EM4 solution, put the chopped leaves into the bucket with a 1:1 ratio, stir until all ingredients are well mixed, transfer the mixture into the prepared jerry can, seal the jerry can tightly and let it sit for at least 14 days, open the jerry can cap daily to release the gas inside.

Figure 2. Pesticide Manufacturing Process

The ingredients used and the process of making them are quite simple, allowing farmers to easily produce botanical pesticides for their crops. Each ingredient used in the botanical pesticides contains its own active substances.

Botanical pesticides with neem and sembukan leaves as the main ingredients are effective in controlling pest insects and can be used to control Plant Disturbing Organisms in agricultural cultivation (Javandira et al., 2022). Neem is a plant known to possess broad-spectrum pesticidal properties. The main component in neem leaves is azadirachtin, although there are other compounds contained in neem (Kardinan, 2014). Neem leaves contain bioactive compounds including azadirachtin, meliantriol, salanin, and nimbin. Azadirachtin, in particular, does not kill insects directly but works by reducing appetite and inhibiting growth and reproduction (Ervinatun et al., 2018). Neem also affects insect behavior and causes physiological stress, leading to starvation in insects exposed to neem-based botanical pesticides (Aluyah et al., 2023).

Sembukan leaves contain active compounds such as saponins, flavonoids, and tannins. Tannins are produced by plants and function as protective substances both inside and outside plant tissues (Yennie & Elystia, 2013). Tannins are generally resistant to decomposition or fermentation. They also reduce animals' ability to consume the plant and prevent leaf decay. Tannins act as astringent agents, shrinking tissues and binding protein structures on the skin and mucous membranes. Therefore, it is believed that this substance can inhibit the development of Plutella xylostella, causing the insect's skin tissues to shrink and dry.

The pest control effectiveness of sembukan and neem leaves is supported by the use of EM4 and rice washing water. EM4 is a mixed culture of beneficial microorganisms native to Indonesia that are useful for soil fertility, plant growth, and production, and are environmentally friendly (Setiawati et al., 2023). EM4 contains fermentation and synthetic microorganisms, including lactic acid bacteria (Lactobacillus sp.), photosynthetic bacteria (Rhodopseudomonas sp.), Actinomycetes sp., Streptomyces sp., yeast, and cellulose-degrading fungi, which ferment organic matter into compounds easily absorbed by plant roots.

Rice washing water contains phosphorus, which plays a role in stimulating root growth and developing a strong root system in seeds and young plants, as well as accelerating fruit and seed ripening (Fadilah et al., 2020). This study also proved that rice washing water is effective for use as a natural pesticide on crops.

Based on the previous discussion regarding the content of ingredients used for making botanical pesticides, several advantages of using botanical pesticides in agriculture can be identified. First, botanical pesticides tend to be more

environmentally friendly because the active ingredients used are natural and biodegradable, thus not causing residue and pollution. Therefore, botanical pesticides are certainly safe for humans. Second, botanical pesticides have lower potential to cause harmful side effects to humans and animals compared to strong synthetic chemical pesticides. Soil health is also better maintained, and the organic matter content in the soil can be increased. Third, botanical pesticides tend to affect plant pests more slowly than synthetic chemical pesticides that act quickly. However, when used properly, botanical pesticides can provide long-term effects and maintain the balance of the agricultural ecosystem, thereby minimizing pest and disease attacks. Fourth, botanical ingredients used in pesticides are often available around the farming area. This can encourage farmers to develop interest and begin considering the use and production of botanical pesticides independently, reducing dependence on commercial products, and creating local economic opportunities. Fifth, by using botanical pesticides, farmers can more easily meet the requirements for obtaining organic farming certification.

The outreach activity on botanical pesticides presented material regarding how to produce botanical pesticides using natural ingredients along with additional supporting materials. Besides explaining the material, the benefits and proper methods for using botanical pesticides on crops were also discussed. This is because both the production and use must comply with certain requirements so that the botanical pesticides can effectively protect the plants from pest contamination.

In the outreach session on making botanical pesticides, a direct demonstration was also conducted on how to make botanical pesticides. The people of Mangaran Village who attended this outreach activity expressed appreciation and listened attentively to the material presented by the KKN 115 and carefully followed the procedures for making botanical pesticides. The enthusiasm was evident from the number of attendees and the large number of questions asked during the Q&A session. According to the people of Mangaran Village, this outreach activity provided substantial benefits and new knowledge, especially for the people of Mangaran Village, the majority of whom work as farmers. Based on the post-activity evaluation, the participants level of understanding was categorized as good, and the implementation of the activity went smoothly. During the activity, participants demonstrated active involvement, as indicated by their seriousness in paying attention to the material, their participation in the practical session on botanical

pesticide production, asking questions about topics not yet understood, and providing constructive suggestions and feedback.

D. CONCLUSION AND SUGGESTION

The outreach and training on botanical pesticides for farmers in Mangaran Village are expected to reduce the community's dependence on chemical pesticides. The outreach and training activities were met with enthusiasm from the farmers, with 26 participants attending, each representing their respective hamlet. The botanical pesticide ingredients used—namely neem leaves, sembukan leaves, rice washing water, EM4, and molasses or liquid sugar—can help sustain the agricultural ecosystem. Botanical pesticides are environmentally friendly because they are made from organic materials, have low side effects, and are capable of pest control. Therefore, the use of botanical pesticides can foster farmers' interest to begin considering the use and independent production of botanical pesticides, and reduce their reliance on synthetic chemical pesticides.

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