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RESEARCH ARTICLE

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Identification of Organophosphate in Soil from Agricultural Areas in Wanasari Subdistrict, Brebes District, Central Java, Indonesia

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Study of organophosphate residue analysis in Wanasari's agricultural land has been done. This research conducted to identify and determine organophosphate group in soil from different locations in Wanasari Subdistrict. This study also describes pesticide use among farmers. Type of this research was observational study with descriptive approach. OP concentration in soil samples detected by GC-MS method. Characteristics of the farmers were also examined in this study ($n = 55$) and the data was colected by interviewing the respondents. The result showed that farmers had moderate level of knowlegde and behaviour of pesticides. This study report that soil sample was contaminated with OP groups. Test results showed that the active ingredients were detected are malathion, chlorpyrifos, and metidation from three different location. Further studies are needed to analysis of effect OP residue to decomposers in soil and the interactions between them.

Keywords: Organophosphate, Agricultural Areas, Soil.

1. INTRODUCTION

Indonesia is an agricultural country, the data from Indonesian statistical agricultural land 2009–2013 showed that the wetland area is 8.112.103 Ha in 2013. Central Java province (952.525 Ha) is a region which has the second largest area of agriculture after East Java (1.102.863 Ha). Cilacap (63.412 Ha) and Brebes (60.341 Ha) district has the highest agricultural area than others city and district in Central Java provinces. Agricultural areas are related to the pesticides usage. Some pesticides are widely used come from the carbamate, pyrrole, organophosphates group.

Organophosphate Pesticides (OP) are usually used in an agricultural area, it is used as insecticide. The widespread use of insecticides caused problems by their interaction with natural biological systems. While some insecticides are intentionally applied directly to the soil, the soil is also a repository for chemicals from drift during foliar application, plant residues containing insecticides and their degradation products, and chemicals deposited by atmospheric precipitation.[1] Main source of insecticide residues in soil is from the large quantities of insecticides applied directly to it to control soil-inhabiting pests, as sprays, dusts, or granules.[2]

Brebes district is the center area of holticultural farming especially onion sector in Indonesia. Farmers usually use chemical insecticides to increase the productivity of onion. Onion is the vulnerable plant to pests such as thrips, onion maggot, head borer, cut worms, etc. This condition makes the farmers using excessively amount of insecticides. Most of farmers aplly chemical insecticides, such as Dursban which chlorpyrifos as the active ingredient.

The previous research showed that residue levels of horticultural dryland with profenofos active ingredient is 62,060 mg/kg[3]. Residues, especially organochlorine and organophosphate compounds, have been found in soil, water, and agricultural products throughout the country.[4] The use of organophosphate also has negative impacts for humans. The research in Campeche, Mexico showed that were significantly reduced of acetylcholinesterase (AChE) activity in human samples during insecticide use.[5] The purpose of this study are identify residue levels of organophosphate in soil, and identify knowlegde and behaviour of farmers use and handling on pesticides.

2. EXPERIMENTAL DETAILS

Primary data collected informations trough a survey which quistionnaires as the tool. The target population of this study was

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onion farmers who had agricultural land in Wanasari subdistrict, Brebes disrict, Central Java, Indonesia. Soil sample taken from onion agriculture in four village in Wanasari subdistrict. Soil sample was taken using a soil corer at a depth of 20 cm. We need approximately 500 g for laboratory testing. Samples were analyzed for organophosphate group of pesticides. Sample shipped to the agrochemical laboratory (Balingtan, Ministry of Agriculture, Bogor, Indonesia).

Analysis was carried out using capillary gas chromatography with specific detectors, after sample extraction with *n*-hexane and cleanup by partitioning between *n*-hexane and acetonitrile.[6] Data were colected between July and August 2016 from 55 farmers located in Wanasari subdistrict. For data analyzing, descriptive statictic as frequency and percentage was used to describe the findings for farmers knowlegde, behaviours, handling and disposal of pesticides.

3. RESULTS AND DISCUSSION

Most types of soil in Brebes is gray alluvial. Distribution of soil types in Wanasari subdistrict are gray alluvial (1552 ha), gray alluvial and brown gray alluvial (3.029 ha), association between humic gley and gray alluvial (1,688 ha), and alluvial hidromorf (957 ha). Survey methods includes interviews and observation have been conducted in this study. Most of the respondent (38,2%) had elementary school education. Most of them are early erderly peoples with the age higher than 45 years. The majority of farmers have worked in agricultural land for 5–15 years and 16–25 years.

Farmers knowledge examined in this study includes pesticides understanding, types of pesticide, impact of pesticides usage, route of entry pesticides into the body, essential information on pesticides labels, pesticides spraying standard, and symptoms of pesticide poisoning. This study reported that the respondents had moderate levels of knowledge about pesticides (41,8%). While, other study reported high levels of farmers knowledge on the pesticides (97,9%).[7] This study also showed that 45,5% respondents had moderate level of pesticides spraying behaviour. Even farmers mix more than 2 till 4 kinds of pesticides when spraying. The research which studied on knowledge, attitudes, and practices indicated that unsafe use of pesticides was the rule common in Third World countries.[8]

Observation has been conducted to determine the type of pesticide commonly used. There are more than 10 types of pesticides that commonly used by farmers in Wanasari subdistrict. Some of them belonging to organophosphate pesticides with the active ingredients are chlorpyrifos 200 g/l and profenophos 452,32 g/l. Chlorpyrifos and profenofos classified to WHO class II or moderately hazardous. Other active ingredients are chlorfenapyr 300 g/l, chlorantraniliprole 50 g/l, fenvalerate 211,62 g/l, 2,4-*d* dhimetil amine 854,52 g/l, permethrin 20,04 g/l, abamectin 17,94 g/l, profenophos 452,32 g/l, sipermetrin 76,58 g/l, fipronil 50 g/l, and acetamipirid 50 g/l.

In soil from Wanasari village, malathion (0,149 mg/kg) and chlorpyriphos (0,011 mg/kg) among organophosphate were detected, while diazinon, fenitrothion, metidation, paration, and profenofos are under limit of detection the GC-MS. The residue of malathion and chlorpyriphos in Tanjungsari village are 0,137 and 0,063 mg/kg. Residue in Sisalam village is 0,014 mg/kg for metidation, 0,145 mg/kg for malathion, and 0,015 mg/kg for clorpyriphos. The residue of malathion is 0,363 mg/kg an clorpyriphos 0,014 mg/kg in Dukuhwringin village. Chlorpyrifos has become one of the most widely used groups of pest control chemicals.[9] Organophosphate pesticide discovery indicates residues in crops after spraying. Chlorpyrifos moved very rapidly at short time after application of the insecticide before first steps of adsorption were fulfilled. After a few hours, the movement was controlled by adsorption and degradation processes.[10]

Former study showed that chlorpyrifos is not susceptible to enhanced microbial degradation and repeated chlorpyrifos application a should have no effect on its persistence or efficacy.[11] Other studies also show the effects of chlorpyrifos on soil, it is reported that chlorpyrifos significantly decreased aerobic dinitrogen-fixing bacteria and dinitrogen fixation,[12] the presence of 10 to 300 μg of malathion significantly reduced the total number of bacteria, and decreased dinitrogen fixation.[13] This also has been reported that either the colloidal organic matter itself or a fraction associated with it, is the most important single factor concerned with the rapid breakdown of malathion in the soil.[14]

Recent study conducted on laboratory experiment reported that the degradation half-live of chlorpyrifos at levels of 4, 8, and 12 mg/kg in soil were calculated to be 14.3, 16.7, and 18.0 d, respectively. Chlorpyrifos residues in soil had a temporary or short-term inhibitory effect on soil microbial functional diversity.[15] Another study showed the time for 50% loss of chlorpyrifos was found to be 23–28 days in the surface soils (acidic pH) and only 7–16 days in the subsurface (alkaline pH).[16] Malathion is considered lower in toxicity and less persistent (1 to 25 days in soil) than other organophosphate pesticides. Malathion is soluble in water and can be highly mobile in soil although the low persistence and application to foliage provide for a relatively low risk to contaminate groundwater.[17] Based on the study it can be seen that chlorpyrifos and malathion are non-persistent pesticides. Pesticide persistence often is expressed in terms of half-life. Nonpersistent pesticides with a typical soil half-life of less than 30 days, moderately persistent pesticides with a typical soil half-life of 30 to 100 days, or persistent pesticides with a typical soil half-life of more than 100 days.[18]

4. CONCLUSION

In conclusion, this study shows that residue found in soil are chlorpyrifos and malathion, in Tanjungsari, Sisalam, Dukuhwringin, Wanasari village, and metidation only found in Sisalam. Majority of farmers had moderate levels of knowlegde, spraying behaviour and pesticides handling practice of organophosphate. The major organophosphate active ingredients are chlorpyrifos and profenofos. Nevertheless, organophosphate residues found in the soil were malathion, chlorpyrifos, and metidation. It is recommend that the government through the agriculture department has to develop policies on the use of pesticides wisely. Further studies are needed to analysis of effect OP residue to decomposers in soil and the interactions between them. This is an important concern for their pesticide residues in soil, they can cause an ecosystem imbalance.

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