AGRIVITA
Journal of Agricultural Science
www.agrivita.ub.ac.id

The Effect of Soil Submersion and Conditioner Materials on Residual Organophosphate Pesticides in Soil and Shallot Bulbs

Ubad Badrudin[1*], Syakiroh Jazilah[1] and Budi Prakoso[2]

[1] Faculty of Agriculture, Universitas Pekalongan, Pekalongan, Central Java, Indonesia
[2] Faculty of Agriculture, Universitas Jenderal Soedirman, Purwokerto, Central Java, Indonesia

ARTICLE INFO

Keywords:
Pesticide Residue
Soil Submersion
Soil Conditioners

Article History:
Received: February 10, 2017
Accepted: August 30, 2021

*) Corresponding author:
E-mail: barofa@ymail.com

ABSTRACT

Soil health decreases and residual pesticides increase due to the application of inorganic fertilizers and pesticides continuously during the cultivation of crops. The effect of 12 hours or 24 hours soil submersion and chicken litters or zeolite application before planting on residual pesticides in soil and bulbs of shallots (*Allium ascalonicum* L.) are studied. Samples of soils and bulbs have proceeded after shallot cultivation conducted in Brebes, Indonesia. Then organophosphate residues in the samples are analyzed using gas chromatography in the Laboratory of the Indonesian Agricultural Environment Research Institute, Bogor. The data are compared to the standard of maximum residue levels (MRL) of pesticides in agricultural products. Results show that residual pesticides in treated soils are below the detection limit of the GC equipment, except malathion is detected with values ranging from 0.039-0.050 ppm. However, residual organophosphate pesticides in the bulbs are mainly below the maximum residue levels. The only exception is chlorpyrifos which has a value above the maximum residue levels of pesticides (0.076 ppm). Farmers should be educated in integrated pest management and applying synthetic pesticides as the last option for controlling pests and diseases.

INTRODUCTION

Shallot (*Allium ascalonicum* L.) is one of the agricultural commodities grown continuously in The Regency of Brebes. This regency becomes the shallot production center in Central Java, Indonesia. The average shallot productivity in Indonesia was 9.69 t/ha. It is less than its potential, 11.10 t/ha (Christoporus, Mustabjad, Hanani, & Syafrial, 2016). Even it is far below the average shallot productivity of Thailand, which is 26.56 t/ha (Waryanto, Chozin, Dadang, & Putri, 2014). However, farmers still use high or even excessive inputs during shallot cultivation as pesticides are considered essential inputs to the production of shallots.

During the cultivation of shallots, most farmers use inorganic fertilizers and synthetic pesticides. It is misused since most farmers in tropical countries have little formal education, and only a few manage to identify diseases and insect pests (Abang, Kouamé, Abang, Hanna, & Fotso, 2014). This results in a decrease in soil health and environmental quality. The application of a high amount of inputs, particularly inorganic fertilizers and pesticides, in the cultivation of plants is considered by farmers to guarantee that the plants produce a high yield and avoid crop failure (Nakatani et al., 2016). Hernández, Chocano, Moreno, & García (2016) state that inorganic fertilizers provide nutrients instantly, improve plant growth and enhance crop production.

According to Shedeed, El-Sayed, & Abo Bash (2014) and Natsheh & Mousa (2014) the continuous and excessive usage of inorganic fertilizers would result in negative impacts on the condition of the soil physically, chemically, and biologically, reduction of its ability to store water, lack of cation

ISSN: 0126-0537 Accredited First Grade by Ministry of Research, Technology and Higher Education of The Republic of Indonesia, Decree No: 30/E/KPT/2018

Cite this as: Badrudin, U., Jazilah, S., & Prakoso, B. (2022). The effect of soil submersion and conditioner materials on residual organophosphate pesticides in soil and shallot bulbs. *AGRIVITA Journal of Agricultural Science, 44*(1), 1-10. http://doi.org/10.17503/agrivita.v41i0.1291

exchange capacity (CEC), and disturbance of soil aeration. In addition, improper usage of pesticides generates environmental pollution and causes pesticide residues in soils and agricultural products (Aktar, Sengupta, & Chowdhury, 2009; Bagali, Patil, Chimmad, Patil, & Patil, 2012). Application of inorganic fertilizers that are not based on soil properties and plant nutrient requirements neither improve soil health nor replace organic matters lost during cultivation (Hernández, Chocano, Moreno, & García, 2016).

Boulange, Thuyet, Jaikaew, Ishihara, & Watanabe (2016) affirm that in fields where crop rotation is practiced, the residues of pesticides applied to the previous crop might be taken up by the following crop depending on the persistence and uptake characteristics. Pesticides have been commonly used in agriculture since the second half of the twentieth century (Pivato et al., 2015). However, the widespread use of pesticides has resulted in drifting, leaching, and running off of pesticides from target crops to off-target areas, adversely impacting the environment (Afari-Sefa, Asare-Bediako, Kenyon, & Micah, 2015).

In general, farmers sprayed pesticides intensively during the cultivation of the crops. Badrudin, Suryotomo, & Prakoso (2015) find that Chlorpyrifos residual pesticides in the soils have been detected and in the shallot bulbs are above the maximum residue levels of pesticides. It is due to farmers spraying the crops with mixed pesticides (Triwidodo, 2020) every 2 or 3 days. Pathak, Solanki, Renuka, & Kundu (2016) confirm that total concentrations of Organochlorine pesticide (OCP) residues in vegetables ranged from 0.31 to 109.03 μg/kg (wet weight). All samples have some contamination of 1 or more OCP residues. Mean concentrations of DDT, HCH, endosulfan, Aldrin, and dieldrin over all vegetables are 27.01 ± 2.67, 23.13 ± 3.92, 9.97 ± 1.83, 1.43 ± 0.79, and 1.06 ± 0.37 μg/kg (wet weight), respectively. The maximum OCP residue accumulation is in root vegetables, followed by leafy and fruit vegetables. Levels of OCP residues are below the recommended maximum residue levels set by the European Commission and Indian government except for classes for dieldrin, making the vegetables unsafe for human consumption.

Technologies to improve soil health and environment quality need to be found. Two of the technologies that could be applied are soil submersion and the use of soil conditioner materials. Before planting, submersion of the cultivated soil could decrease residual pesticides in the ground (Ogolla et al., 2016). In addition, the soil conditioner materials improve the characteristics of the soil physically, chemically, and biologically and reduce the soil degradation resulting from the use of fertilizers and pesticides irrationally (Akbar Basri et al., 2013; Jemal & Abebe, 2016).

According to Shahraki, Ganjali, & Javadzadeh (2017), organic manure is numerous. It improves the behaviors of several elements in soils through active groups (fulvic and humic acids) that retain the details in complex chelate forms. Organic amendments increase soil pH and reduce exchangeable acidity; exchangeable aluminum and exchangeable iron altered soil chemical properties in a way that enhances the availability of phosphorus (Ch'ng, Ahmed, & Ab. Majid, 2014). It increases nutrient content in the soil and positively influences soil and microorganisms' physical and chemical properties to encourage their life (Bonanomi et al., 2020; Lasmini, Kusuma, Santoso, & Abadi, 2015). Moreover, Ayeni (2011) and Yoldas, Ceylan, Mordogan, & Esetlili (2011) stated that organic fertilizers contained plant nutrients and enhanced soil productivity. However, Melese, Yli-halla, & Yitaferu (2015) find that manure application in acid soil do not increase plant height, dry shoot biomass, and P uptake of wheat. Zeolites are excellent carriers, stabilizers, and regulators of mineral fertilizers. The zeolites enable better plant growth, improve the efficiency of nitrogen and potassium fertilizers, improve water infiltration and retention, crop yield, retain nutrients for long-term use by plants. It improves soil quality, reduces loss of nutrients, helps absorb toxic metals from the soil, and makes them less available for uptake and accumulation in crops (Safiul Azam et al., 2013; Soltys, Mironyuk, Tatarchuk, & Tsinurchyn, 2020). Zeolite has a beneficial effect on the content of total nitrogen, ammonia nitrogen, and phosphorus in the above-ground parts of spring rapeseed (Radziemska & Mazur, 2017). Moreover, Rehan et al. (2017) state that catalytic features of zeolites such as microporous structure and the high surface area improve plant growth and yield.

The purpose of this study is to determine pesticide residues in the soil and shallot bulbs after submerging the soils for 12 hours or 24 hours and applying chicken litters or zeolite in the ground before planting.

MATERIALS AND METHODS

Research Location

A field experiment was conducted in the District of Wanasari, The Regency of Brebes, from May to August 2016.

Experimental Design

The soil was submerged for 12 hours or 24 hours before planting. In addition, 20,000 kg/ha chicken litters or 15,000 kg/ha zeolite was applied before planting. Shallots were grown without pesticide application on the treated soils for 55 days. The preventive measures for controlling pests and diseases were done using light traps, glue traps, and sex pheromones. Inorganic fertilizer applied was 150 kg/ha Urea, 400 kg/ha ZA, 200 kg/ha SP-36, and 20 kg/ha KCl. Samples of soils and bulbs were taken from treated soils after harvesting the shallots. The bulbs were sun-dried for 3 days or 7 days.

Soil samples were taken from 5 points in one experimental unit. Then the soil samples from the same treatment were put in one plastic bag. One kg of bulbs from the same treatment was randomly taken and put in a plastic bag. Samples of soils and bulbs were stored in boxes filled with frozen gel boxes to keep the temperature low while storing and transporting the samples from the location to the Indonesian Agricultural Environment Research Institute laboratory in Bogor. Organophosphate pesticide residues in the samples of soils and bulbs of shallots were analyzed using Gas Chromatography.

The samples were processed and analyzed based on Indonesian Agricultural Environment Research Institute working Instruction Methods 2009 numbers 5.4.1.2.2. and 5.4.1.2.11. as follows: 50 g of soil sample was put in a glass stoppered Erlenmeyer, then 100 ml of acetone was added. After shaking for 30 minutes, the solution was transferred to another glass container through a Gooch filter covered by elite 545. The process of adding acetone, shaking, and filtering was repeated twice. An evaporator dried the filtrate. Then, 8 ml of n-hexane was added to the residue to resolve the residue. Then 1 to 2 µl of the solution was injected into GC. Fifteen grams of sliced bulb sample was put in a glass blender then 30 ml of acetone was added. After blending for 30 seconds, 30 ml dichloromethane dan 30 ml petroleum ether 40–60^{o}C were added. Blending was continued for another 30 seconds. The mixed solution was transferred to another glass container through Wittman filters. Next step, 25 ml of filtrate was transferred to a glass flask. The filtrates were dried using a vacuum rotary evaporated at 40^{o}C. Drying was continued by flowing Nitrogen Gas. The residue was resolvent by adding 5 ml iso octane: toluene (90:10, v/v). 1 to 2 µl of the solution was injected into GC.

Data Analysis

The pesticide residue data were compared to the maximum residue levels of pesticides in agricultural products following the Joint Decree of the Indonesian Minister of Agriculture and Minister of Health, *No. 881/Menkes/SKB/VIII/1996;711/Kpts/TP.270/8/1996.* The data were also correlated to the data of pesticide residue in soils and bulbs taken from farmer farms in this area and analyzed the previous year.

RESULTS AND DISCUSSION

Pesticide Residues in the Treated Soils

The result showed that the organophosphate residues in the treated soils were below the limit of detection (LoD) of the GC equipment. However, the Malathion active ingredient values ranged from 0.039 ppm to 0.050 ppm (Table 1). All the values were below the standart (on average 0.136 ppm and the highest 0.235 ppm) found from previous research (Table 2) (Badrudin & Suryotomo, 2015). The Chlorpyrifos residue in the treated soil was below the limit of detection of the GC equipment. In contrast, the value of the chlorpyrifos in farmer soils was on average 0.194 ppm, and the highest value was 0.743 ppm (Table 2). Joko, Anggoro, Sunoko, & Rachmawati (2017) mention that residual malathion pesticide taken from the soil where farmers cultivated shallot in the same area in 2016 was 0.1490 ppm. In addition, Nining, Nazli, Mas'ud, Machfud, & Sobir (2019) report that residual chlorpyrifos pesticide in the soil at Wanasari district is 0.278 ppm. This indicated that submerging the soil and applying soil conditioner materials before planting could reduce the soil's pesticide residues. Suwardi (2009) states that submerging soils and using soil conditioner materials generated the binding and leaching of the pesticide residues previously attached or bound to soil particles.

Alen, Zulhidayati, & Suharti (2015) write that submerging the soil before planting and watering soil while cultivating the crops could dissolve pesticide residues. Pesticide residues could be hydrolyzed under the amount of available water and pesticide concentration. Moreover, Motoki, Iwafune, Seike, Otani, & Akiyama (2015) stated that some pesticides absorbed into soil particles could be eluted into soil water. El-Saeid & Selim (2016) noted that the reduction of pesticide residues was influenced by several factors, including the mechanical and physical treatments such as washing activities with water that might result in the removal of pesticide residues due to the dissolution. The soil conditioner materials improved the health and quality of the soils in terms of their physical, chemical, and biological properties.

According to Pérez-Lucas, Vela, Escudero, Navarro, & Navarro (2017), the addition of organic wastes significantly increased the sorption of the studied pesticides. The addition of organic fertilizers improved soil structure and enhanced the activities of helpful soil organisms (Seran, Srikrishnah, & Ahamed, 2010). Furthermore, Minardi, Haniati, & Nastiti (2020) stated that adding zeolite had the best improvement on soil chemical properties, soil organic matter, and pH. Zeolite improved the soil chemical adsorption power and decreased the groundwater contamination risk. The microporous nature of zeolite played a vital role in thermal cracking reactions by adsorbing selective larger hydrocarbon chain molecules and other impurities to produce improved quality liquid soil. The catalyst's surface area and pore volume could be increased significantly by chemical treatment such as acid leaching or thermal activation to enhance further its catalytic functions (Sriningsih et al., 2014). The amendments were necessary to optimize soil productivity (Kavitha & Sujatha, 2015).

The soil amendment such as soil conditioner could be organic matter and zeolite. Organic fertilizers could improve soil physical properties, water holding capacity, and organic carbon content. In addition, it supplied good quality of nutrients (Ayeni & Adetunji, 2010; Lasmini, Kusuma, Santoso, & Abadi, 2015). Natural zeolites were alumina-silicates complex structured minerals containing several earth metals such as Na, Ca, K, Mg, and Fe (Nizami et al., 2016; Rabai, Ahmed, & Kasim, 2012), as adsorbents and ion exchangers, remove heavy metals (Latosińska, 2016). As a soil amendment, zeolite had beneficial effects on the growth and yield of crops (Safiul Azam et al., 2013; Theofanoudis, Petropoulos, & Antoniadis, 2015).

Table 1. The analysis results of the pesticide residues with the type of organophosphate in the soil

Treatments	Organophosphate (ppm)													
	Dia	MRL	Fen	MRL	Met	MRL	Mal	MRL	Chl	MRL	Par	MRL	Pro	MRL
PITI	-	-	-	-	-	-	0.047	-	-	-	-	-	-	-
PIT2	-	-	-	-	-	-	0.039	-	-	-	-	-	-	-
P2TI	-	-	-	-	-	-	0.044	-	-	-	-	-	-	-
P2T2	-	-	-	-	-	-	0.050	-	-	-	-	-	-	-

Remarks: Dia: Diazinon, Fen: Fenitrothion, Met: Metidation, Mal: Malathion, Chl: Chlorpyrifos, Par: Paration, Pro: Profenofos, MRL: Maximum Residual Limit, P1: soil submersion for 12 hours, P2: soil submersion for 24 hours, T1: soil conditioner of chicken manure, T2: soil conditioner of zeolite, -: not detected

Table 2. The analysis results of the pesticide residues with the type of organophosphate in the soil and bulb of farmer in Brebes district in 2015

Sample	Organophosphate (ppm)			
	Diazinon	Malathion	Chlorphyrifos	Profenofos
Soil	0.011	0.136	0.194	0.056
Bulbs	0.042	0.027	0.055	-

Remarks: Source: Badrudin & Suryotomo (2015)

Pesticide Residues in Bulbs

Laboratory analysis of the residues of organophosphate pesticides in shallot bulbs indicated that most pesticide residue values were still below the maximum residue limits of pesticides (Table 3). Badrudin, Suryotomo, & Prakoso (2015) find that pesticide residues, especially active ingredients from the organophosphate chlorpyrifos, in bulbs of shallots are above the maximum residue limits. The value of pesticide residues below the maximum residue limits might result from synthetic pesticides not applied during shallot cultivation. During the cultivation of shallot, only preventive measures were used against the potential presence of pests and diseases of the shallot crops, namely light traps, material feeder (sex pheromones), and glue traps. Furthermore, the emerging pests were controlled mechanically by taking the pests manually.

Submersion of soil will leach some soil content. Satpathy, Tyagi, & Gupta (2012) say that leaching could reduce residual pesticides such as malathion, fenitrothion, and chlorpyrifos. In addition, Andrade et al. (2015) reported that leaching was more effective on water-soluble pesticides. Residual diflubenzuron was the lowest since it was more soluble in the water than the other pesticides.

The application of chicken manure possibly reduced environmental pollution (Ali et al., 2018). The farm manure treatments lowered DDT residues than that of samples without fertilizer. The addition of corn straw and farm manure increased soil organic matter content and decreased the soil pH, retard the degradation of DDT in the soil (Wang et al., 2006). Previous researchers found that 50-100 ton manure per ha reduced Atrazine, HO-Atrazine, Propachlor, and HOpropachlor (Doyle, Kaufman, & Burt, 1978).

De Smedt, Ferrer, Leus, & Spanoghe (2015) reported that zeolite had a high affinity to pesticides and acted as an absorbent of residual pesticide in wastewater treatment. Meanwhile, Pucarevic, Stojic, & Kuzmanovski (2017) said zeolite is alumina silicates with very high adsorption capacity and good catalytical characteristics with good chemical and thermal stability.

Table 3. The analysis results of the pesticide residues with the type of organophosphate in the shallot bulbs

Treatments	Organophosphate (ppm)													
	Dia	MRL	Fen	MRL	Met	MRL	Mal	MRL	Chl	MRL	Par	MRL	Pro	MRL
B1PITI	0.084	0.5	0.034	0.05	0.029	0.2	0.242	0.5	0.033	0.05	<0.0101	0.7	0.013	0.05*
B1PIT2	0.054	0.5	<0.0100	0.05	0.010	0.2	0.084	0.5	0.020	0.05	<0.0101	0.7	<0.0101	0.05*
B1P2TI	0.091	0.5	0.017	0.05	0.065	0.2	0.159	0.5	0.018	0.05	<0.0101	0.7	<0.0101	0.05*
B1P2T2	0.061	0.5	0.015	0.05	0.012	0.2	0.123	0.5	0.020	0.05	<0.0101	0.7	0.01	0.05*
B2PITI	0.043	0.5	0.013	0.05	0.015	0.2	0.137	0.5	0.028	0.05	<0.0101	0.7	0.011	0.05*
B2PIT2	0.101	0.5	0.014	0.05	0.059	0.2	0.114	0.5	0.034	0.05	<0.0101	0.7	0.019	0.05*
B2P2TI	0.072	0.5	0.011	0.05	0.017	0.2	0.099	0.5	0.023	0.05	<0.0101	0.7	<0.0101	0.05*
B2P2T2	0.104	0.5	0.013	0.05	0.024	0.2	0.233	0.5	0.076	0.05	0.012	0.7	0.017	0.05*

Remarks: Dia: Diazinon, Fen: Fenitrothion, Met: Metidation, Mal: Malathion, Chl: Chlorpyrifos, Par: Paration, Pro: Profenofos, MRL: Maximum Residual Limit, B1: drying of tubers for 3 days, B2: drying of tubers for 7 days, P1: submersion of soil for 12 hours, P2: submersion of soil for 24 hours, T1: soil conditioner of chicken manure, T2: soil conditioner of zeolit, *: the Japan Food Chemical Research Foundation

Applying synthetic pesticides to control pests and diseases during plants cultivation would leave residues on the plants, have adverse effects on human health, and disturb the ecosystem (Ahmed, Randhawa, Yusuf, & Khalid, 2011; Aktar, Sengupta, & Chowdhury, 2009). After harvesting, the bulbs were dried. The drying could reduce pesticide residues in the bulbs due to evaporation, hydrolysis, and chemical degradation (Amvrazi, 2011). Moreover, Akogbéto, Djouaka, & Kindé-Gazard (2006) said that solid sunrays degraded insecticide residues generated by agricultural practices. However, the value of pesticide residue of chlorpyrifos was 0.076 ppm. It was above the maximum residue limits (MRL) of pesticides which were 0.05 ppm. The areas surrounding the research had been cultivated conventionally. Most farmers applied synthetic pesticides during shallot cultivation. Amilia, Joy, & Sunardi (2016) and Sharma, Peshin, Shankar, Kaul, & Sharma (2015) stated that the pesticide residues that remained in the soil resulted from direct pesticides usage. The pesticide residues could be carried away by the flow of water, wind, or air to other areas and crops.

CONCLUSION

It can be concluded that submersion of soil 12 to 24 hours and applying organic fertilizer and zeolite before planting reduced pesticide residues in the soil and bulbs of shallot. Pesticides residue in the treated soils only malathion was detected and other pesticides not detected; residual pesticides on bulbs of shallot harvested from treated soils were below the maximum residue levels.

ACKNOWLEDGEMENT

The authors would like to thank the Directorate of Research and Community Service (The Ministry of Research, Technology and Higher Education), which funded the research project.

REFERENCES

Abang, A. F., Kouamé, C. M., Abang, M., Hanna, R., & Fotso, A. K. (2014). Assessing vegetable farmer knowledge of diseases and insect pests of vegetable and management practices under tropical conditions. *International Journal of Vegetable Science*, *20*(3), 240–253. https://doi.org/10.1080/19315260.2013.800625

Afari-Sefa, V., Asare-Bediako, E., Kenyon, L., & Micah, J. A. (2015). Pesticide use practices and perceptions of vegetable farmers in the cocoa belts of the Ashanti and Western Regions of Ghana. *Advances in Crop Science and Technology*, *3*(3), 1000174. https://doi.org/10.4172/2329-8863.1000174

Ahmed, A., Randhawa, M. A., Yusuf, M. J., & Khalid, N. (2011). Effect of processing on pesticide residues in food crops - A review. *Journal of Agricultural Research*, *49*(3), 379–390. Retrieved from https://apply.jar.punjab.gov. pk/upload/1374741403 _92_543__2931 --4013-1_%2810%29.pdf

Akbar Basri, M. H., Abdu, A., Jusop, S., Ahmed, O. H., Abdul-Hamid, H., Kusno, M.-A., … Junejo, N. (2013). Effects of mixed organic and inorganic fertilizers application on soil properties and the growth of kenaf (*Hibiscus cannabinus* L.) cultivated on bris soils. *American Journal of Applied Sciences*, *10*(12), 1586–1597. https://doi.org/10.3844/ajassp.2013.1586.1597

Akogbéto, M. C., Djouaka, R. F., & Kindé-Gazard, D. A. (2006). Screening of pesticide residues in soil and water samples from agricultural settings. *Malaria Journal*, *5*(1), 22. https://doi.org/10.1186/1475-2875-5-22

Aktar, W., Sengupta, D., & Chowdhury, A. (2009). Impact of pesticides use in agriculture: Their benefits and hazards. *Interdisciplinary Toxicology*, *2*(1), 1–12. https://doi.org/10.2478/v10102-009-0001-7

Ali, M., Khan, N., Khan, A., Ullah, R., Naeem, A., Khan, M. W., … Rauf, K. (2018). Organic manures effect on the bulb production of onion cultivars under semiarid condition. *Pure and Applied Biology*, *7*(3), 1161–1170. https://doi.org/10.19045/bspab.2018.700135

Amilia, E., Joy, B., & Sunardi. (2016). Residu pestisida pada tanaman hortikultura (Studi kasus di Desa Cihanjuang Rahayu Kecamatan Parongpong Kabupaten Bandung Barat). *Jurnal Agrikultura*, *27*(1), 23–29. https://doi.org/10.24198/agrikultura.v27i1.8473

Amvrazi, E. G. (2011). Fate of pesticide residues on raw agricultural crops after postharvest storage and food processing to edible portions. In M. Stoytcheva (Ed.), *Pesticides - Formulations, Effects, Fate* (pp. 575–594). IntechOpen. https://doi.org/10.5772/13988

Andrade, G. C. R. M., Monteiro, S. H., Francisco, J. G., Figueiredo, L. A., Rochac, A. A., & Tornisielo, V. L. (2015). Effects of types of washing and peeling in relation to pesticide residues in tomatoes. *Journal of the Brazilian Chemical Society*, *26*(10), 1994–2002. https://doi.org/10.5935/0103-5053.20150179

Ayeni, L. S. (2011). Integrated plant nutrition management: A panacea for sustainable crop production in Nigeria. *International Journal of Soil Science*, *6*(1), 19–24. https://doi.org/10.3923/ijss.2011.19.24

Ayeni, L. S., & Adetunji. (2010). Integrated application of poultry manure and mineral fertilizer on soil chemical properties, nutrient uptake, yield and growth components of maize. *Nature and Science*, *8*(1), 60–67. Retrieved from http://www.sciencepub.net/nature/ns0801/06_2101_Ieye_ns0801_60_67.pdf

Badrudin, U., & Suryotomo, B. (2015). Kajian residu pestisida pada budidaya bawang merah (Allium ascalonicum L.) dengan aplikasi bahan pembenah tanah dan pestisida nabati untuk mewujudkan pertanian ramah lingkungan. Laporan Tahunan Penelitian Hibah Bersaing. Universitas Pekalongan. Retrieved from https://repository.unikal.ac.id/168

Badrudin, U., Suryotomo, B., & Prakoso, B. (2015). Residual pesticide study on shallot cultivation (Allium ascalonicum L.) in Brebes district. In T. Sumaryanto, E. Soesilawati, S. D. W. Prajanti, Subiyanto, J. V. Flier, R. M. D. Sail, & R. Darnsawasdi (Eds.), *The 1st Unnes International Conference on Research Inovation and Commercialization (UICRIC) for Better Life 2015*. Paper presented at Proceedings of Conference Research and Community Service Institute, Semarang (pp.267-269). Semarang State University. Retrieved from http://lib.unnes.ac.id/24043/

Bagali, A. N., Patil, H. B., Chimmad, V. P., Patil, P. L., & Patil, R. V. (2012). Effect of inorganics and organics on growth and yield of onion (*Allium cepa* L.). *Karnataka Journal of Agricultural Sciences*, *25*(1), 112–115. Retrieved from https://www.researchgate.net/publication/277057702_Effect_of_inorganics_and_organics_on_growth_and_yield_of_onion_Allium_cepa_L

Bonanomi, G., De Filippis, F., Zotti, M., Idbella, M., Cesarano, G., Al-Rowaily, S., & Abd-ElGawad, A. (2020). Repeated applications of organic amendments promote beneficial microbiota, improve soil fertility and increase crop yield. *Applied Soil Ecology*, *156*, 103714. https://doi.org/10.1016/j.apsoil.2020.103714

Boulange, J., Thuyet, D. Q., Jaikaew, P., Ishihara, S., & Watanabe, H. (2016). Development and validation of the SPEC model for simulating the fate and transport of pesticide applied to Japanese upland agricultural soil. *Journal of Pesticide Science*, *41*(4), 152–162. https://doi.org/10.1584/jpestics.D16-027

Ch'ng, H. Y., Ahmed, O. H., & Ab. Majid, N. M. (2014). Improving phosphorus availability in an acid soil using organic amendments produced from agroindustrial wastes. *The Scientific World Journal*, *2014*, 506356. https://doi.org/10.1155/2014/506356

Christoporus, C., Mustabjad, M. M., Hanani, N., & Syafrial, S. (2016). Using production input and productivity of local shallot with the implementation of good agriculture practices in Donggala, Indonesia. *Russian Journal of Agricultural and Socio-Economic Sciences*, *9*(57), 33–40. Retrieved from http://rjoas.com/issue-2016-09/article_06.pdf

De Smedt, C., Ferrer, F., Leus, K., & Spanoghe, P. (2015). Removal of pesticides from aqueous solutions by adsorption on zeolites as solid adsorbents. *Adsorption Science & Technology*, *33*(5), 457–485. https://doi.org/10.1260/0263-6174.33.5.457

Doyle, R. C., Kaufman, D. D., & Burt, G. W. (1978). Effect of dairy manure and sewage sludge on 14C-pesticide degradation in soil. *Journal of Agricultural and Food Chemistry*, *26*(4), 987–989. https://doi.org/10.1021/jf60218a008

El-Saeid, M. H., & Selim, M. T. (2016). Effect of food processing on reduction of pesticide residues in vegetables. *Journal of Applied Life Sciences International, 8*(1), 1-6. https://doi.org/10.9734/JALSI/2016/26801

Hernández, T., Chocano, C., Moreno, J.-L., & García, C. (2016). Use of compost as an alternative to conventional inorganic fertilizers in intensive lettuce (*Lactuca sativa* L.) crops—Effects on soil and plant. *Soil and Tillage Research*, *160*, 14–22. https://doi.org/10.1016/j.still.2016.02.005

Jemal, K., & Abebe, A. (2016). Determination of bio-char rate for improved production of Lemmon grass (*Cymbopogon citratuc* L.). *International Journal of Advanced Biological and Biomedical*

Research, *4*(2), 158–166. https://doi.org/10.26655/ijabbr.2016.6.6

Joko, T., Anggoro, S., Sunoko, H. R., & Rachmawati, S. (2017). Pesticides usage in the soil quality degradation potential in Wanasari Subdistrict, Brebes, Indonesia. *Applied and Environmental Soil Science*, *2017*, 5896191. https://doi.org/10.1155/2017/5896191

Kavitha, C., & Sujatha, M. (2015). Evaluation of soil fertility status in various agro ecosystems of Thrissur District, Kerala, India. *International Journal of Agriculture and Crop Sciences*, *8*(3), 328–338. Retrieved from https://www.cabdirect.org/cabdirect/abstract/20153188675

Lasmini, S. A., Kusuma, Z., Santoso, M., & Abadi, A. L. (2015). Application of organic and inorganic fertilizer improving the quantity and quality of shallot yield on dry land. *International Journal of Scientific & Technology Research*, *4*(4), 243–246. Retrieved from https://www.ijstr.org/final-print/apr2015/Application-Of-Organic-And-Inorganic-Fertilizer-Improving-The-Quantity-And-Quality-Of-Shallot-Yield-On-Dry-Land.pdf

Latosińska, J. (2016). Zeolitization of sewage sludge ash with a fusion method. *Journal of Ecological Engineering*, *17*(5), 138–146. https://doi.org/10.12911/22998993/65463

Melese, A., Yli-halla, M. J., & Yitaferu, B. (2015). Effects of lime, wood ash, manure and mineral P fertilizer rate on acidity related chemical properties and growth and P uptake of wheat (*Triticum aestivum* L.) on acid soil of Farta district, Northewestern highlands of Ethiopia. *International Journal of Agriculture and Crop Sciences*, *8*(2), 256–269. Retrieved from https://researchportal.helsinki.fi/en/publications/effects-of-lime-wood-ash-manure-and-mineral-p-fertilizer-rate-on-

Minardi, S., Haniati, I. L., & Nastiti, A. H. L. (2020). Adding manure and zeolite to improve soil chemical properties and increase soybean yield. *Sains Tanah-Journal of Soil Science and Agroclimatology, 17*(1), 1-6. https://oi.org/10.20961/stjssa.v17i1.41087

Motoki, Y., Iwafune, T., Seike, N., Otani, T., & Akiyama, Y. (2015). Relationship between plant uptake of pesticides and water-extractable residue in Japanese soils. *Journal of Pesticide Science*, *40*(4), 175–183. https://doi.org/10.1584/jpestics.D15-017

Nakatani, M., Ito, M., Yoshimura, T., Miyazaki, M., Ueno, R., Kawasaki, H., & Todoroki, Y. (2016). Synthesis and herbicidal activity of 3-{[(hetero)aryl]methanesulfonyl}-4,5-dihydro-1,2-oxazole derivative; Discovery of the novel pre-emergence herbicide pyroxasulfone. *Journal of Pesticide Science*, *41*(4), 133–144. https://doi.org/10.1584/jpestics.D15-078

Natsheh, B., & Mousa, S. (2014). Effect of organic and inorganic fertilizers application on soil and cucumber (*Cucumis sativa* L) plant productivity. *International Journal of Agriculture and Forestry, 4*(3), 166-170. Retrieved from http://article.sapub.org/10.5923.j.ijaf.20140403.03.html

Nining, E., Nazli, R. S. S., Mas'ud, Z. A., Machfud, M., & Sobir. (2019). Profil residu insektisida organofosfat di kawasan produksi bawang merah (*Allium ascalonicum* L.) Kabupaten Brebes Jawa Tengah. *Jurnal Pengelolaan Sumberdaya Alam Dan Lingkungan*, *9*(4), 999–1009. Retrieved from https://journal.ipb.ac.id/index.php/jpsl/article/view/23691

Nizami, A. S., Ouda, O. K. M., Rehan, M., El-Maghraby, A. M. O., Gardy, J., Hassanpour, A., … Ismail, I. M. I. (2016). The potential of Saudi Arabian natural zeolites in energy recovery technologies. *Energy*, *108*, 162–171. https://doi.org/10.1016/j.energy.2015.07.030

Ogolla, A. E., Njau, N., Mwirigi, P., Muui W., C., Kibet, N. K., & Mwangi, M. (2016). Climate change effects on rainfall patterns and it's implications on sorghum and millet production in Kenya: A review. *The International Journal Of Science & Technoledge*, *4*(8), 44–52. Retrieved from https://ir-library.ku.ac.ke/bitstream/handle/123456789/20179/Climate change....pdf?sequence=1&isAllowed=y

Pathak, S., Solanki, H., Renuka, A., & Kundu, R. (2016). Levels of organochlorinated pesticide residues in vegetables. *International Journal of Vegetable Science*, 22(5), 423–431. https://doi.org/10.1080/19315260.2015.1066915

Pérez-Lucas, G., Vela, N., Escudero, J. A., Navarro, G., & Navarro, S. (2017). Valorization of organic wastes to reduce the movement of priority substances through a semiarid soil. *Water, Air, & Soil Pollution*, *228*(3), 119. https://doi.org/10.1007/s11270-017-3305-9

Pivato, A., Barausse, A., Zecchinato, F., Palmeri, L., Raga, R., Lavagnolo, M. C., & Cossu, R. (2015).

An integrated model-based approach to the risk assessment of pesticide drift from vineyards. *Atmospheric Environment*, *111*, 136–150. https://doi.org/10.1016/j.atmosenv.2015.04.005

Pucarevic, M., Stojic, N., & Kuzmanovski, I. (2017). Removal of pesticides from water using zeolites. *Kuwait Journal of Science*, *44*(1), 99–105. Retrieved from https://journalskuwait.org/kjs/index.php/KJS/article/view/1314

Rabai, K. A., Ahmed, O. H., & Kasim, S. (2012). Improving formulated nitrogen, phosphorus and potassium compound fertilizer using zeolite. *African Journal of Biotechnology*, *11*(65), 12825–12829. Retrieved from https://www.ajol.info/index.php/ajb/article/view/129123

Radziemska, M., & Mazur, Z. (2017). Chemical composition of spring rapeseed grown in copper- contaminated soil amended with halloysite and zeolite. *Journal of Ecological Engineering*, *18*(2), 38–43. https://doi.org/10.12911/22998993/67502

Rehan, M., Miandad, R., Barakat, M. A., Ismail, I. M. I., Almeelbi, T., Gardy, J., … Nizami, A. S. (2017). Effect of zeolite catalysts on pyrolysis liquid oil. *International Biodeterioration & Biodegradation*, *119*, 162–175. https://doi.org/10.1016/j.ibiod.2016.11.015

Safiul Azam, F. M., Al Labib, B., Jabin, D., Rahman Sayeed, M. S., Islam, S., Akter, S., … Rahmatullah, M. (2013). Study on synergistic effect of Zeolite and supplementary fertilizer in soil on flowering of *Solanum melongena* L. (Solanaceae) and growth of *Citrus aurantiifolia* (Christm.) Swingle (Rutaceae). *American-Eurasian Journal of Sustainable Agriculture*, *7*(2), 108–113. Retrieved from http://www.aensiweb.net/AENSIWEB/aejsa/aejsa/2013/108-113.pdf

Satpathy, G., Tyagi, Y. K., & Gupta, R. K. (2012). Removal of organophosphorus (OP) pesticide residues from vegetables using washing solutions and boiling. *Journal of Agricultural Science*, *4*(2), 69–78. https://doi.org/10.5539/jas.v4n2p69

Seran, T. H., Srikrishnah, S., & Ahamed, M. M. Z. (2010). Effect of different levels of inorganic fertilizers and compost as basal application on the growth and yield of onion (*Allium cepa* L.). *The Journal of Agricultural Sciences*, *5*(2), 64–70. https://doi.org/10.4038/jas.v5i2.2783

Shahraki, M. G., Ganjali, H. R., & Javadzadeh, S. M. (2017). Effect of manure and foliar application of humic acid on yield and yield component of *Nigella sativa*. *International Journal of Agriculture and Bioscience*, *6*(1), 25–27. Retrieved from https://www.cabdirect.org/cabdirect/abstract/20173108184

Sharma, R., Peshin, R., Shankar, U., Kaul, V., & Sharma, S. (2015). Impact evaluation indicators of an Integrated Pest Management program in vegetable crops in the subtropical region of Jammu and Kashmir, India. *Crop Protection*, *67*, 191–199. https://doi.org/10.1016/j.cropro.2014.10.014

Shedeed, S. I., El-Sayed, S. A. A., & Abo Bash, D. M. (2014). Effectiveness of bio-fertilizers with organic matter on the growth, yield and nutrient content of onion (*Allium cepa* L.) plants. *European International Journal of Science and Technology*, *3*(9), 115–122. Retrieved from https://www.eijst.org.uk/images/frontImages/gallery/Vol._3_No._9/13._115-122.pdf

Soltys, L. M., Mironyuk, I. F., Tatarchuk, T. R., & Tsinurchyn, V. I. (2020). Zeolite-based composites as slow release fertilizers (Review). *Physics and Chemistry of Solid State*, *21*(1), 89–104. https://doi.org/10.15330/pcss.21.1.89-104

Sriningsih, W., Saerodji, M. G., Trisunaryanti, W., Triyono, Armunanto, R., & Falah, I. I. (2014). Fuel production from LDPE plastic waste over natural zeolite supported Ni, Ni-Mo, Co and Co-Mo metals. *Procedia Environmental Sciences*, *20*, 215–224. https://doi.org/10.1016/j.proenv.2014.03.028

Suwardi. (2009). Teknik aplikasi zeolit di bidang pertanian sebagai bahan pembenah tanah. *Jurnal Zeolit Indonesia*, *8*(1), 33–38. Retrieved from https://journals.itb.ac.id/index.php/jzi/article/view/1723

Theofanoudis, S., Petropoulos, S., & Antoniadis, V. (2015). The effect of manure, zeolite and mineral fertilizer on the yield and mineral composition of cauliflower. In *VIth International Agricultural Symposium "Agrosym 2015"* (pp. 1058–1062). Jahorina, Bosnia and Herzegovina. Retrieved from https://www.cabdirect.org/cabdirect/abstract/20163076001

Triwidodo, H. (2020). Brown planthoppers infestations and insecticides use pattern in Java, Indonesia. *AGRIVITA Journal of Agricultural Science*, *42*(2), 320–330. https://doi.org/10.17503/agrivita.v0i0.2501

Wang, F., Bian, Y.-R., Jiang, X., Gao, H.-J., Yu, G.-F., & Deng, J.-C. (2006). Residual characteristics of organochlorine pesticides in lou soils with different fertilization modes. *Pedosphere*, *16*(2), 161–168. https://doi.org/10.1016/S1002-0160(06)60039-8

Waryanto, B., Chozin, M. A., Dadang, & Putri, E. I. K. (2014). Environmental efficiency analysis of shallot farming: A *stochastic frontier translog regression approach*. *Journal of Biology, Agriculture and Healthcare*, *4*(19), 87–100. Retrieved from https://www.iiste.org/Journals/index.php/JBAH/article/view/15214

Yoldas, F., Ceylan, S., Mordogan, N., & Esetlili, B. C. (2011). Effect of organic and inorganic fertilizers on yield and mineral content of onion (*Allium cepa* L.). *African Journal of Biotechnology*, *10*(55), 11488–11492. Retrieved from https://www.ajol.info/index.php/ajb/article/view/96168