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Research Article

Application of wood vinegar coconut shell and NPK fertilizer to maintain sustainable agriculture of upland rice production

Yugi R. Ahadiyat*, Sapto Nugroho Hadi, Okti Herliana

Laboratory of Agroecology, Faculty of Agriculture Universistas Jenderal Soedirman
Jl. Dr. Soeparno Karangwangkal Purwokerto

*corresponding author: ahadiyat_yugi@yahoo.com

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Abstract : Objective of this study was to know the effect of NPK fertilizer and wood vinegar coconut shell on upland rice yield and, pest and disease intensity. Inpago Unsoed 1 was a main object in this study. Application of different dose of NPK as main plot viz. 50% and 100% recommended dose and concentration of wood vinegar coconut shell of ratio i.e. 1: 20, 1: 40, 1: 60, 1: 80 and 1: 100 were tested. Observation variables were number of panicle per hill, number of seed per hill, percentage of filled seed, seed weight per hill, weight of 1000 seeds and weight of seed per effective plot. Application of wood vinegar coconut shell with concentration of 1:20 improved grain yield of upland rice and reduced 50% NPK application, and suppress intensity of pest and disease.

***Keywords**: Inpago Unsoed 1, NPK fertilizer, upland rice, wood vinegar coconut shell*

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Introduction

Rice is a major component of the national food security system and determines national stability. Rice farming is the backbone of the rural economy, where most Indonesians live (Suryana, 2005). Efforts to increase rice production needs to be done with intensive management, right cropping and fertilization system. The total land area for rice cultivation in Indonesia in 2015 reached 8 million ha, most of the rice cultivation carried out on the rice field that is 4.9 million ha (61.25%) and a small portion of 3.1 million ha (38.75%) on dry land. Productivity of wetland rice is about 4.75 tons ha^{-1} while rice productivity in dry land in average about 2.52 t/ha (BPS, 2016).

The problem encountered in intensive cultivation of upland rice are yield instability and declining land productivity, especially in dry land areas due to the decrease of soil organic matter content and leaching of various nutrients (Suwarno et.al. 2005). Other constraints faced in increasing rice production are mainly low productivity, land abatement and conversion (Supriana et al., 2009) and climate anomalies (Pinem, 2008). Therefore, through the optimization of the utilization of dry land resources and management technology, it is estimated that it can produce 11.34 million tons of upland rice per year (Idjudin and Marwanto, 2008). The development of more environmentally friendly upland rice management needs to be done to increase the production level in order to support the national rice production.

Plant management that needs to be a concern is fertilization as one way to increase the productivity of the plant with sufficient nutritional needs. However, in fact synthetic fertilizers are not proportional to obtained optimum rice yield. The use of synthetic fertilizers continuously causes to be ineffective. It is due to agricultural land that has been saturated by chemical residues remaining. Astiningrum (2005) states that excessive use of synthetic fertilizers can cause residues derived and carrying agents left in the soil that will degrade the quality and quantity of agricultural production. Conventional agricultural activities that are oriented only on maximizing yields by relying on synthetic chemicals in the form of fertilizers and pesticides continuously, resulting in degradation of environmental quality (fertile soil, clean air, and natural ecosystem) and decreasing national rice productivity.

The use of solid and liquid organic fertilizers from different organic materials has been studied in some crops i.e. on shallot (Wahyunindyawati et al., 2012) and carrot (Fahrurrozi et al., 2015). Other results showed that organic fertilizer has the potential to reduce the use of NPK fertilizers by 25-50% and tends to increase the growth, yield components, and yield of rice (Padmini et al., 2008; Sulistiyawati and Nugraha, 2010; Amilia, 2011). Excessive use of synthetic pesticides causes environmental pollution as well. Application of coconut shell is to be a useful liquid smoke in the agricultural world. Coconut shell wood vinegar has potential as a bio-pesticide (Wijaya et al., 2008; Tiilikkala et al., 2010; Payamara, 2011; Hashemi et al., 2014) and as bio-fertilizer (Nurhayati et al., 2006; Payamara, 2011; Hagner, 2013).

The objective of this study was to improve the efficiency of NPK fertilizer application with coconut shell wood vinegar application and their capacity to suppress pest and disease intensity to maintain sustainable agriculture.

Materials and Methods

The main object of this research was upland rice of Inpago Unsoed-1. Fertilizers of Urea, SP18 and KCL, and coconut shell wood vinegar were used as materials. Seeds were planted using a dose of 45 kg/ha. Other materials needed were paper and plastic samples, plastic rope, paper, experimental name plate, bamboo, and bird nets. Supporting tools used in this research include water gauge, soil moisture meter, lux meter, thermo hygrometer, seed separation and counter, altimeter, hoe, scissor, hand sprayer, hand counter, cutter , millimeters blocks, weigh balance and ovens. The field experiment was conducted by using Split Plot Design with three replicates. The main plot factor of fertilizer consists of 50% and 100% dosage of NPK recommendation and the coconut shell wood vinegar plot factor consisted of no application and dissolved with a ratio of 1:20, 1:40, 1: 60, 1: 80 and 1: 100.

Land area used for research location is about 350 m^2. Size per plot was 2x4 m and total plots by repeated three times were 36 plots. Distance between plots in a block was 0.5 m while the distance between blocks was 1 m. Fertilization was applied by giving urea (46% N) dose of 100 kg N/ha, with three applications in 15, 30 and 45 days after sowing (das) and SP18 (18% P_2O_5) and KCL (50% K_2O) kg P_2O_5/ha and 50 kg K_2O/ha were given at 15 days after sowing (das), according to the treatment. The number of panicles per hill was observed during the phase between the formation of panicle - filling of seed. The number of seeds of filled and unfilled per panicle, number of seeds, weight of 1000 grainss, weight and number of filled grains per hill, weight and number of filled and unfilled grains per hill, and the weight of the grains per effective plot were taken. Observation of intensity of pest and disease was according to Tarigan (2006) and Luice (2014), respectively.

Results and Discussion

Yied and yield components in NPK fertilizer application showed no significant differences with number of panicles per hill (19-20), number of grains per hill (1720-1800), percentage of filled grain (52-55%), grain weight per hill (28-30g), weight of 1000 grains (24-25g) and weight of grain per effective plot (2250-2340 g) (Figures 1 and 2). Application of coconut shell wood vinegar (CSWV) gave a significant effect on the yield and yield components.

Application of CSWV 1:20 showed the highest yield on all variables except weight of 1000 seeds i.e. the number of panicles per hill (23.30), the number of grains per hill (2247.20), the percentage of filled grain (57.97%), the weight of grain per hill (40.22g) and weight of grain per effective plot (3092.50g) (Figures 3 and 4). Application of CSWV with concentrations of 1: 100 showed the lowest yield on the number of panicles per clump (17.40), the number of grains per hill (1467.13), and the weight of grain per hill (23.68 g) (Figure 3). Likewise, no ACTK application showed low results on the number of panicles per hill (17.50), the number of grains per hill (1502.37), the percentage of filled grain (49.94%), the weight of grain per hill (23.81 g) and grain weight per effective plot (1904.84 g). Weight of 1000 grains showed that did not differ significantly with the range of 23-25g by application of CSWV compared to no application of CSWV (Figures 3 and 4).

High yields of upland rice were supported by a low intensity of pest attack and pathogen of less than 6 in general. In fact, application of CSWV 1:20 could suppress the lowest level of pest and pathogen intensity compared to other CSWV concentrations against grasshoppers and leaf role and brown leaf spots (Figure 5). CSWV is potential as bio-pesticide (Wijaya et al. 2008; Tiilikkala et al., 2010; Payamara, 2011; Hashemi et al., 2014) and as bio-fertilizer (Nurhayati et al., 2006; Payamara, 2011 ; Hagner, 2013).

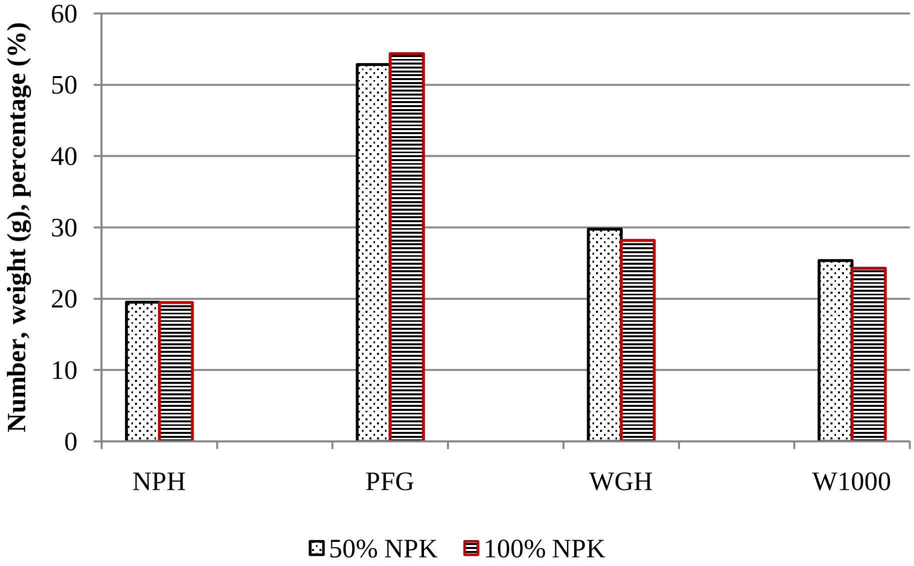

Figure 1. Influence of application of fertilizer with different dose to the number of panicles per hill (NPH), percentage of filled grain (PFG), weight of grain per hill (WSH) and weight of 1000 grain (B1000).

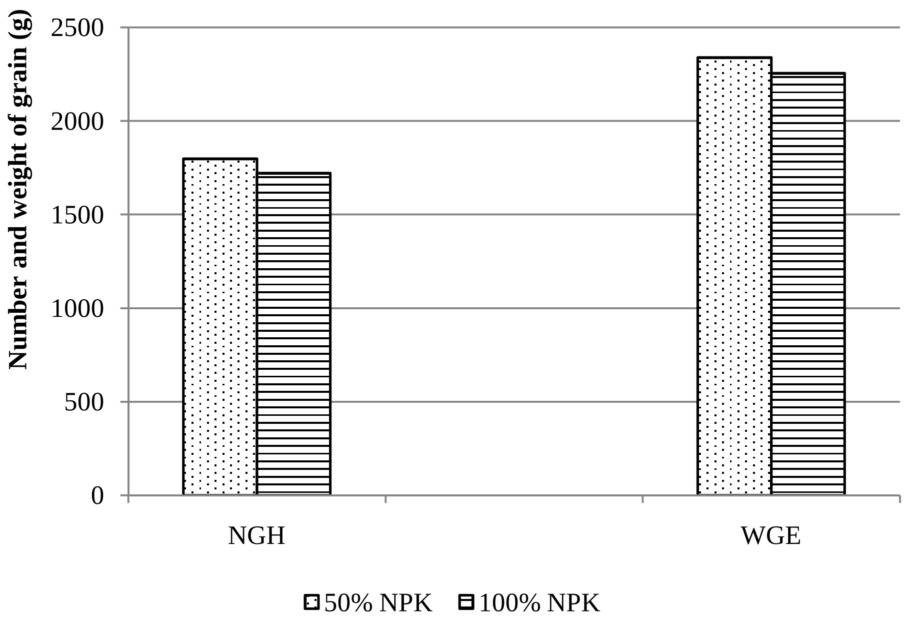

Figure 2. The effect of fertilizer application with different doses on the number of grains per hill (NGH), and the weight of grain per effective plot (WGE).

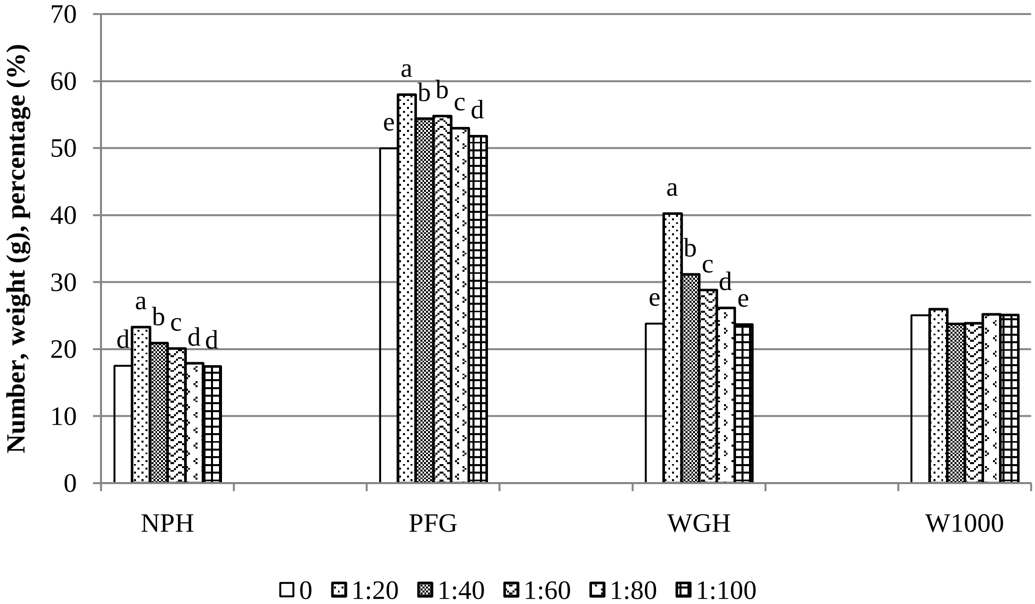

Figure 3. Effect of coconut shell liquid smoke application with different concentration to the number of panicles per hill (NPH), percentage of filled grain (PFG), weight of grain per hill (WGH) and weight of 1000 grain (W1000).

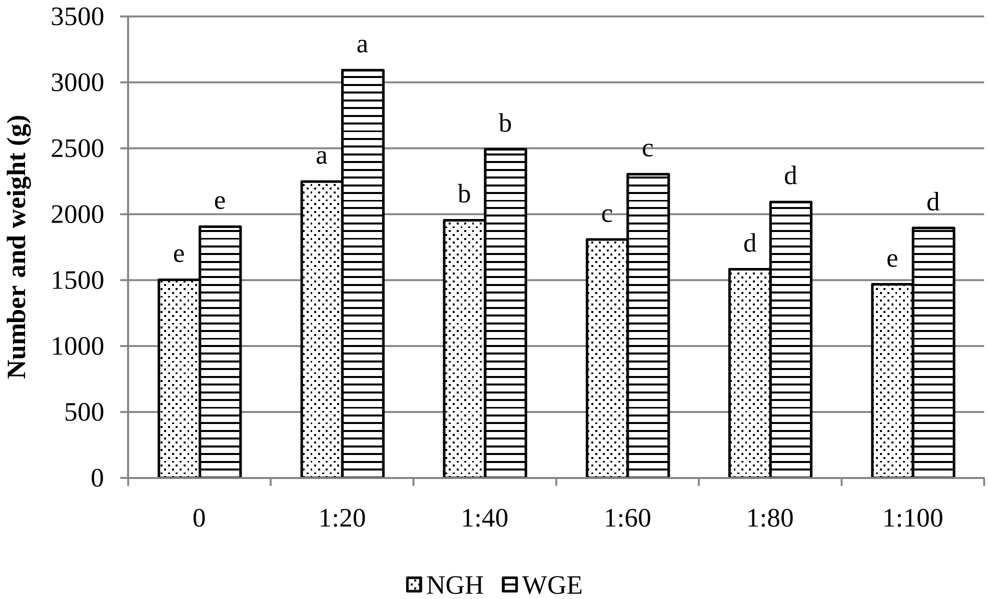

Figure 4. Effect of coconut shell wood vinegar application with different concentrations on grain per hill (NGH), and weight of grain per effective plot (WGE).

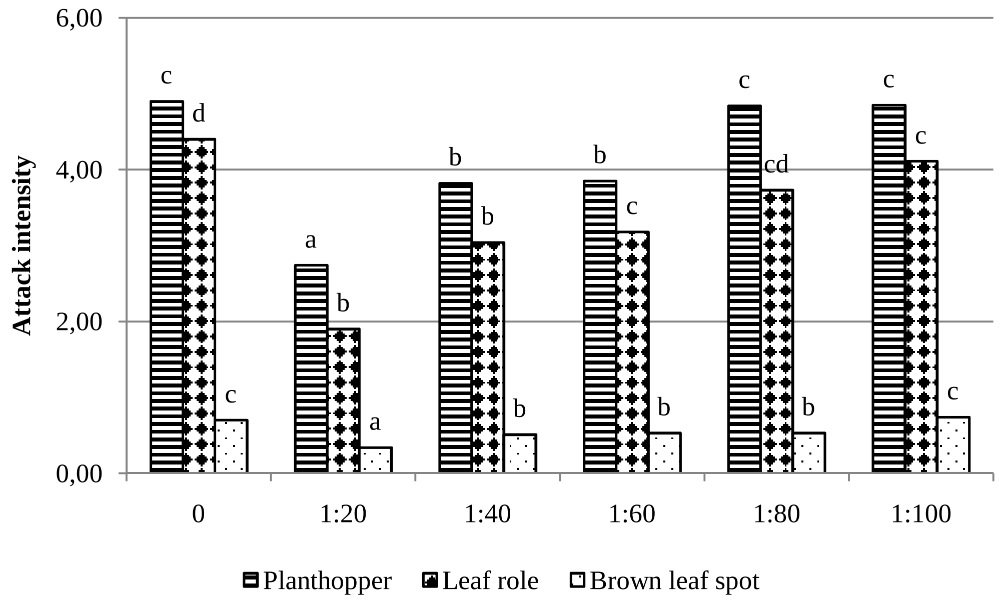

Figure 5. Effect of coconut shell wood vinegar application with different concentrations on pest (plant hopper and leaf role) and disease (brown leaf spot) attacks.

Conclusion

The application of coconut shell wood vinegar with concentration of 1:20 could increase the yield of upland rice on number of panicle and grain yield, and weight of grains per hill, percentage of filled grains and weight of grain per effective plot and also increased efficiency about 50% of NPK fertilizer. Thus, this concentration suppressed the intensity of pest and disease attack.

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References

Amilia, Y. 2011. Use of Liquid Organic Fertilizer to Reduce Dose of Inorganic Fertilizer Use in Wetland Rice (*Oryza sativa. Skripsi.* IPB. Bogor. 47 p. (*in Indonesian*)

Astiningrum, M. 2005. Waste Management, *Majalah Ilmiah Dinamika* Universitas Tidar Magelang 15 Agustus 2005. Magelang 8 p. (*in Indonesian*)

BPS. 2016. Rice Production and Productivity. Jakarta (*in Indonesian*)

Fahrurrozi, Muktamar, Z., Setyowati, N., Sudjatmiko, S. and Chozin, M. 2015. Evaluation of Tithonia-enriched Liquid Organic Fertilizer for Organic Carrot Production. Journal of Agricultural Technology 11(8):1705-1712.

Hagner, M. 2013. Potential of the slow pyrolysis products birch tar oil, wood vinegar and biochar in sustainable plant protection-pesticidal effects, soil improvement and environmental risks. *Dissertation*. University of Helsinki 42p.Finland.

Hashemi, S.M., Safavi, S.A. and Estaji, A.. 2014. Insecticidal Activity Of Wood Vinegar Mixed With *Salvia leriifolia* (Benth.) extract against *Lasioderma serricorne* (F.). *Biharean Biologist* 8 (1): 5-11.

Idjudin, A.A, and Marwanto S. 2008. Reformation of dry land management to support food self-sufficiency. *Jurnal Sumberdaya Lahan* 2:113 – 123. (*in Indonesian*)

Luice, A. T. 2014. The effect of fertilization on the level of pest attack on peanuts in North Sulawesi. Proceedings of Seminar on Research Results of Bean and Tuber Crops 2014. Agricultural Technology Assessment Institute of North Sulawesi, Manado. (*in Indonesian*)

Nurhayati, T., Pasaribu, R. A. and Mulyadi, D.. 2006. Production dan Utilization of Charcoal and Wood Vinegar of Mixture Wood Sawdust. Institute of Forest Research and Development Bogor 24(5):1-23. (*in Indonesian*)

Padmini, O.S., Tohari, Prajitno, D and Syukur, A. 2008. Combination of organic fertilizer-NPK in rice-based rotation for increasing chemical properties of soil and rice yields *Ilmu Pertanian* 15(1):59 – 68. (*in Indonesian*)

Payamara, J. 2011. Usage of Wood Vinegar as New Organic Substance. *International Journal of ChemTech Research* 3(3):1658-1662.

Pinem, R. 2008. Policy of Rice Seeding Supporting P2BN, Proceeding of Seminar on Appreciation of Rice Research Results Supporting P2BN.

Department Research and Development, Ministry of Agriculture. Jakarta. pp. 1-8. (*in Indonesian*)

Sulistyawati, E. and Nugraha, R. 2010. Effectiveness of Urban Waste Compost as Organic Fertilizer in Increasing Productivity and Reducing Production Cost of Rice Cultivation. Institut Teknologi Bandung. 11 p. (*in Indonesian*)

Suryana A., 2005. Research Policy and Readiness of Rice Technology Innovation in Supporting Food Self-Reliance, Towards Sustainable Rice Self-Sufficiency. Institute of Agriculture Research and Development, Bogor. (*in Indonesian*)

Suwarno, H.M., Toha and Ismail, B.P. 2005. Availability technology and opportunity to develop upland rice. Inovation of technology to sustainibility food self-sufficiency (1st book). Center of food crop research and development. Institute of Agriculture Research and Development. pp.129-143. (*in Indonesian*)

Tarigan, N. 2006. The types of insects and the intensity of their attacks on various cropping patterns of vetiver. *Buletin Teknik Pertanian* 1 (1): 1-4. (*in Indonesian)*.

Tiilikkala, K. L. Fagernäs and J. Tiilikkala. 2010. History and Use of Wood Pyrolysis Liquids as Biocide and Plant Protection Product. *The Open Agriculture Journal,* (4):111-118.

Wahyuningdyawati, Kasijadi, F. and Abu. 2012. Effect of organic fertilizer "biogreen granule" on growth and yield of red onion. *Journal Basic Science and Technology* 1(1):21 – 25. (*in Indonesian*)

Wijaya, M., Noor, E., Irawadi, T.T. and Pari, G. 2008. Characteristics of chemical components of liquid smoke and their utilization as biopesticides. *Bionature* 9(1):34-40. (*in Indonesian*)