The effectiveness of acetic acid solution againsts brown planthopper pest (*Nilaparvata lugens* Stal.) of ciherang rice (*oryza sativa* L).

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Abstract. One of the main pests that attack rice crops, is brown planthopper (*Nilaparvata lugens* STAL.). This study aimed to determine the potential of acetic acid solution as an insecticide to control brown planthopper and their effects on rice plant Ciherang variety. The research was conducted in the plastic house at Beberan village, Ciruas, Serang District and the Biotechnology Laboratory of Agriculture Faculty; University of Sultan Ageng Tirtayasa and Greenhouse of Indonesian Rice Research Institute Subang; West Java in April to June 2016. The research arranged out experimentally and used a completely randomized design (CRD), which consisted of 7 treatments and 4 replications. The data obtained were statistically analyzed by analysis of variance and Duncan's New Multiple Range Test at 5% level. The results showed that acetic acid can control the brown plant hopper, the highest mortality namely at concentration 30%. Rice plants showed symptoms of poisoning in acetic acid concentration of 25% and 30% and Acetic Acid no effect on high rendering rice crop.

Keywords: Acetic Acid, Concentration, brown plant hopper, and Ciherang Rice variety.

1. Introduction
According to Banten Central Statistics Agency data [3], rice production is predicted to increase 6.21%. The area of rice harvest in 2015 rose 2.21% to 369,631 ha with productivity rising 5.35%
to 57.20 quintals/ha. But the area of paddy fields fell by 28.64% to 17.67 ha as well as productivity decreased by 0.67% to 37.06 quintals/ha.

Efforts to increase rice production are faced with obstacles and problems, including pest attacks. Losses caused by pests account for 13% of total production. One of them is the brown plant hopper pest which in the mid-1970s had caused a national disaster in rice cultivation [1]. In 1960-1970 there was an explosion of brown plant hopper pests in West Java and Central Java, the area of rice plantations attacked by brown plant hopper reached 1.5 million ha with yield losses of more than 2.3 million tons. In the period of 2000-2005, the area of rice crop damaged by this pest reached an average of 20,000 ha/year [5].

According to [4], the brown plant hopper pest is not a familiar name for farmers. Pests that have the Latin name Nilavarpata lugens are the most difficult to overcome among other pests. Besides its very small size, this type of pest is also very fast population, even a female plant hopper when laying eggs can produce 100-500 eggs and also at a temperature of 25°C. Wereng is also able to live up to the age of 30 days.

Wereng has a type of mouth piercing tool sucking plant fluids. The part that pierces into plant tissue is a pair of mandible stylets and one pair of maxillary stylets. Brown planthopper attacks in the field fluctuate, ranging from mild to reaching the peak of its development during an explosion that causes puso/burning (hopperburn). Stem worms directly attack rice plants by sucking plant cell fluids on the phloem tissue so that the plants become dry. While the non-direct attack is planthopper can transfer three viruses that are harmful to rice plants, namely the vacuum dwarf virus, type 1 dwarf virus, and type 2 grass dwarf virus [2].

Facing these obstacles, most Indonesian farmers use chemical insecticides. Unwise use of chemical insecticides has a negative impact on the environment and humans. In Asia in recent years, N. Lugens has developed and become resistant to chemical insecticides [10]. This technology is quite popular because its effects can be seen in a relatively short time after application and chemical insecticides are easy to obtain when needed. However, this technology is relatively expensive for farmers, and dangerous for humans, animals, non-targeted species, and the environment if the application is not in accordance with procedures. Other technologies that can be used as components of pest control are alternative insecticides, one of which is vinegar [7].

Based on empirical data, the results of tests conducted by Karawang farmers of the Subur Farmers Group (2015), the use of acetic acid can eradicate the attack of planthopper pests on rice plants. Then in a preliminary test where a solution of acetic acid in a volume of 150ml/L can eradicate planthopper pests 75%. From the test of 25 rice plants infused with 100 planthopper, acetic acid can eradicate 78 nymphs of planthopper (LD50).

In fact, the use of chemical insecticides has not been able to overcome the problem of brown planthopper pests themselves. Farmers need to find alternative insecticides that can increase the mortality of planthopper pests. Based on this, research is needed on the effectiveness of the use of Acetic Acid solutions on planthopper pests (Nilaparvata lugens stal) in rice plants (Oryza sativa L) Ciherang variety.

2. Materials and methods
This research was carried out from April to June 2016 at the Beberan Village Plastic House, Serang Regency, Banten Province, also at Biotechnology Laboratory, Faculty of Agriculture, University of Sultan Ageng Tirtayasa, and Greenhouse Sukamandi Rice Research Center.
In this study, the tools used were buckets, aspirators, labels, mylar plastic cages with a diameter of 15 cm, height 50 cm with gauze covers, scissors, hoes, bamboo, plastic, 50% paranet, test tubes, nameplate, mini sprayer, tools write and documentation (camera).

The materials used are Ciherang Varieties rice seeds, soil, vinegar which contain acetic acid at a concentration of 25%, 2-3 instar brown plant hopper which is propagated in the greenhouse of Sukamandi Subang Rice Research Center. The experimental design used was a Completely Randomized Design (CRD) applied to a homogeneous environment, the same plant species and the same plant varieties. The treatment consisted of one factor with 7 levels each repeated 4 times so that there were 28 experimental units. Each experimental unit consisted of 5 individual rice plants so that there were 149 total number of individual rice plants, the need for leafhoppers for insecticide testing was 20 individuals (IRRI, 2002). So that the number of planthopper needed is 560 2-3 planthopper nymphs.

This study used acetic acid solution as an alternative insecticide to the mortality of brown plant hopper pests in rice plants. Wereng is propagated in the Subang Paddy Plant Center. While the rice varieties used were Ciherang varieties.

The treatment of acetic acid in this study consisted of 7 factors, namely:
- α 1: 0% (0 ml Acetic Acid / L)
- α 2: 5% (50 ml Acetic Acid / L)
- α 3: 10% (100 ml Acetic Acid / L)
- α 4: 15% (150 ml Acetic Acid / L)
- α 5: 20% (200 ml Acetic Acid / L)
- α 6: 25% (250 ml Acetic Acid / L)
- α 7: 30% (300 ml Acetic Acid / L)

To find out the difference between treatments, α 5% variance (F Test) was carried out and if there were no differences α further 5% DMRT test was performed.

3. Results and discussion
3.1. Percentage of Slope Mortality (N.lugens) (%)
Treatment of acetic acid (A) with various concentrations there was a significant difference in the percentage of mortality of N. Lugens to the control treatment. This can be seen in observations 2 hours to 10 hours after application. (Table 1).

| Concentrations of Acetate Acid % | Average mortality of N. Lugens after time of application [hour (h)] |
|---------------------------------|---------------------------------------------------------------|
|                                 | 2 h  | 4 h  | 6 h  | 8 h  | 10 h |
| 0                               | 1.75 e | 1.10 c | 1.25 d | 1.31 a | 1.31 a |
| 5                               | 6.17 c | 1.35 b | 1.10 d | 1.10 a | 1.10 a |
| 10                              | 6.83 c | 1.39 b | 1.25 d | 1.10 a | 1.10 a |
| 15                              | 7.44 b | 1.45 b | 1.45 c | 1.25 a | 1.25 a |
| 20                              | 8.32 a | 1.10 c | 1.50 bc | 1.10 a | 1.10 a |
| 25                              | 8.75 a | 1.10 c | 2.02 a | 1.10 a | 1.10 a |
| 30                              | 8.30 a | 2.05 a | 1.66 b | 1.45 a | 1.45 a |
The results of variance in Table 1 show that acetic acid has an effect on the mortality of brown plant hopper pests at 2 hours, 4 hours and 6 hours after application. Based on the 5% DMRT test results at observation 2 hours after application showed that 25% concentration produced the highest percentage of mortality (8.75%), not significantly different from the concentration of 30% (8.30%) and concentration of 20% (8.32%). Concentration of 20% (8.32%) was significantly different from a concentration of 15% (7.44%), a concentration of 10% (6.83%), a concentration of 5% (6.17%) and a concentration of 0% (1.75%). Concentration of 15% (7.44%) was significantly different from the concentration of 10% (6.83%), concentration of 5% (6.17%), concentration of 0% (1.75%). The 10% concentration was not significantly different from the concentration of 5% (6.17%), and it was significantly different from the concentration of 0% (1.75%). While the concentration of 0% (1.75%) which shows the lowest percentage of mortality.

Based on the 5% DMRT test results observed 4 hours after application showed that the concentration of 30% produced the highest percentage of mortality (2.05%), significantly different from the concentration of 25% (1.10%), concentration of 20% (1.10%), concentration of 15% (1.45%), a concentration of 10% (1.39%), a concentration of 5% (1.35%) and a concentration of 0% (1.10%). Concentration of 15% (1.45%) was not significantly different from the concentration of 10% (1.39%) and concentration of 5% (1.35%). While the lowest percentage of mortality at a concentration of 0% (1.10%) was not significantly different from the concentration of 25% (1.10%) and a concentration of 20% (1.10%).

Based on the results of the 5% DMRT test on observations 6 hours after application showed that the concentration of 25% produced the highest percentage of mortality (2.02%). Significantly different from the concentration of 30% (1.66%), concentration of 20% (1.50%), concentration of 15% (1.45%), concentration of 10% (1.25%), concentration of 5% (1.10%) and concentration of 0% (1.25%). Concentration of 30% (1.66%) was significantly different from concentration of 20% (1.50%), concentration of 15% (1.45%), concentration of 10% (1.25%), concentration of 5% (1.10%) and concentration of 0% (1.25%). Concentration of 20% (1.50%) was not significantly different between concentration of 30% (1.66%) and concentration of 15% (1.45%), significantly different from concentration of 10% (1.25%), concentration of 5% (1.10%) and concentration of 0% (1.25%). While the lowest percentage of mortality at a concentration of 5% (1.10%) was not significantly different from a concentration of 10% (1.25%) and a concentration of 0% (1.25%).

So it was concluded that the higher the concentration of acetic acid, the higher the percentage of mortality. This can be understood because pure or concentrated solution of acetic acid is very corrosive and can cause painful burns [9], so the nature of this acetic acid solution can damage skin tissue resulting in mortality of brown plant hopper.

Based on the results of observations for 2 hours, 4 hours, 6 hours, 8 hours, and 10 hours the average percentage of mortality in Table 1 shows that the most effective time for the mortality of brown plant hopper pests is that of observation 2 hours after application. (presented in Figure 3) and tends to decrease in the observations 6 hours, 8 hours, and 10 hours after application, this decrease is caused by the number of mortality of brown plant hopper which has decreased in the previous hours.

Based on observations (Table 2.) acetic acid gives a different effect on the phytotoxicity of rice plants. Phytotoxicity score 0 indicates no damage and rice plants showed normal growth during
vegetative periods, while score 2 showed that rice plants were poisoned with an abnormal shape or leaf color.

Table 2. Effects of acetic acid application on scoring of phytotoxicity of rice plants

| Concentrations of Acetate Acid % | Number of leaf | Damaged leaf | Phytotoxicity score |
|---------------------------------|---------------|-------------|--------------------|
| 0                               | 20            | 0           | 0                  |
| 5                               | 22            | 0           | 0                  |
| 10                              | 21            | 0           | 0                  |
| 15                              | 22            | 1           | 0                  |
| 20                              | 23            | 1           | 0                  |
| 25                              | 22            | 3           | 2                  |
| 30                              | 21            | 3           | 2                  |

Based on Lasmini and Wahid in [8] At the concentration of acetic acid 0%, 5%, 10%, 15% and 20% the phytotoxicity score of rice plants is 0, with a toxicity level of 0% (at a concentration of 0%, 5%, 10%), 4.55% (at a concentration of 15%), 4.35% (at a concentration of 20%). Whereas at the concentration of acetic acid 25% and 30% the phytotoxicity score of rice plants was 2 with 13.64% and 14.29% poisoning levels. It is caused at a concentration of 0% to 20% acetic acid solution is not too concentrated so it does not affect plant phytotoxicity rice, but at concentrations of 25% to 30% concentrated acetic acid solution that affects phytotoxicity in rice plants.

3.2. Rice plant height

One parameter observed is plant height which is the most easily observed growth indicator when given treatment. Stem height is a plant size that is often observed both as an indicator of growth and as a parameter used to measure environmental influences or the treatments applied [6].

Table 3. Average Growth in Rice Plant Height (cm) for 4 Observations

| Concentrations of Acetate Acid % | Observation [Week After Planting (WAP)] |
|---------------------------------|-----------------------------------------|
|                                 | 1            | 2            | 3            | 4            |
| 0                               | 27.9         | 31.0         | 34.9         | 39.3         |
| 5                               | 28.0         | 32.4         | 36.1         | 41.0         |
| 10                              | 25.5         | 30.5         | 33.8         | 38.9         |
| 15                              | 28.0         | 31.6         | 36.4         | 39.9         |
| 20                              | 29.9         | 31.1         | 34.1         | 38.8         |
| 25                              | 25.4         | 31.4         | 34.1         | 37.6         |
| 30                              | 26.3         | 34.6         | 37.3         | 41.5         |
| KK (%)                          | 10.30        | 6.29         | 7.80         | 8.01         |

Note: All numbers are no different

Based on variance shows that acetic acid has no significant effect on the growth of rice plant height. Descriptive observation results at 1 week after application of normal rice plant height at a concentration of 0% but at a concentration of 25% rice plants experienced a low plant height compared with other concentrations. At 2 WAP plant height was equally good at both 0% and other concentrations as well as 3 weeks after application and 4 weeks after application. This is due
to the influence of the open environment so that acetic acid compounds can be mixed with the outside air so that the growth of rice plants that applied acetic acid has no effect on plant height even though plant height is different from control plant height where the application is not given acetic acid solution. This can be understood because according to Banteng (2010) in [6], that when acetic acid is applied into the soil, acetic acid will evaporate into the air and naturally damaged in the atmosphere by sunlight, so it does not affect the soil nutrients needed for rice growth.

4. Conclusions
In the present study it can be concluded as follows:
1. Acetic acid influences the control of brown plant hopper (*Nilaparvata lugens* STAL).
2. The most effective concentration of acetic acid solution to the morality of brown plant hopper is at a concentration of 30% and acetic acid has no effect on phytotoxicity in rice plants to a concentration of 20%. At a concentration of 25% to 30% can affect the phytotoxicity of rice plants but does not affect the height growth of rice plants.

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