Influence of Liquid Smoke Cinnamon Against Attacks Leaf Rot Disease (*Phytophthora Infestans*) on Potato (*Solanum Tuberosum*L.)

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Abstract. Shaped research experiments on the effect of using liquid smoke cinnamon against late blight (*Phytophthora infestans*) on potato (*Solanum tuberosum* L.) has been conducted in the village of Gunung Tujuh Pelompek District of Kerinci regency in Jambi Province. The purpose of this study was to determine the effect of the use of liquid smoke against late blight (*Phytophthora infestans*) on potato and other effects related to growth factors and production of potato (*Solanum tuberosum* L). The experiments were conducted in the field using a randomized block design with 8 treatments and 3 replications thus obtained 24 experimental unit. Each experimental unit consisted of 35 plants that amount altogether 840 plants. As the plant sample under observation for variable growth is as much as 5 samples and disease variables is the entire plant for each plot. The treatments were the use of multiple doses of liquid smoke for spraying are: A = non-treated liquid smoke (WAPer only), B = fungicide interval of 7 days, C = treated liquid smoke 25 cc/liter of WAPer alternating with fungicides, D = treated liquid smoke 50 cc/liter of WAPer alternating with fungicides, E = treatment liquid smoke 75 cc/liter of WAPer hose alternating with fungicides, F = treatment liquid smoke 100 cc/liter of WAPer alternating with fungicides, G = liquid smoke treatment of 125 cc/liter of WAPer alternating with fungicides, and H = treatment liquid smoke 150 cc/liter of WAPer. The data were analyzed statistically by F test if the F-test has a significantly different effect and then continued with Duncan's New Multiple Range Test (DNMRT) at the 5% significance level. The experimental results show that the use of different doses of liquid smoke shows the influence of different highly significant observation parameter namely: plant height, length, and width of leaves, leaf number, and weight of tubers per plant, number of tubers per plant, tuber weight per plot, intensity rot disease and the percentage of leaf blight attack. Plants treated with the liquid smoke with a rate of 125 cc punctuated alternately with fungicides showed intensity and percentage of the lowest disease. It is advisable to do further studies with different doses and with no fungicide treatment on the season and a different location.

1. Introduction

According to Steadi [1], the growth and development of potatoes within the last decade is quite astonishing. In 1991, world potato production could reach 267 million tons in 2007 increased to 320 million tons. Furthermore, developing countries also produce one of these food ingredients. Since 2005, potato production in the third world production surpassed developed countries. This is partly because (i) the success of the third world in the cultivation of potatoes; (ii) the tendency of the third world...
population increasingly diversifying in its consumption, and (iii) a decrease in potato production in
developed countries as a result of plant pests (OPT) [1].

Potatoes in the world are a major food crop after rice, wheat, and corn. In Indonesia, the potato is
still consumed. As vegetables and snacks, not as a substitute for staple food rice [2]. Susilo [3], states
that, nutrients contained in 100 grams of material (potato) is 347 Cal calories, 0.3 grams protein, 0.1
grams fat, 85.6 grams carbohydrates, calcium (Ca) 20 grams, phosphorus (P) 30 mg, iron (Fe) 0.5 mg
and 0.04 mg of vitamin B.

Further illustrated by Firmansyah [4] that the Agricultural Development of the Government of
Indonesia put emphasis on horticulture. The increase in production is directed to improve the living
standards and welfare of farmers, expand employment opportunities, and guarantee the availability of
the product at a decent price level for growers and consumers. Based on the source of food energy,
commodity horticulture important role because this commodity is a source of vitamins and minerals and
carbohydrates that need attention in its development.

Horticultural crops are generally a prospective commodity to be developed; it can be seen by the
increasing demand horticulture along with increasing public awareness about nutrition and awareness
to consume these products. Horticultural commodity needs increasingly large due to the increased
awareness of health and income generation as well as welfare society. Therefore, the expansion of
planting area of horticultural commodities through the growth of new production centers still needs to
be done [5].

One of the horticultural crops cultivated and has economic significance for farmers are crop
potatoes. Although potatoes are just one vegetable but are a commodity that is much loved by the
community. Therefore, the potato plays an important role in the results of more. Role important
agricultural crops in the trade and meet the demand for vegetables for the family as well as industrial
materials. In the harvest season in unison price is relatively low and the time out of the harvest season
the price is quite high [5].

Prospects for potatoes are also supported by the increasing number of industries requiring raw
materials potatoes, as well as the need for vegetables in the household. It is not only the domestic demand
but also export more and thus the presence of potato increase. With would still be much needed by
society [5].

In Kerinci district, Jambi province, potato production center is at Kayo Aro and the District of
Gunung Tujuh, which is one of the agricultural areas that have developed. People who live in this area,
the majority of his life in terms of agriculture and the main commodity is cultivated are potatoes [5].

The vast potential of the potato crop in the district of Gunung Tujuh Kerinci in Jambi Province is
an area of 9460 ha. This potential is contributing to boost the potential of Kerinci and Jambi as potato
production centers in Indonesia [6].

In the last two years, at least four times a growing season crop productivity decreases, one of the
causes of the decline in production is the attack of late blight caused by the fungus Phytophthora
infestans. Late blight has recently attacked the potato crop in the region, namely from the beginning of
potatoes developed. During this time the potato controls grower conventional chemical pesticides [6].

Eradication conventionally, initially eradication profitable way, because it can reduce losses due
to pests and diseases. But it did not last long; farmers increasingly feel that to obtain the same yield with
previously forced to increase the frequency and dosage spraying. Over time will lead to a reduction in
farmers’ profits [7].

A decrease in productivity envisaged in Kerinci District Agriculture Office database that is in the
year 2012 with a harvested area amounted to 3.642 with a total production of 68 600 tones so that when
calculated production per hectare is 18.83 tones, this figure decreased compared to 2006 with a harvested
area of 2.277 hectares with a production of 51 369 tones with an average productivity of 22.56 tons/ha.
In 2013 decline in production impact on the rise in commodity prices of potatoes which reached Rap
6.500/kg from the farmer, because of lack of supply. The decline in production was also affected by the
saturation of potato growers due to trauma will be business failures caused by pests and depletion of
working capital for the previous growing season. According to Plops [8] a decrease in the hardest hit in
the five-year last namely in 2013. with acreage of 450 ha with 248 ha and the harvest is the average
production of only 12 tons/ha. When compared with 2006. a decrease in productivity almost 100%
which time the productivity above 22 tons/ha. Eradication of pests and diseases using pesticides continuously in particular types of fungicides (fungicides) and insecticides (pest) has an impact not only in terms of technical and economical but also have an impact on environmental degradation, the occurrence of residues on crops they produce, as well as there is contamination on human blood and cause damage to the ecosystem. For that, we need a natural alternative to control efforts, particularly in the control of late blight on potato [9]. Efforts to reduce pesticide use one way to use liquid smoke cinnamon on the basis of (a) Liquid smoke is a natural product that is environmentally friendly. As an anti-fungal, anti-bacterial, anti-oxidant, anti pests and plant diseases. Liquid smoke as a natural preservative can also be used as a preservative in food [10]. (b) There are two main compounds liquid smokes which have the effect of bactericidal/bacteriostatic are phenols and organic acids in the form of combinations of these compounds effectively work together to affect microbes [11]. (c) The compounds in the liquid smoke such as phenol, formaldehyde, and bacteriostatic organic acids that influence the development of bacteria [12]. (d) There are seven components in the pyrolysis liquid smoke results i.e. 2.6 dimethyl phenol, phenol (ital.), 2-methyl phenol (o-cresol), 4-methyl phenol (p-cresol), 2-methoxyl phenol (guaiacum), 2-methoxy-4 methyl phenol and 4-ethyl-2-methoxy phenol [13]. Preliminary experiments in the planting season at a separate place with the use of liquid smoke cinnamon at a dose of 50 ml/l of WAPer compared to the control (no liquid smoke cinnamon) showed a reaction to the attacks rotten leaves and affect the growth, development, and yield of potatoes. Based on the descriptions above, has done research in the form of an experiment with the title: Influence of liquid smoke cinnamon Against Attacks Leaf Rot Disease (Phytophthora infestans) On Potato (Solanum tuberasum L.) Based on the problems above, this study aims to 1) Knowing cinnamon liquid smoke effect against late blight in potato crops, as well as other impacts related to growth, development, and yield. 2) The effective dose. Knowing use liquid smoke cinnamon may affect, inhibiting late blight attack.

2. Materials and Methods

2.1 Materials

Research in the form of field trials has been conducted in the village of Gunung Tujuh Pelompek District of Kerinci regency in Jambi Province altitude of 1.250 meters above sea level with the soil type and sol.

The materials used in the study; granola varieties of potato seeds, compost, fertilizer (Urea, ZA, SP36, NPK Mutiara), pesticides (insecticides, fungicides, herbicides) and liquid smoke cinnamon as a treatment.

While the tools are used machetes, hoes, plastic drums, plastic rope, sacks, buckets, plastic sheeting, measuring cups, mixer, hand sprayer, gauge/meter, scales, and other stationeries.

2.2 Method of Implementation

2.2.1 Experimental design

The design is a randomized block design (RAK) with 8 treatments and 3 replications so that there are 24 experimental units. Plot an experimental unit is the size of 240 x 380 cm and a spacing of 80 x 30 cm, on each plot an there were 35 plants, so to experiment required 840 plants. The whole plant becomes the object of observation for the disease and 5 samples for observation of plant growth and production. Placement of plants in the experimental plot and plan experiments Appendix 2. The data obtained were analyzed statistically with test F. If F-count is greater than F-table at the 5% significance level, then continued by Duncan's New Multiple Range Test (DNMRT) at the 5% significance level. The treatment given to the trial in various doses of liquid smoke:

A = untreated liquid smoke
B = fungicide interval of 7 days
C = treated liquid smoke 25 cc/liter of WAPer and alternating with a fungicide
D = treated liquid smoke 50 cc/liter of WAPer and alternating with a fungicide
E = treatment liquid smoke 75 cc/liter of WAPer and alternating with a fungicide
F = treatment liquid smoke 100cc/liter of WAPer and alternating with a fungicide
2.2.2  

**Stages Activity:**

**a) Land clearing and tillage.**
Before tilling, first cleaned of weeds and plant debris, wood, and rocks that can interfere with the growth plant. Tillagedoes with tilling the soil as deep as 25-30 cm by using a hand tractor plow. Tillage aims crush and grinds the soil, then after cleaning the grass, leveled and made plot an/plot according to the research plan.

**b) Preparation of treatment plots and channel drainage**
Plots treated shaped raised bed made with a North-South direction so that the spread of sunlight can be evenly distributed throughout the plant. Beds with a width of 240 cm, length 380 cm, height 30 cm with the distance between treatment plots are 100 cm. Subsequently made drainage channel on land on the outskirts of the lowest place with a width of 50 cm with the lower than on land. Among the plot treatments, on the outskirts of beds planted with hedges namely corn crop by planting jota 30 cm in order to prevent the spread of late blight of potato plants. Planting hedges carried out in conjunction with the planting of seed potatoes and the corn crop in the crop at the age of 2 months so as not to overshadow the potato crop.

Liquid smoke is not only used for spraying also applied through the soil (plant material treatment) that is by spraying to the ground at the time before the laying of seed tubers. Spraying is done with the same dose, which is 150 cc/liter of WAPer.

c) **Creation of a kerf**
The planting hole and composting. Kerf, the planting hole made the cut in every bed, each 80 cm distance so that the kerf/planting hole leads East-West with a depth of 5-10 cm. Kerf made by using a rope and a hoe, so much so that each plot contained 35 plants treatment. Kerf then sowed compost at a dose of 10 kg each plot/experimental unit.

d) **Planting and basic fertilization**
Planting is done by placing the seed tubers in the kerf as a planting hole that has been set as a spacing, with one seed tubers each point/planting hole with the position of the shoot in the direction of the direction of the kerf, then performed the basic fertilization consisting of chemical fertilizers: Urea 12 g, ZA 8 g, KCl 5 g, SP-36 to 15 g per plant with way in placer among potato seed tubers and then covered with soil about 10 cm thick.

e) **Maintenance of plants**
Maintenance of the plant consists of weeding, fertilizing aftershocks, heap, and control of plant pests and diseases.

1) **Weeding**
The first weeding is done chemically, at the age of 11 days after planting or when plants grow towards. Weeding is done by spraying using a contact herbicide with a dose of 2 cc/liter of WAPer, herbicide active ingredient parquet which aims to eradicate weeds in the early phase growth weed. On currently staple crops have not grown and that appears is a small weed. The weeding both done mechanically, namely when heap at the age of one month (4 WAP) in conjunction with the provision of supplementary fertilizer and heap.

2) **Fertilization subsequent**
Fertilization subsequent aftershocks were given at the time when the plant was 4 WAP, with the aim that the fertilizer can be buried so avoid evaporation and washing. Continuation fertilizers are chemical fertilizers NPK Multipara (16:16:16) 5 g/crop, sown on a circumference around the root zone of plants.
3) Heap
Heap was done twice: when the plant 4 WAP, and 8 weeks after planting. Heap was used hoes to hoard the entire row of plants by taking soil between crop kerf formed such that the rows of ridges/heap in the root zone (rhizosfir) potato plants.

4) Control pests, disease control, and application of liquid smoke Pest Control
Pest control is done intensively with a view to the threshold control of sucking insects and caterpillars and Liriomyza, using insecticides Winder with a dose of 2 cc/liter of WAPer, Metindo a dose of 3 g/liter of WAPer for caterpillar pests and Padang with a dose of 2 g/liter of WAPer to the flyleaf, and consider pests that attack while taking into account the control threshold. Disease control to achieve the objectives, then spraying fungicide performed 7-10 days after their initial attack symptoms are marked/found active spots on the plants (stalks, leaves, and branches). To complete control of this disease is carried out by using liquid smoke applications, between applications using pesticides ie alternating between spraying with pesticide.

Application of liquid smoke Use of liquid smoke is done by spraying the entire plant every 7 days between spraying with a fungicide with a treatment that is: 25 cc/l, 50 cc/l, 75 cc/l, 100 cc/l, 125 cc/l, in each treatment plot, and a plot that does not use liquid smoke (just flushing WAPer) and liquid smoke plot with a dose of 150 cc/l without the use of fungicides.

f) Harvest
Harvesting is done by looking at the criteria that are ripe harvest the leaves and stems have yellowed and died; the tuber is not easily scratched (peeling) and age to 115 days after planting. Bulbs are harvested by means of dismantling it carefully so as not to cause defects in the bulbs and subsequently weighing is done to determine the production of each plot.

g) Observation
Observations variable observed in the study include(1) Variable plant growth. Plant growth consisting of: plant height, number of branches, width, and long leaves, and leaves, (2) Production variables. Production includes the weight and number of tubers per sample, weight of tuber per plot, and, (3) Disease variables. The disease that includes when the first symptoms appear, the intensity and the percentage of late blight attack.

h) Growth Variable
1) Plant High (cm)
Plants high tall measured using a meter from the surface of the marker until the growing point of the plant. Observations were carried out from 4 WAP (weeks after planting) up to 10 WAP old plants with an interval of a week. Measurement data plus 5 cm (high stakes) and graphed increase plant height, while the last observation analyzed statistically.

b) The number of branches. The number of branches was calculated on the number of branches that grow on each tuber/stem of the plant. Calculation time intervals beginning about age 4 WAP a week until the plants 10 WAP. Last observation data analyzed statistically.

2) The length and width of leaves (Cm)
Observation of the length and width of leaves is done one time simultaneously with the last observation height. Leaf length measured from the base of the leaf to the tip of the leaf, while the leaf width measured at the widest part of the leaf or the midpoint of the length of the leaf.

d) The number of leaves. The number of leaves counted all the leaves on each clump of plants, on the certain plot. Observation conducted from 4 WAP to 10 WAP old plants at intervals of a week. Last observation data analyzed statistically.

i) Production variables
1) Weight and number of tubers per plant sample (kg)
Weight tubers weighed upon completion harvest of plant samples at each treatment. Potato tubers first cleaned of soil attached at harvest. Then the bulbs were weighed each sample. The number of tubers is calculated at each plant sample by observing how much the number of tubers contained in any plant sample.

2) Tuber weight per plot (kg)
Weights on each plot were weighed upon completion of harvest. Bulbs are weighed are tubers that are not attacked by pests or diseases. After being selected the weighing is done to determine weights for each plot.

j) Variable of disease
When the first symptoms appear. When the first symptoms appear the counting starts from planting until the symptoms of late blight (marked by patches. The intensity of attack (%). Observation of the intensity of the attack was done at the age of 4 s/d 8 WAP, with interval week. The data obtained were the graph of disease progression, and the last observational data were analyzed statistically. The intensity of the attack is calculated using the formula:

\[ I = \frac{\sum (n \cdot v)}{Z \cdot N} \times 100 \% \]

- \( I \) = Intensity of attack (%)
- \( n \) = Number of plants that have the same category of damage scale
- \( v \) = Value of damage scale of each attack category
- \( Z \) = Highest damage scale value
- \( N \) = Number of plants or parts of plants observed

1) Percentage of attack
Observation of the percentage of attacks performed at age 4 s/d 8 WAP, with the interval of a week. The data obtained were the graph of disease progression, and the last observational data were analyzed statistically. Attack percentage is calculated using the formula:

\[ P = \frac{a}{b} \times 100 \% \]

- \( P \) = Rate of attack (%),
- \( a \) =The number of plants affected,
- \( b \) = Number of plants observed

Percentage measurement of plant damage rate caused by disease attack presented in Table 1.

| Table 1. Disease Score System |
|-----------------------------|
| Value scale | The level of damage to crops (%) |
| 0 | There are no symptoms of attack |
| 1 | > 0 – 20 |
| 2 | > 20 – 40 |
| 3 | > 40 – 60 |
| 4 | > 60 – 80 |
| 5 | > 80 – 100 |

Source [14].
3. Result and Discussions

3.1 High Plant (Cm)

The observation of the potato plant height on the use of multiple doses of liquid smoke, having analyzed statistically by ANOVA and the results show the influence of a very different. While the average height of the potato crop due to the use of liquid smoke can be seen in Table 2.

| Treatment | High to plant (cm) |
|-----------|--------------------|
| A         | 20.71 a            |
| C         | 38.75 b            |
| H         | 42.78 c            |
| G         | 44.38 c            |
| D         | 44.57 c            |
| B         | 46.42 c            |
| F         | 46.74 c            |
| E         |                    |
| CV        | 5.04 %             |

Note: The figures in the same column followed by the same lowercase according to DNMRT no significant effect on the level of 5%.

The Table 2 above shows that the use of multiple doses of liquid smoke significantly different effect on the potato plant height after further test DNMRT at 5% significance level. Increasing the dose of liquid smoke, followed by an increase in the potato plant height, although not linear. High potato plants are getting treatment A (without treatment) was significantly different from that treated plants with liquid smoke. Furthermore, plants that received treatment C (liquid smoke 25cc/l of WAPer alternating with a fungicide) significantly different from the plants that receive treatment H, G, D, B, F, and E, six treatments (H, G, D, B, F, E) had no significant others. Lowest potato plant height (20.71 cm) is a plant that without treatment, while the highest cr op is potato plants treated E (liquid smoke 75cc/l of WAPer alternating with a fungicide). This provides evidence that the administration of liquid smoke to give effect to the potato plant height.

The results were the highest for plant height is on plants that receive treatment E, this shows that the elements in the bladder in liquid smoke is suspected to function as stimulants Substances Plant (PGR) on the potato plant vegetative phase. The next allegation, different plant height is applied with liquid smoke and are not applied is caused by the potato plants are not applied to the liquid smoke attacked by late blight, so that growth is not normal.

Lestari [15] mention that there is PGR named Atonik the main ingredient is arthonitro phenol, phenol paranitro, 2.4 dinitro phenol, and sodium nitoguaiakol. This composition there are similarities with the composition of the liquid smoke are also consisted phenol, then declared also that if the concentration is excessive plant growth regulator may hamper growth.

High potato plant as shown in Figure 1. The highest obtained at treatment plants that receive E with the dose of liquid smoke is higher (the commission of F, G, and H), plant height increasingly showed a decrease. The influence of the use of liquid smoke to decreased plant growth that was related to the presence of phenol content similarity to the PGR Atonik. Lestari [15], have indicated that if PGR given in excessive doses can inhibit plant growth.
Figure 1. Graph of the high growth rate of the potato plants 3 s/d 10 WAP due to liquid smoke treatment

3.2 Number of Branches (pieces)

The observation of the number of branches of the potato crop in the use of multiple doses of liquid smoke after analyzed statistically by analysis of variance and the results show that the effect did not differ significantly. While the average number of branches of the potato crop due to the use of liquid smoke can be seen in Table 3.

Table 3 shows that the use of multiple doses of liquid smoke was not a significantly different effect on the number of branches of the potato crop. This is because the treatment of a disease late blight continues to run unchecked, and at the age of 4 WAP plants already dying, it is in line with the opinion written Setiadi [1] states that late blight is a disease caused by fungi/fungal pathogens (disease-causing) who lives one season to the next and can infect not only the leaves but also other plant parts (roots, stems branches and buds).

The number of branches on the potato crop is usually influenced by the mother bulb used is the number of tubers and the weight of seed tubers are planted, this statement as stated by Hill [16] which states that the greater and the weight of seed tubers are planted, it will be the more buds and main branches.
Table 3. Average number of branches of the potato crop due to the use of liquid smoke.

| Treatment | Number of branches (fruit) |
|-----------|---------------------------|
| A         | 2.80                      |
| C         | 2.93                      |
| D         | 3.13                      |
| B         | 3.27                      |
| H         | 3.47                      |
| G         | 3.47                      |
| F         | 3.60                      |
| E         | 3.73                      |

CV = 23.35 %

Note: The numbers on the same row are not significantly different according to the F test at 5% level.

3.3 The length and leaf width (cm)

The observation of the length and width of leaves of potato plants due to liquid smoke, having analyzed statistically by analysis of variance and the results show a very different effect real. While the average length and width of leaves of potato plants due to the use of liquid smoke can be seen in Table 4.

Table 4. Average length and width of leaves of potato plants to the use of liquid smoke

| Treatment | Longleaf (Cm) | leaf width (Cm) |
|-----------|---------------|-----------------|
| A         | 5.08 a        | 3.31 a          |
| C         | 5.53 a        | 3.24 a          |
| H         | 7.39 b        | 4.76 b          |
| G         | 7.71 b        | 4.92 b          |
| B         | 7.79 b        | 4.85 b          |
| F         | 8.07 b c      | 5.15 b          |
| E         | 8.85 c        | 5.41 c          |
| D         | 8.88 c        | 5.81 c          |

CV = 6.29 % 5.83

Note: The figures in the same column followed by the same lowercase according to DNMRT no significant effect on the level of 5%.

Based on the observation of leaf length in the above table shows that the use of liquid smoke gives a different real effect. Increase dose of liquid smoke followed by long leaves of potato plants. The use of liquid smoke longest leaf of 8.88 cm showed that at 25 cc liquid smoke treatment alternating with a fungicide (D) and further enhanced their liquid smoke treatment dose (E, F, G, H, C) a potato plant leaf length decreases.

As well as the observation of leaf length, leaf width observation as shown in Table 4. The above demonstrates that administration of a liquid smoke significantly different effect on potato leaf width. The dose increase on liquid smoke followed by the addition of a potato plant leaves leaf width. The widest leaves of potato plants were 5.81 cm ie plants that receive treatment D, increasing the dose of liquid smoke treatment E, F, G, and H, broad leaves of potato plants are thought to be caused more lessen. This liquid smoke compositions such as phenol alleged there are similarities with the content of the PGR.

As pointed out by Lestari [15] that there is a trademarked PGR Atonik the main ingredient is arthonitro phenol, phenol paranitro, 2.4 dinitro phenol and sodium nitoguaiakol this composition there
are similarities with the composition of the liquid smoke are also consisted phenol and stated that PGR compositions containing it, if excessive concentrations can inhibit growth and stimulate the growth at low concentrations.

3.4 The number of leaves (leaf)

The observation of the number of leaves on plant potatoes due to the use of liquid smoke after analyzed statistically by analysis of variance and the results show the effect is very significant. While the average number of leaves of potato plants due to the use of liquid smoke can be seen in Table 5.

Table 5. Average number of leaves of potato plants due to the use of liquid smoke

| Treatment | The number of leaves (leaf) |
|-----------|-----------------------------|
| A         | 11.07 a                     |
| B         | 52.67 b                     |
| C         | 49.73 b                     |
| D         | 65.00 b                     |
| E         | 63.33 b                     |
| F         | 58.40 b                     |
| G         | 66.87 b                     |
| H         | 64.87 b                     |
|          | CV = 16.53 %                |

Note: The figures in the same column followed by the same lowercase according to DNMRT no significant effect on the real level of 5%.

Table 5 shows that the use of liquid smoke to give effect to the number of leaves of potato plants, where there is the real distinct difference between the treated liquid smoke with no treatment. The highest number of leaves is a plant that receives treatment G, while the lowest number of leaves is no treatment A. This is because the plants are treated with treatment A leaf rot disease continues to run uncontrollably and at the age of 4 WAP plants already dying because of being attacked by the disease blight.

Hartus [17] states that the leaf blight or late blight Phytophthora infestans that attacks potato plants caused by fungi, including families Phythiaceae if not control the disease is highly virulent in an instant the plants will die, it is certainly the death of the plant starts from falling leaves of plants diseased. The use of liquid smoke on the optimum dose as seen in the table above is the treatment of the G indicates that the administration of the dose of liquid smoke can increase the highest number of leaves of potato. Gani [18] mention that the provision of liquid smoke affect the growth of parts of plants of medicinal raw materials (that is utilized is the tuber) that leaves god name latin Gynura pseudochna (Lour) DC, stated that after the plants sprayed with a liquid smoke on optimum dose showed no reaction to good plant growth and a high number of leaves of the plant. Budaraga research results et.al [19] that the liquid smoke cinnamon is put in the process of pyrolysisat 400°C temperature containing phenol 0.57% and 4.13% carbonyl which can act as an antimicrobial.

3.5 The weight and number of tubers per plant

The observation of the weight and number of tubers of potato plants due to the use of liquid smoke, having analyzed statistically highly significant different show effect. The average weight and number of tubers of potato plants due to the use of liquid smoke can be seen in Table 6. Based on the observation weights as shown in the chart above shows that the use of liquid smoke was significantly different effect on the weight of the potato tuber crop. The highest weights are on potato who receive treatment E and the lowest weight of the tuber is in treatment A. Observation number of tuber crops in the chart above shows that the use of multiple doses of liquid smoke to give effect to the number of bulbs plant bulbs potato. Amount most was the potato plants that are subjected to E and the lowest is in treatment A.
Table 6. The weight and number of tubers per plant potatoes from application of liquid smoke

| Treatment | Weight of Tuber (Kg) | Amount tuber (pieces) |
|-----------|----------------------|-----------------------|
| A         | 0.02 a               | 4.20 a                |
| C         | 0.31 b               | 6.07 a b              |
| B         | 0.40 b               | 7.13 b                |
| H         | 0.77 c               | 12.87 c               |
| D         | 0.81 c d             | 15.11 c               |
| G         | 0.85 c d             | 13.93 c               |
| F         | 0.91 c d             | 14.60 c               |
| E         | 0.95 d               | 15.60 c               |

CV = 14.2%

Note: The figures in the same column followed by the same lowercase according to DNMRT no significant effect on the real level of 5%.

The treatment of liquid smoke at a certain dose to the observation of the number and weight of tubers crops showed a close relationship with the observation of leaf number, width and length of the leaves on the amount of liquid smoke giving the salvation of the leaves from the attack of late blight. It is strengthened with the opinion put forward Baihaqi [20] states that the weight and number of tuber crops of potato also has a positive correlation with the number and size of the leaves of plants because the leaves are part of the plants that make the process of photosynthesis is the largest among the organs of plants other.

A very real difference in the weight and number of tubers basically goes on treatment compared to treatment A and D, E, F, G, and H are potato plants without treatment compared to plants treated with the liquid smoke in alternating with a fungicide. Because the plants are getting treatment as dead plants, which in its infancy late blight disease.

Harts [17] states that the leaf blight or late blight attacked the potato crop caused by fungi, if not controlled then it is highly malignant disease in a heartbeat plant will die, it is certainly the death of the plant. In circumstances like this would plant the potato crop have not yet entered the enlargement ripening bulbs and tubers so that the weight is still low.

3.6 Weight tuber per plot (kg)

The observation of the tuber weight per plot plant potatoes due to the use of liquid smoke after analyzed statistically by analysis of variance and the results show a very different effect real. While the average weight of tuber per plot potato crop due to the use of liquid smoke can be seen in Table 7 below.

Table 7. Weight potato tubers per plot from application of liquid smoke

| Treatment | Weight Tuber Per Plot (Kg) |
|-----------|-----------------------------|
| A         | 0.92 a                      |
| C         | 13.60 b                     |
| B         | 17.31 b                     |
| D         | 26.83 c                     |
| H         | 28.38 c d                   |
| G         | 28.91 c d                   |
| F         | 32.08 d                     |
| E         | 33.23 d                     |

CV = 12.19%

Note: The figures in the same column followed by the same lowercase according to DNMRT no significant effect on the real level of 5%.
Table 7 show that the use of multiple doses of liquid smoke to give effect to the weight of potato tuber per plot. The highest weights are the plants that are getting treatment E and the lowest weight of the tuber is in treatment A. It showed that the results weights per plot are the most dominant in the treatment of severe E. Consistent with tubers per plant are showing the same weight in the weight tubers per plot. Production of (heavy) bulbs per plots is influenced by the number of leaves and number of leaves also have an effect against late blight of plants, where the number of leaves more shows are not affected by late blight, and therefore its production is higher than the plants that the number of leaves fewer. Baha’i [20] also stated that: The number of leaves of potato plants that make the growth parameter is an indicator variable intensity of leaf blight (Phytophthora infestans) on the percentage level of organ damage leaves and has associated with the production of potato tubers.

3.7 The intensity of the attack of late blight (%)
The observation of the intensity of the attack of late blight on potato plant on the use of multiple doses of liquid smoke after analyzed statistically and the results show the effect is very significant. While the average intensity of late blight in potato crops due to the use of liquid smoke can be seen in Table 8. Based on observations of the intensity of the attack of late blight in Table 8. Shows the intensity of late blight on potato plants of various doses of the use of liquid smoke showed significantly different without liquid smoke. The intensity of the attack of late blight of potato plants highest in treatment A and intensity of late blight of potato plants treatment decreases with increasing liquid smoke in a row on the treatment of 25 cc, 50 cc and so on until the treatment of 150 cc. This means that the higher administration of liquid smoke will be correspondingly reduced the intensity of late blight in plants which is caused by the fungus Phytophthora infestans.

| Treatment | The intensity of attack (%) |
|-----------|-----------------------------|
| H         | 0.64                        |
| G         | 0.66                        |
| F         | 0.74                        |
| E         | 0.93                        |
| D         | 0.96                        |
| B         | 2.60                        |
| C         | 6.28                        |
| A         | 46.21                       |

CV = 37.33 %

Note: The figures in the same column followed by the same small hurt not significant according to DNMRT the real level of 5%.

Doha, Tahiti, Way [21], stated that the concentration of liquid smoke significantly affect the activity of anti-fungal, increasingly high concentration liquid smoke the higher the activity of anti-fungal, further write mechanism compounds the antimicrobial/antifungal phenols include reaction with cell membranes fungal spores causing loss of cell nuclei mold spores.

The intensity of the attack of late blight on the potato as shown in Figure 2 shows the real difference is between 46.21 on treatment A and ranged from 0.64 to 6.28 with liquid smoke treatment plots. Plants in treatment A shows that the fungal pathogen is growing rapidly, it has been in accordance with the opinion of Harts [17] which states that the leaf blight or late blight Phytophthora infestans that attack potato plants caused by fungi, including families Phytiaeae when not in control of the disease this is very fierce in the blink of the plants will die, especially in the summer fog and rain.
Figure 2. Graph The intensity of the attack of late blight of potato plants 3 s/d 10 WAP from the application of liquid smoke.

3.8 Percentage of attack of late blight (％)
The observation of the percentage of attack of late blight on potato plant due to the use of liquid smoke after analyzed statistically by analysis of variance revealed the effect is very significant. While the average percentage of attack of late blight in potato crops due to the use of liquid smoke can be seen in Table 9.
Table 9. Percentage of attack of late blight on potato from application of liquid smoke

| Treatment | Percentage |
|-----------|------------|
| H         | 9.52 a     |
| G         | 10.48 a    |
| F         | 12.38 a    |
| E         | 15.24 a    |
| B         | 16.19 a    |
| D         | 17.14 a    |
| C         | 41.91 b    |
| A         | 84.76 c    |

CV = 20.51 %

Note: The figures in the same column followed by the same lowercase according to DNMRT no significant effect on the real level of 5%.

Table 9 shows the percentage of leaf rot disease without treatment (A) was significantly different from potato plants which obtain liquid smoke and fungicide treatment (treatment B), then the percentage of late blight in plants treated liquid smoke 25 cc/l of WAPer (treatment C) bred also apparent with other treatments. Potato plants were treated fungicides and various doses of liquid smoke had no significant another neighbor (D, B, E, F, G, and H).

The percentage of leaf rot disease is highest in plants that receive treatment A, while the low pitch is a plant that receives treatment H. This shows that the content of the liquid smoke serves as fungistatic that can prevent the development of fungi of late blight of potato, such as opinion put forward by Velmurugan [22] component in liquid smoke/pyrolysis results that some phenolic compounds and acids can act as an antifungal, written by Oramahi [12] there are seven phenolic compounds in the liquid smoke that is able to cope with the fungus.

The percentage of attack of late blight on the potato as shown in Figure 3 shows a highly significant difference between the plants without treatment (84.76%) where the graph shows rapid development until attack percentage of plants at 4 weeks. Next, on plants who receive treatment, liquid smoke percentage attack interval fluctuate according to giving liquid smoke. This shows after administration of liquid smoke decreased the percentage of late blight attack. Percentage range for the plants treated liquid smoke is 9.52% to 17.14%, the higher the dose of liquid smoke then the percentage attack of late blight on potato decreased.

Achrom and Kurniasih [23] which states that the functional components of liquid smoke and acid phenol compounds work synergistically to prevent and control the growth of microbes such as fungi, the way it works is to slow down and kill inoculum a result of their contact with the liquid smoke inoculum. Furthermore, according to Mary [24] adds that the liquid smoke contains components that can be bactericidal phenol.
Figure 3. Graph percentage of attack of late blight of potato plants 3 s/d 10 WAP liquid smokes as a result of treatment.

4. Conclusions
Based on the results of experiments that have been done it can be concluded as follows:
Treatment of multiple doses of liquid smoke to plant potatoes provide a significant influence on the observation parameters: plant height, length and width of leaves, leaf number, weight and amount of tuber crops, tuber weight per plot, the intensity of late blight, rot disease and percentage leaf, while the number of branches no effect significantly different. Plants treated with liquid smoke cinnamon with a rate of 125 cc punctuated alternately with fungicides showed intensity and percentage of the lowest disease.

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