

Repellence test of spices (garlic, chili, and pepper) to rat (*Rattus rattus diardii* L.)

Swastiko Priyambodo^{1, *}, Dewi Safitri¹

¹Department of Plant Protection, Faculty of Agriculture, Bogor Agricultural University

* Corresponding author: swaspri@gmail.com

Abstract Rat is wild animal that has been associated with human life, i.e. parasitism for causing harm to people, leads to disruption and damage, being vectors of human disease. Rat population must be controlled or managed, using both chemical and non-chemical methods. Aims of the study was to determine the effectiveness of garlic, chili, and pepper and its combination as a repellent agent against house rat. Results of this research can be used as a basis for developing a system of house rat control in settlement habitat. Repellence test was conducted in two methods, i.e. in the arena and in the cage. Materials used as a repellent were garlic, chili, and pepper. Each material was tested in a single, double, and triple in combination of all spices. Test animals used were 10 head of house rats that have undergone adaptation for one day. Test in arena used 5 rats and 5 other rats in the cage. Test in arena using a rectangular arena measuring 300 cm (L) x 100 cm (W) x 50 cm (H). The base of arena is made of plywood, the sides are made of thick zinc-coated board and the top is covered by a wire ram. Cage test made of aluminum measuring 40 cm (L) x 40 cm (W) x 50 cm (H) coated wire ram. Each replicates using two cages are placed opposite each other and connected by 400 cm plastic gutter pipe with a diameter of 10 cm. Analysis of variance used a completely randomized design with 7 treatments and 5 replications. Data process performed using the SAS program for Windows (Duncan test with $\alpha = 5\%$). Variables measured were daily grain consumption, the effectiveness of the repellent, and rats' body weight changes. In the arena, a mix of three ingredients was the most effective repellent, whereas in the cage garlic was the most effective. Pepper was not effective to repel rats. Body weight of rats in the cage and arena showed increased and decreased. The decrease in body weight showed that repellent treatment cause stress, even after rats were able to adapt to the environment.

Keywords repellent, spices, house rats

1. Introduction

Rats are wild animals that have been associated with human life. Association of rat with human nature often parasitism cause various problems and disorders for people in a variety of fields such as: Agriculture, livestock, house hold, and health [1]. Rats have the advantage over other mammals. It is an omnivore and have a high reproductive capacity, and can adapt to environmental changes made by humans [2]. Activity in house rats tightened their front teeth, dig a hole and make a nest cause harm because it causes damage to office buildings, factories, ware houses, and homes. Rats are also a vector for human diseases [1].

Given so many problems that can be caused by the presence of rats, then the various methods are developed to control it. Common control to rats is the use of rodenticides that probably emerge negative impacts on humans, pets, livestock, and other non-target animals. To minimize the negative impact on the use of rodenticides, it required a more secure way of control. Rats have the ability of sense that is support their activities. Among its five sensory organs, only a sense of sight is not well developed. The ability of smell and olfactory in rats can be used by human to attract or repel rats from some where. The use of repellent is one way to control which utilizes the sense of smell and olfactory of rats. Repellent material will indirectly cause the deaths and reduce the ability to survive in a population [1].

Rat repellent materials have been developed and tested in a variety of control. Some rat repellent material are sulfur, lime, carbolic acid, kerosene, oil of peppermint, n-butyl mercaptan (the active ingredient of animal smell skunk), bactericide, actidione, and sodium fluosilicate [1]. Peppermint oil which has a distinctive odor can be the basis of consideration of the use of repellent derived from spices. The information of the use of repellent using spices is very little.

Aims of this study is to determine the effectiveness of three types of spices and their combinations as repellent against to house rat (*R. rattus diardii*). Benefits of this study can be used as a basis for developing a system for rat control in habitat settlement in a practical, efficient, and does not have a negative impact to the environment.

2. Materials and Methods

This research was conducted at the Laboratory of Vertebrate Pests, Department of Plant Protection, Faculty of Agriculture, Bogor Agricultural University (IPB) for three months. Test animals used are house rat (*R. rattusdiardii*) obtained from catching rat around campus IPB Darmaga. Pre-requisite of test animals used are: Healthy, adult, large in size, and not pregnant. The animals were adapted in the laboratory for one day with dry grain fed. After 24 hours, five rats were weighed one by one as the initial weights for the first treatment. While the other five used in the following method.

The test materials used as are pellent were chili, garlic, and pepper. Repellent was made by crushing the materials in a blender, based on the treatment being tested. In each treatment, the test material and water mixed at the ratio of 1:2 (250 g: 500 ml). Results filtered and used to test. The results are stored in a squeeze bottle in ten containers, 5 containers for repellent treatment and 5 containers for water control. Repellent and water used in each container 50 ml.

Arena used rectangular with a size of 280 cm (L) x 100 cm (W) x 50 cm (H). Base of arena were made of plywood, the sides are made of thick zinc-coated boards, and the topis covered by a wire ram. At the to pof arena there were three holes in the middle, on the left and right which are used as doors for placing food and water. There were five arenas used in this study, all of the arena were covered by black plastic. At one corner of the arena placed feed grain (20 g), were paired with are pellent (50 ml). Drinking glass of water at the center of the arena. Bamboo tube where rat hide were placed near the corner of treatment. In another corner was given 20g ofrice and 50 ml of water as a control. The treatment is conducted in the arena with 7 treatments with each treatment consisted of 5 replicates.

Study in the laboratory (cage) performed afterin the arena was completed. Test in the laboratory using 10 pieces of aluminum cages measuring 40 cm (L) x 40 cm (W) x 50 cm (H) coated wire ram. Each replicates using two cages that are placed opposite each other and connected with modified pipes measuring 400 cm long and 10 cm in diameter. Pipe is inserted into the cage by a hole made by cutting the wire at the cage door. In the cage with the treatment, placed20 g grain feed paired with 50 ml repellent and drinking water is always available enough. In the untreated cage, thesame method but the 20 g of grain in the opposite site with water as control (50 ml).

Variables measured were daily grain consumption levels, changes in body weight of rats from the beginning to the end of the treatment, as well as the effectiveness of there pellent. The effectiveness of there pellent is calculated using the following formula:

$$LR=(CC-CR)/CC \times 100\%$$

LR: Level of repellence; CC: Consumption on control (without repellent);

CR: Consumption with repellent

The experimental design used was a completely randomized design with seven treatments and five replications. The seven treatments were: (1) chili, (2) garlic, (3) pepper, (4) chili-pepper, (5) chili-garlic, (6) garlic-pepper, and (7) chili-pepper-garlic. All treatments performed in the arena with each treatment consisted of five replicates. Each treatment takes five days of observation. The second round is done in the laboratory with seven equal treatments with each consisting of five replications. Data processing was performed using the SAS system for windows, further analysis of variance used Duncan's multiple range test at level $\alpha = 5\%$.

3. Results and discussion

Consumption of house rats (*R. rattusdiardii*) to the grain with and without repellent treatment in the arena showed significantly different results (Table 1).

Table 1. Consumption (g) of house rat (*R. rattusdiardii*) to the grain with and without repellent and repellence level treated in the arena

Treatment	With repellent	Without repellent	Repellence Level (%)
Chili	2.01 b	4.88 a	58.79 a
Garlic	1.58 b	4.66 a	65.99 a
Pepper	2.17b	4.72 a	51.25 a
Chili and garlic	1.44 b	4.06 a	64.61 a
Chili and pepper	1.80 b	4.56 a	60.55 a
Garlic and pepper	1.82 b	4.32 a	57.96 a
Chili, garlic, and pepper	1.32 b	4.68 a	71.69 a

Data consumption in the same row (with and without repellent) followed by the different letter showed significantly different based on Duncan's multiple test at level $\alpha = 5\%$

Data repellence level in the same column (repellence level) followed by the same letters showed no significantly different based on Duncan's multiple test at level $\alpha = 5\%$

Table 1 showed that the level of the most effective repellence row as follows: chili, garlic, pepper > garlic > chili and garlic > chili and pepper > chili >

garlic and pepper > pepper. Treatment of a mixture of three ingredients spices repellence showed the highest level of repellence (71.69%). The highest level of repellence of these mixture may be caused by: (1) Mixtures of these three materials have as strong smell that is affected the consumption pattern so rats. (2) Rat did not dare to take the risk to consume the grain fed repellent, because rat fed near the repellent feel safe for him, therefore rat prefer to eat places that feel comfortable and secure than the perceived dangerous place [3].

A treatment of garlic and garlic-chili as repellent material produces a high enough level of repellence (65.99 % and 64.61 %). Pepper was less effective to repel rat. It can be seen from a low-level repellence between treatments with a control that is equal to 51.25% although still significantly different between the treatment and the control. Less effective of pepper to repel rats caused by odor of pepper generated less strong repellent, lower influence the consumption patterns of rat. Repellence level of a repellent material could be measured by how much feed containing repellent is still eaten by rats [4].

Among the seven repellent treatment caused no significantly different results, as well as non-repellent treatment (control). This suggests that the level of the seventh repellence of such materials repel rats, so that rats prefer grain in areas that are not impaired. The nature of the rats were alert and suspicious of the new stuff around it causing low level consumption. Rats will avoid feed or the environment in which he considers dangerous, because of its adverse effects, so that the grain is not taken. None the less, the rats still had the courage to try less comfortable atmosphere, although only slightly and will not linger in the area. It can be seen from there mains of grain consumed at an angle with repellent treatment, although only slightly, and the behavior of grain ruffled so scattered around the bait, and the bait upside down. Rats have a high courage so that the amount of consumption good at an angle with and without repellent were not significantly different. Consumption of house rats to the grain with and without are repellent treatment in the cage showed in Table 2.

From the data obtained in the cage tests could be seen that the effective repellent to rats is garlic, chili, and chili-garlic. Although a mixture of chili-garlic showed a higher level than garlic-pepper, but showed no significant differences with control. The mixture of garlic-pepper showed significantly different from controls. This is due to the diversity of observation data from the treatment of chili-garlic. The garlic-pepper treatment indicates

homogenous data. The four other repellent treatment showed no significantly different results and it can be concluded less effective to repel rats.

Table2. Consumption (g) of house rat (*R. rattusdiardii*) to the grain with and without are pellent and repellence level treated in the cage

Treatment	With repellent	Without repellent	Repellence Level (%)
Chili	2.10 b	5.26 a	60.04 a
Garlic	1.60 b	5.03 a	68.13 a
Pepper	4.11 a	4.38 a	6.15 a
Chili and garlic	2.73 a	5.45 a	50.00 a
Chili and pepper	2.62 a	4.79 a	45.36 a
Garlic and pepper	2.82 b	4.45 a	36.68 a
Chili, garlic, and pepper	2.88 a	4.71 a	38.81 a

Data consumption in the same row (with and without repellent) followed by the different letter showed significantly different based on Duncan's multiple stat level $\alpha = 5\%$
Data repellence level in the same column (repellence level) followed by the same letter showed no significantly different based on Duncan's multiple stat level $\alpha = 5\%$

According to predictions, treatment in the cage should give significantly different results than treatment in the arena, because it is done in the laboratory by creating two places (the cages) which were connected with pipes will result in rats prefer areas untreated. Reality shows otherwise. Rats are not bothered with repellent near the grain, so that their diet remains high, both in treatment with and without repellent. The lack of effective in the four-repellent may be caused by the long enough adaptation period of rats in the laboratory (35 days). This caused the rats to recognize the area around (no stress) and also are familiar with the repellent due to the producing repellent treatment in the arena (first stage of testing) is done in the laboratory. The test animal did not feel afraid to consume close repellent grain in large quantities.

Materials chili, garlic and a mixture of both showed real different results between with and without repellent. While the other four are not effective, The effectiveness of garlic and chili in laboratory to repel rats, due to the first and second treatment testing done. So that the rat was still afraid to approach the grain with repellent. In subsequent treatment showed a fairly high level of consumption in the cage with and without treatment, because the test animals adapted to the repellent and not be in a state of stress during treatment.

Results of cage test on a wider range can be caused by several factors supporting the existence of rats such as sound, temperature, humidity, and light. Rats in the cage did not stress by noises that can interfere with activities and conditions in the laboratory are relatively dark in the arena caused covered with black plastic, so as to adapt to the environment and consumption patterns are not disturbed eating.

Comparison of the grain consumption in with and without repellent treatment showed that chili – garlic control and chili control showed the highest consumption level of rats, on the other hand chili–garlic repellent not showed the lowest consumption. Garlic repellent showed the lowest, followed by chili repellent. Rats have to adapt to the environment, and its occurred in the chili dan garlic treatment.

The body weight of rats tested in arena showed that remained in the first week, increased in the second and third week, followed by decreased in the fourth week. Increased in the fifth week, followed with decreased in the last two weeks. The body weight of rats tested in cage showed decreased on the first two weeks, followed by an increased in the next five weeks. The decrease in body weight of the rats showed that there pellent treatment can cause stress, even after threats were able to adapt to the environment.

The behavior of rats experiencing stress could be seen from its activities in the form of ruffled feed and swirl in the arena. Aggressive behavioris thought to be one form of stressre action to the treatment given. The emergence of stress in animal is not able to adapt to the pressures cause stress that comes from outside [5]. The major changes to the size and function of some reproductive organs and behavior, occurs as a consequence of the introduction of a laboratory or experimental. In addition as a resultof stress, energy used rats during treatment is very high. Energy needs are derived from feed consumption only slightly (due to low levels of consumption), so as to meet the needs of energy reserves stored in the body un used [6]. Long treatment time (35days), the rats will lead to decreased weight during reatment [7].

4. Conclusion

Result of research conducted in the arena showed that a mixture of the three ingredients of spice (chili, garlic, and pepper) is the most effective repellent to repel rats, where as in the laboratory garlic is the most effective repellent. Pepper is not effective as a repellent to the rats. It can be seen from a low-