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The Antibiotic and Antixenotic Resistance of Some Peanut (*Arachis hypogea* L.) Varieties after the Organic Fertilizer Application

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Abstract - Resistant varieties is one of the important components in integrated pest management. Studies of the Antixenotic and antibiotic resistance of peanut (*Arachis hypogea* L.) varieties aims to obtain varieties resistant and suitable to be cultivated in the province of North Sulawesi. Research using factorial experiment, treatment peanut varieties: Local varieties (V1), Giraffe (V2), Bison (V3), Bima (V4), Elephant (V5) and Rabbit (V6). Organic fertilizer treatments: Without fertilization (P0) and Super Petroganik as much as 20 tonnes/ha (P1) with three replications. Application of organic fertilizer made one month before planting seeds. Antixenosis and antibiosis resistance research results at 30 days after planting (DAP), the highest stomata diameter contained in P1V1 treatment is 12.62 μm, the longest trichomes on P0V3 is 88.07 μm, the highest stem cotrtex on P1V2 is 88.30 μm, and the highest contained on P1V6 is 9.96 mg/g. The result of the 60 DAP is obtained that the highest yields diameter stomata, trichomes length and content of flavonoids in P1V6 each is 13.85 μm, 136.33 μm and 14:57 mg/g, being the highest cortex diameter on P1V5 is 158.80 μm. Based on the results of analysis of variance, flavonoid content peanut varieties 30 DAP and 60 DAP significantly different ($P < 0.05$), while the diameter of stomata, trichomes numbers and length number, and corticial stem not significant ($P > 0.05$). Resistance mechanisms developed peanut plants are antibiosis.

Index terms - Antixenosis, antibiosis, varieties of peanut *(Arachis hypogaea* L.)

I. INTRODUCTION

Peanut *(Arachis hypogaea* L.) as one of the commodity crops that have high economic value. Utilization of peanut plants is very diverse, which can be consumed directly, as industrial raw materials and animal feed. Groundnut seeds contain fat, protein, vitamin A, E, K and B-complex, calcium, phosphorus, lecithin and choline, as well as contain phytosterols and arginine.

Data of Crops Research Institute for Legumes and Tuber, Malang City, this time in Indonesia has released high yielding varieties of groundnut, where each variety has unique characteristics in terms of biological properties of the plant, the chemical composition of the seeds, resistance to pests and diseases, and tolerance of abiotic [1].

In the cultivation of peanuts, the insect pests and pathogens is one of the causes of declining production. The main insect pests on crop peanuts is *Aphis craccivora, Lamprosema indicata, Aproaerema modicella, Empoasca* sp., *Spodoptera litura, Chrysodeisis chalchites, Helicoverpa armigera, Odontotermes* sp., [2] and [3].

Controlling insect pests on crop plants, including peanuts, with synthetic pesticides are exaggerated and application of pesticides is not wise can result environmental pollution, animal death of non-target, the simplification of the natural food chain and biodiversity, bioaccumulation / biomagnification, pest resistance and killing natural enemies [4]. One way to reduce dependence on the use of synthetic pesticides is by planting crops resistant to insect pests. This tactic is the most effective, economical and environmentally friendly.

Cultivation of peanuts give the higher returns compared to other crops such as corn, soybeans and green beans. Peanut risk of crop failure due to pests and diseases is smaller compared with soybean [2]. This means that peanuts have been developing resistance to insect pests and pathogens.

Mechanism of plant resistance against insect pests divided three forms, namely**:** 1) antixenosis, 2) antibiosis and 3) tolerance [5]. Antixenosis resistance in the form of plant morphological characters include (1) the density, rigidity, length and shape of trichomes, (2) the color and shape of leaves, (3) the cell walls are thickened, 4) characteristics of the stem, (5) a layer of wax and silica. In addition to the morphological properties of plants, stem anatomical structures that play a role in plant resistance are the elements that have lignified xylem and phloem fibers. [6]. Antixenosis resistance lowers requirements on host insects to eat, oviposition and shelter antibiosis resistance in the form of production of plant metabolites that cause the death of the insect pests or physiological disorders [7].

Chemical compounds can act as repellent, feeding deterrent, toxins and also influence the ability of insects to take up nutrients from plant tissues that are swallowed. Flavonoids are chemical compounds that contribute to antibiosis resistance of plants to insects, microbes and pathogens [8]. Peanuts produce flavonoids namely chlorogenic acid, quercetin and rutin [9].

One way to meet the nutrient requirements and increase production plants is the organic fertilization. Organic fertilizer is fertilizer made from organic materials that are degraded organically, and can improve the nature of the chemical, physical and biological soil [10]. Organic fertilizers have the following functions: 1) Providers macro nutrients like N, P, K, Ca, Mg and S, and micronutrients such as Zn, Cu, Mo, B, Mn and Fe, 2) Increase cation exchange capacity and 3) formation complex compounds with metal ions are toxic to plants such as Al [11]. Application of organic fertilizers in the cultivation of peanuts can increase plant growth and development, including antixenosis resistance and antibiosis plants.

The antixenotic and antibiotic mechanisms on the varieties of peanut aims to find suitable varieties cultivated in North Sulawesi, and forms of resistance mechanisms developed peanut plants.

II. MATERIALS AND METHODS

2.1 Procedure and Location of Research

This research used factorial experimental design with three replications. Treatment 1: Varieties peanuts (V): Local (V1), Giraffe (V2), Bison (V3), Bima (V4), Elephant (V5), Rabbit (V6). Treatment 2: Types of Organic Fertilizer (P): Without organic fertilizer (Control) (P0) and Super Petroganik (P1). Application of organic fertilizers as much as 20 tonnes / ha done one month before planting seeds. Peanut seeds obtained from the Research Institute for Legumes and Tuber (Balitkabi) Malang, local varieties obtained from farmers. Antixenosis and antibiosis resistance measurement peanut plants carried on 30 and 60 DAP. This research was conducted in Tomohon City, North Sulawesi, Indonesia.

2.2 Antixenosis Resistance

Observations antixenosis peanut resistance is to make an incision on the leaves and stems of plants peanuts, and carried out the shooting magnification of 10 times using optilab camera microscope. Measuring length of samples conducted with Raster Image program. The parameters observed were diameter, number and length of stomata the stomata, trichomes number, and stem corticial diameter.

2.3 Antibiosis Resistance

Antibiosis resistance research carried out with analyze the flavonoid compounds in samples of peanut include color reaction test and determining the total content flavonoids with the spectrometer [12] and [13]. Extraction of sample: a total of 1 g sample of peanut flour was macerated with 5 ml of ethanol and macerated for 24 hours. Extracts of the results of maceration then evaporated on a watch glass. Determination of total flavonoid content by spectrometer: A sample of 1 g was added 5 mL of 80% ethanol, divortex, macerated for 24 hours, filtered and evaporated. A total of 2 mL of the extract was added to 2mL 2% aluminum chloride that has been diluted with ethanol, then divortex and read at a wavelength of 415 nm. The content of total flavonoids quercetin equivalents expressed as in mg / g of extract [14].

2.4 Statistical Analysis

Data were analyzed by analysis of variance and continued with Least Significant Difference Test (LSD) using SPSS version 17.

III. RESULTS AND DISCUSSION

Antixenosis resistance data include stomata diameter, number of trichomes, long trichomes and the diameter of the peanut stem cortex at 30 DAP is presented in Table 1. Based on data from Table 1 shows that the data the highest average diameter of stomata on P1V1 is 12.62 ± 0:38 μm, the number of trichomes on P0V3 and P0V5 is 3:33 ± 0:58 μm, long trichomes on P0V3 is 88.07 ± 2:31 μm, diameter of the cortex in P1V2 is 88.30 ± 5.86 μm, the flavonoid content is 9.96 ± 0:46 P1V6 mg / g.

TABLE 1
ANTIXENOSIS and ANTIBIOSIS RESISTANCE DATA on PEANUT PLANT in 30 DAP

No.	Treatments	Parameters				
		Diameter Stomata (μm)	Amount of Trichomes	Trichomes Length (μm)	Stem Corticial Diameters (μm)	Stem Content of Flavonoids (mg / g)
		± SD	± SD	± SD	± SD	± SD

1	P0V1	12:25 ± 0:06	3:00 ± 1:00	81.73 ± 21:09	67.00 ± 4:11	5.80 ± 1:03
2	P0V2	12:08 ± 0:13	2.67 ± 1:15	82.93 ± 21:36	73.70 ± 2.90	5.75 ± 0.83
3	P0V3	11.74 ± 0:25	3:33 ± 0:58	88.07 ± 2:31	67.00 ± 7.71	5:46 ± 1:20
4	P0V4	11.88 ± 0:20	2:33 ± 0:58	71.73 ± 4:41	72.60 ± 5:18	4:28 ± 0.77
5	P0V5	11.81 ± 0:44	3:33 ± 0:58	74.52 ± 4.85	63.40 ± 2:33	6.82 ± 0:23
6	P0V6	12:28 ± 0:07	2.67 ± 1:15	76.23 ± 3:42	62.30 ± 3:51	7:02 ± 0.67
7	P1V1	12.62 ± 0:38	2.67 ± 1:15	74.17 ± 7:32	83.60 ± 6:43	7:02 ± 1:09
8	P1V2	12:29 ± 0:10	2:33 ± 1:53	82.67 ± 11.86	88.30 ± 5.86	6:11 ± 1:28
9	P1V3	12:40 ± 0:05	3:00 ± 1:00	78.97 ± 24.08	87.50 ± 4:56	5.95 ± 1:13
10	P1V4	12:37 ± 0:32	2.67 ± 0:58	55.50 ± 8.60	77.10 ± 9.87	5.92 ± 1:17
11	P1V5	12:53 ± 0:40	2:00 ± 0:00	82.23 ± 5.92	76.10 ± 5.67	6.95 ± 0.74
12	P1V6	12.60 ± 0:06	2:33 ± 1:53	86.10 ± 22:15	81.20 ± 9:06	9.96 ± 0:46

Average data measurement antixenosis resistance and antibiosis peanut plants at 60 DAP is presented in Table 2.

TABLE 2
ANTIXENOSIS and ANTIBIOSIS RESISTANCE DATA on PEANUT PLANT in 60 DAP

No.	Treatments	Parameters				
		Diameter Stomata (μm)	Amount of Trichomes	Trichomes Length (μm)	Stem Corticial Diameters (μm)	Stem Content of Flavonoids (mg / g)
		± SD	± SD	± SD	± SD	± SD
1	P0V1	12.86 ± 0:05	3:00 ± 1:00	89.97 ± 7.60	108.97 ± 7:09	7:23 ± 0:41
2	P0V2	12:58 ± 0:33	2.67 ± 0:58	90.53 ± 2:37	113.23 ± 11:51	6.76 ± 0:33
3	P0V3	12.84 ± 0:22	3.67 ± 0:58	86.10 ± 21:33	104.27 ± 3.88	6:35 ± 0:45
4	P0V4	12.66 ± 0:06	2.67 ± 0:58	77.87 ± 7:57	117.13 ± 11:34	6:04 ± 0.78
5	P0V5	12.78 ± 0:11	3:00 ± 1:00	86.13 ± 7:16	107.73 ± 4:48	7:53 ± 1:17
6	P0V6	12.90 ± 0:32	2.67 ± 0:58	91.93 ± 16:46	105.73 ± 2.94	10:10 ± 1:13
7	P1V1	13:31 ± 0:34	3:00 ± 0:00	134.67 ± 23:03	136.13 ± 7:50	8:09 ± 0:41
8	P1V2	13:43 ± 0:03	3:00 ± 0:00	115.40 ± 24.14	123.33 ± 13.87	8:09 ± 0:18
9	P1V3	12.93 ± 0:22	2:00 ± 1:00	109.93 ± 10.64	143.23 ± 29.28	8:03 ± 1:33
10	P1V4	13:31 ± 0:43	3:33 ± 0:58	109.33 ± 7.77	156.90 ± 19:35	8:02 ± 0.79
11	P1V5	13:32 ± 0.90	2.67 ± 0:58	130.00 ± 35.68	158.80 ± 21:28	9.94 ± 0.67
12	P1V6	13.85 ± 0.60	2.67 ± 1:53	136.33 ± 11:59	137.67 ± 20.80	14:57 ± 0.90

Based on data from Table 2 shows that the highest yield for the average diameter of the stomata, long trichomes and flavonoid content in P1V6 respectively, are 13.85 ± 0.60 μm, 136.33 ± 11:59 μm and 14:57 ± 0.90 mg / g, the average number of trichomes on P0V3 namely 3.67 ± 0:58, the diameter of the cortex in P1V5 is 158.80 ± 21:28 μm.

Variant Analysis antixenosis parameter data and antibiosis peanut plants are presented in Table 3.

TABLE 3
RESULTS ANALYSIS OF RESISTANCE VARIANTS ANTIXENOSIS AND ANTIBIOSIS PEANUT PLANTS

Parameters	Growth 30 DAP		Growth 60 DAP	
	Value F	Sig	Value F	Sig
Diameter Stomata	0.93	0:48	1:23	0:32
Number of trichomes	0:43	0.83	1.82	0:15
Long trichomes	0.80	0:56	0:50	0.77
The cortex Diameter Trunk	1:35	0:23	1:23	0:31
Content of Flavonoids	3:40	0:02	1:15	0:01

Based on the results of analysis of variance in Table 3, application of organic fertilizer significantly affected the flavonoid content of peanuts in the growth of 30 DAP (sig = 0:02) and 60 HST (sig = 0.01) in (Sig <0.05). Furthermore, the application of organic fertilizer effect is not significant to the diameter of the stomata, trichomes number, length and diameter of cortical stem trichomes on the growth of 30 DAP and 60 DAP (sig> 0.05). BNT analysis results obtained between different P1V6 with other treatments.

This study used six varieties of peanuts which is a hybrid. varieties Giraffes derived from the results of a single cross local varieties Java with ICGV 86021, varieties Bison derived from a single cross varieties of Rabbit with mutant varieties of Elephants (SHM2), varieties Milky derived from the selection of strains of local variety of Bima Nusa Tenggara Barat, varieties of elephant derived from the selection offspring Schwarz crosses Spanish -21 18-38, Rabbit varieties derived from IRRI Philippines with numbers Acc-12 [1].

Plant resistance against insect pests is the ability of plants to reduce damage caused by pests. Resistant varieties generally have the ability to suppress the development of pest populations to not cause economic damage.

The nature of plant resistance against insect pests is a genetically controlled trait and expresed in form the morphological/physival and/or biochemical resistance impede the movement of insects, eating, oviposition and as host. Morphological features include leaf epidermal thickness, the wax coating on the surface of the leaves and stems, the density of trichomes, braktea twisting, shape and color of the leaves [15] and [16].

Measurement parameters antixenosis and antibiosis resistance to the growth of 30 DAP, found that organic fertilizer Super Petroganik can raise the average diameter of the stomata, trichomes length and diameter of the stem cortex, although the results of analysis of variance is not sifnificant on the level of test 0.05.

Peanut plants have stomata kidney shape, cell cover comprises a pair of cells that look symmetrical. Cell cover is fine cellulose fibers are arranged in a circular cell wall called radial miselasi. Cells closing stomata control the diameter by changing the shape widened or narrowed the gap between the two cells. Diameter stomata do not affect directly against antixenosis resistance, but associated with plant physiology and photosynthesis is the reaction product of primary and secondary metabolic compounds. The result showed that organic fertilizer Super Petroganik raise the diameter of stomata, the highest data on the measurement of the 30 DAP is 12.62 ± 0:38 P1V1 μm, and measuring 60 DAP on P1V6 namely 13.85 ± 0.60 lm.

Results of the study the number of trichomes peanut plants showed that organic fertilizers do not increase the number of trichomes that is in the range of 2.00 to 3.67. Number of trichomes of a plant genetically inherited and the influence of abiotic factors. The amount of leaf trichomes can be increased when induced by abiotic stress such as ultraviolet rays is high and damage by insect pests (inductive resistance). Furthermore, for the length parameter trichomes, found that organic fertilizer can increase the length of trichomes on the measurement of 30 DAP dan 60 DAP, the highest data on treatment P1V6 is 86.10 μm ± 22:15 11:59 ± 136.33 μm.

The existence of both density and long trichomes influenced on insect pest behaviour, trichomes as part of the resistance antixenosis effect on insect behavior, eating and opposition activity [17] and [18] and crop selection as the host [15]. Non-glandular trichomes have function as a defense, while the glandular trichomes produce a gland that acts as a mechanical trap. Some trichomes have glands that produce secondary metabolites such as terpenoids and alkaloids, these compounds are toxic, repellent, trap to insects and other organisms [19], trichomes also inhibits and damaging insects have chewing mouth type of tool [6].

Characteristics stems are solid stems, hard and woody is one factor antixenosis resistance [6]. The thickness of the cortex is associated with stem-sucking insect species that uses pkloem liquid as a source of energy and xylem fluid as a source of water, salts and minerals. Results of research at 30 DAP, the largest cortical thickness was found in the P1V2 namely 88.30 ± 5.86 μm, and for 60 DAP on P1V5 treatment is 158.80 ± 21:28 μm.

Flavonoids are the largest group of phenolic compounds, and in plants usually contain several kinds of flavonoids, with very different functions include pigmentation and defense [20]. Flavonoid as chemical resistance (antibiosis) is very influential to pests. The analysis of resistances at 30 DAP and 60 DAP obtained P1V6 treatment have the highest flavonoid content is 9.96 ± 0:46 mg/g and 14:57 ± 0.90 mg/g dry matter. Organic fertilizers generally raise the flavonoid content in all varieties of peanuts. Flavonoids synthesized in plants during normal growth for the signal and defense, and flavonoid induction, which is synthesized by plants in response to the influence of physical damage, infection and stress. Flavonoids are repellent to eat, lowers digestibility and are the toxin [8].

In this study encountered insect *Lamprosema indicata, Aproaerema modicella, Spodoptera litura Aphis craccivora, Empoasca sp.* and *Chrysodeisis chalchites.* The lowest total population of insect pests found in rabbit variety, followed by local varieties, elephants, giraffes, bison and bima. The nature of this resistance is highly correlated with the flavonoid content of secondary metabolites. Peanuts producing several flavonoid compounds namely chlorogenic acid, quercetin and rutin. Peanut resistance mechanism is controlled by antibiosis mechanism.

IV. CONCLUSION

Based on the results of research are: (1) resistance antixenosis and antibiosis peanut plants on growth 30 DAP, which is the highest average diameter of stomata on P1V1 is 12.62 ± 0:38 μm, the number of trichomes on P0V3 and P0V5 is 3:33 ± 0:58 μm, the length of trichomes on P0V3 is 88.07 ± 2:31 μm, diameter of the stem cortex on P1V2 is 88.30 ± 5.86 μm, the flavonoid content is 9.96 ± 0:46 mg / g on P1V6. (2) The results on growth 60 DAP shows that the highest diameter average of the stomata, trichomes length and content of flavonoids in P1V6 respectively are 13.85 ± 0.60 μm, 136.33 μm and ± 11:59 14:57 ± 0.90 mg / g, mean average number of trichomes on P0V3 is 3.67 ± 0:58, corticial stem diameter at 21:28 P1V5 is 158.80 ± μm. (3) The mechanism of resistance that is developed peanut plants is antibiosis.

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