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Infection of Several Sclerotium Rolfsii Races on Peanut Growing In Drought Treatment

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***Abstract*:** *This study aimed to determine the infection of several races of Sclerotium rolfsii on peanut grown in drought treatment. This research was conducted in Microbiology Laboratory and Greenhouse of Agriculture Faculty, Mataram University, from January to April 2016. The experiment was designed using Randomized Complete Design (RAL) in two factors namely drought treatment factor and the inoculation factor of several races of S. rolfsii, ie: r0 (without infection of S. rolfsii / control, r1 (inoculation of S. rolfii isolated from peanut in Tanjung, North Lombok), r2 (inoculation of S. rolfsii isolated from Lili daffodil, r3 (inoculation of S. rolfsii isolated from peanut in Ta'a Village, Dompu Regency), r4 (inoculation of S. rolfsii isolated from peanut in Teke Village, Bima Regency). Research result indicates that each of the S. rolfsii races have different rates of infection to damage of the plant grown in drought conditions. The highest infection happened in r4, followed by r3, r2 and r1, respectively from the highest to the lowest.*

***Keywords*:** *S. rolfsii, Race pathogen, drought stress.*

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I. Introduction

One of the main crops grown in dry land is peanuts. Average production of peanut nationally in the last five years (2011-2015) amounted to 13.02 kw / ha. Meanwhile, in West Nusa Tenggara (NTB) the average production in the period was 14.27 kw / ha. This production value is low enough compared to intensive cultivation production which can reach 20 - 25 kw / ha (Central Bureau of Statistics of NTB, 2016; Sumarno, 2003). This condition (low production) is allegedly caused by pest and limited availability of water. The shortage of water can affect the success of cultivation. Lack of water can result in the leaf water potential decreases and disturb leaf chlorophyll formation (Alberte et al., 1977). Water deficit takes the water for photosynthesis to decrease, while disturbed photosynthesis can disturb the distribution of photosynthate. The decline of photosynthate results in the falling of flowers, pods and seeds that have been formed (Sloane et al., 1990).

In addition to water deficit problems, infection of pathogens is also a constraint to the development of peanut, particularly infection of the Seclerotium rolfsii (Department of Agriculture, 1991). Pathogen infections can decrease the quantity and quality of peanut yields. According to Backman and Brenneman (1997), the decline in outcomes due to S. rolfsii attacks can reach 25-80%. In Dry land, irrigation system is difficult to apply. This condition makes inokulum fungal hard to remove, so that inoculum remains exist throughout the growing season. Drought condition and infection of S. rolfsii pathogens may happen in a single constrain factor in plants, but, it generally happens simultaneously in the same time. The drought and infection of S. rolfsii pathogens can lead to damage, especially at the molecular, cellular, physiological and morphological levels. This certainly affects crop production (Atkinson and Urwin, 2012).

S. rolfsii attack can make a 25-80% decrease in yield (Backman and Brenneman, 1997). The threat to the production decline is related to the handling of S. Rolfsii attacking the crops. A field observation shows that peanut is susceptible to stem rot caused by S. rolfsii. Beside the ability to adapt well in unfavorable environments, S. rolfsii is able to form new physiological races in different characters. The emergence of the new physiological races is a major problem in controlling these pathogens. Each race has a growing ability and a different degree of pathogenicity to the host plant. The existence of many races of physiology causes the difficulty of controlling pathogens due to lack of further understanding of the diverse new physiological races. Based on the description, this research aimed to determine the infection rate of several racial S. rolfsii in peanut grown in drought conditions.

II. Research Methods

2.1 Location and time of research

This research was conducted in Microbiology Laboratory of Faculty of Agriculture, University of Mataram and experimental plastic house of Agricultural, Fishery and Forestry Extension Agency of Mataram City, BP3K Mataram Subdistrict, located in East Pagutan Village, and started from January to April 2016.

2.2 Tools and Materials Research

Materials used in this study are peanut seeds, isolates S. rolfsii, PDA. The tools used are tools in the laboratory (oven, analytical scales), tools in the field and stationery.

2.3 Experimental design

The experimental design used was Completely Randomized Design (CRD) with factorial treatment arrangement, namely: (1) the drought treatment in 2 levels; k1 (soil moisture condition) and k2 (drought conditions) (2) the inoculation of several races of S. rolfsii, done in 5 levels: r0 (without S. rolfsii / control infection), r1 (inoculation of S. rolfii isolated from peanut in Tanjung, Lombok Utara), r2 (inoculation of S. rolfsii isolated from Lili daffodil, r3 (inoculation of S. rolfsii inoculation of S. rolfsii isolated from peanut in Ta'a Village, Dompu Regency), r4 (inoculation of S. rolfsii isolated from peanut in Teke Village, Bima Regency). The treatment was combination of two factors, repeated three times to get 30 unit of experiment (polybag).

2.4 Provision of Planting Media, Planting and Maintenance of Plants

Planting medium used was land taken from rice cultivation. The soil was dried, then sifted and inserted in polybags weighing 10 kg / polybag. The seeds used were strains derived from gamma irradiation in Dr. Ir. A. Farid Hemon's research. Before the seeds were inserted into the planting hole, firstly each planting hole was sprinkled by Furadan 3G. In each polybag, it was made 2 planting holes and each planting hole, it was planted a seed of peanut then covered with fine soil.

Plant maintenance includes fertilizing, weeding, irrigation, and pest and disease control. Fertilization was done using a compound fertilizer NPK-Ponska as much as 75 kg per hectare or 3.2 gr per polybag. Weeding is done by cleaning the plants from weed disturbance. The provision of water was based on the determined drought treatment. Pest control was done mechanically by taking pests on the plant by hand and by using a chemical pesticide, Demolish 18 EC.

2.5 Treatment of Drought

All plants watered until it reached field capacity from the beginning of planting to the age of 15 days after planting (dap). Field capacity was determined by watering planting medium to saturation, indicated by dripping of water at the basic aeration hole of polybag. Treatment of drought was started from 16 days after planting to 85 days after planting. When the plant ws 15 dap, some plants do not in drought treatment (crops was in soil moisture and field capacity conditions) and others are kept in drought conditions as a result of reduced water delivery. Plants with drought treatment were doused up to field capacity every 4-7 days (a day after 70% of wilting symptoms on the leaves). The wilting phenomenon began when the soil water content reaches <60-70% of the field capacity, which was calculated based on the weight difference of the water when the plant was in the field capacity and began to wither. Treatment of drought was given until the plant was 85 dap. The next plant was treated in optimum condition until the crop was harvested (Hemon, 2006).

2.6 Inoculation Culture of Several Races of *S. rolfsii*

The pathogen of S. rolfsii used was isolated from the peanut plant originating from Dompu Regency, Bima Regency, North Lombok Regency and isolate from Lili Bakunng. Pure culture of the 4 Races was propagated in Potato Dextrose Agar media (PDA). The isolate was cultured up to 6 days after growing. This culture would be used for inoculation of peanut crops. The pure cultures and the media were cut into pieces using a 5 ml boren cook to get a uniform culture size. Plant inoculation was performed on plants aged 20 days after planting, when the plant was in drought or on field condition soil. The inoculation of several Races of S. rolfsii was based on the treatment. Treatment without infection (r0) was performed without S. rolfsii infection.

The treatment of r1 was carried out by directly spraying the r1 culture suspension of S. rolfsii at the base of the plant stem. The treatment of r2 was carried out by directly spraying the r2 culture suspension of S. rolfsii at the base of the plant stem. The treatment of r3 was carried out by directly spraying the r3 culture suspension of S. rolfsii at the base of the plant stem. The treatment of r4 was carried out by directly spraying the r4 culture suspension of S. rolfsii at the base of the plant stem.

2.7 Data analysis

The data obtained was analyzed using statistical analysis; variance analysis (ANOVA) at significance of 5%. If it is found a significant difference in factor one and factor two, it is done the further test using Honestly Significant different (HSD) on the same significant level.

III. Results And Discussion

Peanuts are grown in drought conditions and then inoculated with several races of S. Rolfsii. Based on the result of variance analysis, each of S. rolfsii race gave a significant effect on the plant height parameters at 30 dap, leaf number at 90 dap, branch number at 60 dap, and branch number at 90 dap, but no significant effect on leaf number at 60 dap (Table 1). Based on the table 1, on parameter 1 (plant height at 30 dap) it is indicated that the different plant height is influenced more by the drought condition than by the infection of S. rolfsii. This result is in line with the state of Harjadi (1988) and Soesanto (2013), suggesting that environmental treatment (drought treatment and pathogen S. rolfsii infection) is the constrain factor that can affect the growth process and crop yield. Especially in drought conditions, it can affect the ability of division and elongation of cells so that the process of growth and crop development were inhibited and crop production eventually is decreased.

Based on the results of research, at age of 30 dap, infection of pathogen S. rolfsii not give dominant effect to the damage of plant. The dominant effect of infection of each racial pathogenic S. rolfsii began to appear at the age of 60 – 90 dap. This is supported by the data in table 1; leaf number at 90 dap, branch number at 60 dap, and branch number at 90 dap indicates that Different race has a significant effect. Although the leaf number parameter at 60 dap does not show a significant effect, but each race gave different values. This was mainly indicated by the treatment of r0 (plants without inoculation of pathogen S. rolfsii) compared to the other treatments (r1, r2, r3, and r4).

On the parameters of leaf number at 90 dap, branch number at 60 dap and branch number at 90 dap, the highest value is shown on the r0 treatment, while the lowest on the r3 and r4 treatment. The presence of significant effect on the parameters of leaf number at 90 dap, branch number at 60 dap, and branch number at 90 dap indicates that the pathogen S. rolfsii can negatively affect the growth of some plant organs such as stems, leaves and pods (Sudarma, 2014). Furthermore, the results show that each of S. rolfsii races have different growth ability and pathogenicity level on the peanut damage (Hemon, 2006). This is in line with the results of this study on the analysis results of the obsalic acid concentration in each racial S. rolfsii used. It is shown that there is different result in each race, respectively r1 = 5.73 gr, r2 = 7.85 gr r3 = 28.4 gr, and r4 = 30.63 gr. To damage the plant, this pathogen will release oxalic acid, polygalactuonase and sellulase, which are toxic to the plant (Sudantha, 2014). Other states also suggest the same that the obsalic acid secreted by the S. rolfsii may increase virulence so that the host plant is damaged (Backman and Brenneman, 1997; Cessna et al., 2000).

Tabel 1. Average value of observation of several parameters on the races of S. Rolfsii

Race of *S. rolfsii*	Parameter				
	1**)	2**)	3**)	4**)	5**)
r0	27,17 c*)	54,40 a*)	61,04 a*)	6,92 a*)	7,63 a*)
r1	30,25 b	48,58 a	53,67 b	5,79 b	6,71 a
r2	30,16 b	53,92 a	49,88 b	6,67 a	7,08 a
r3	29,51 b	49,15 a	38,56 c	6,23 a	5,77 ab
r4	32,01 a	49,40 a	20,40 d	6,15 a	3,31 b

Note: *) The numbers followed by the same letter in the same column are not significantly different based on the 5% HSD. **) 1 = Plant height at 30 dap (cm), 2 = leaf Number at 60 dap (strands), 3 = Leaf number at 90 dap (strands), 4 = Branch number at 60 dap (stem), and 5 = Branch number at 90 dap (Stem).

The results of this study show that the treatment of several races of S. rolfsii gave a significantly different effect on some parameters observed such as dry weight of root, pod content, dry weight of pod, and infection symptom score. Table 2 shows that the lowest values of all observed parameters are shown by r4 treatment. S. rolfsii r4 used in this study gave a very significant negative effect on the decrease of value on several parameters. The low yields in the treatment of r4 indicate the high rate of crop damage due to infection of the race. This is in line with the symptom score of infection, indicating that r4 provides the highest infection symptom score. The significant differences are influenced by the nature and characteristics possessed by each of the pathogen race.

Table 2. Average value of observation of several parameters on the races of S. Rolfsii.

Races of *S. rolfsii*	Parameters			
	A**)	B**)	C**)	D**)
r0	1,66 a*)	6,50 a*)	5,65 a*)	0,00 e*)
r1	1,65 a	7,98 b	6,69 b	1,79 d
r2	1,55 a	6,19 a	5,90 ab	2,88 c
r3	1,47 a	2,54 c	1,99 c	4,13 b
r4	0,77 b	0,98 d	0,97 d	4,67 a

The numbers followed by the same letter in the same column are not significantly different based on the 5% BNJ test. **) A = dry weight of root, B = pod content, C = dry weight of pod and D = infection symptom score

In this study, it was also analyzed the concentration of obsalic acid of each race. The result shows that each race gave different concentrations of obesalic acid. The concentration of obsalic acid was directly proportional to the infection symptom score on the host plant. The relationship between the concentration of obsalic acid and the infection symptom score on the peanut is described in Figure 1.

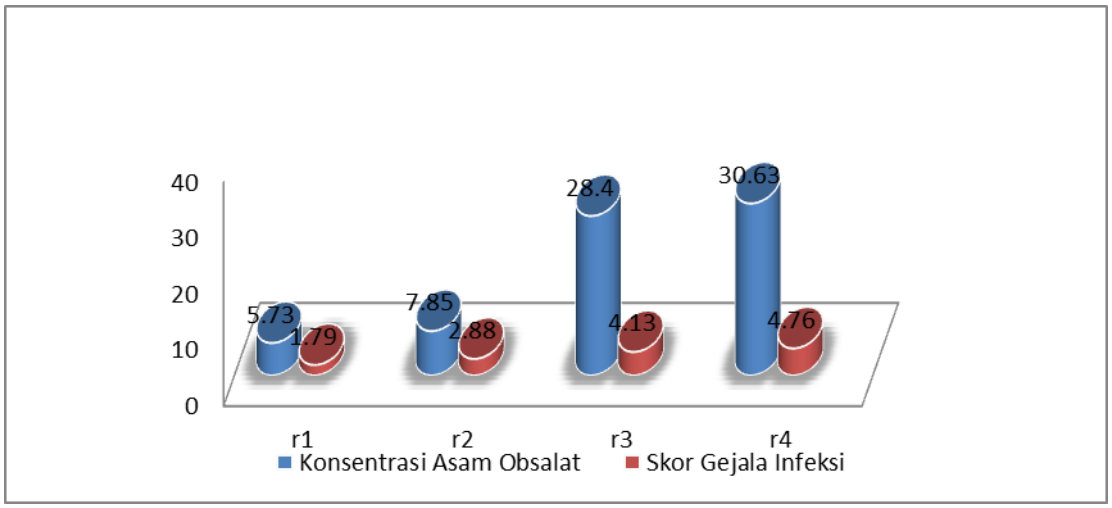

Figure1. Comparison of obsalic acid and the infection symptom score on each race of *S. Rolfsii*

Figure 1 shows the concentration of obsalic acid is proportional to the infection symptom score. This means that the greater the concentration of obsalic acid secreted by the pathogen S. rolfsii, then the peanut damage level is higher. The highest concentration of obsalic acid was shown by r4 of 30.63 gr, with infected symptom score of 4.67, followed by r3 of 28.4 gr with infected symptom score of 4.13, r2 of 7.85 gr with infected symptom score of 2.88 g, and r1 of 5.73 gr with infected symptom score of 1.79.

IV. Conclusions

Based on the results of the research, it can be concluded that each race S. rolfsii used in this study has a different level of effectiveness to the damage of the peanut grown in drought conditions. The Ras S. rolfsii used in this study had different rates of successive infections. The highest infection happened in r4, followed by r3, r2 and r1, respectively from the highest to the lowest.

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