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Jurnal ini berisi artikel mengenai uji pengaruh pemberian kitosan terhadap umur simpan mangga (*Mangifera indica* L.) varietas gedong gincu; respon pertumbuhan dan hasil tanam caisim (*Brassica juncea* L.) pada sistem hodroponik berbeda; suppression potency of secondary metabolites from weed pathogenic fungi towards narrow leaf weeds, corn, and rice; analisis pertumbuhan tanaman padi tercekam salinitas dengan penambahan bahan organik pada media tanam dan perbedaan umur bibit; serta efektivitas zat pengatur tumbuh dalam merangsang pertumbuhan tunas bulbil porang (*Amorphophalus muelleri* Blume).

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ARTICLES

PENGARUH PEMBERIAN KITOSAN TERHADAP UMUR SIMPAN MANGGA (Mangifera indica. L.) VARIETAS GEDONG GINCU

Neneng Sri Mulyati, Pandu Sumarna, Juri juswadi; Faisal Al Asad

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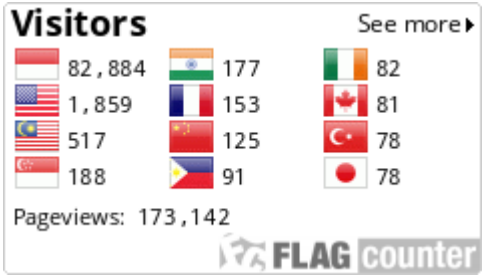

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Neneng Sri Mulyati, Pandu Sumarna, Juri juswadi; Faisal Al 'Asad

PDF

RESPON PERTUMBUHAN DAN HASIL TANAMAN CAISIM (Brassica Juncea L.) PADA SISTEM HIDROPONIK BERBEDA

Selvy Isnaeni, Nasrudin

PDF

SUPPRESSION POTENCY OF SECONDARY METABOLITES FROM WEED PATHOGENIC FUNGI TOWARDS NARROW LEAF WEEDS, CORN, AND RICE

Loekas Soesanto, Anida Amalia Rahma, Abdul Manan, Endang Mugiastuti

PDF

ANALISIS PERTUMBUHAN TANAMAN PADI TERCEKAM SALINITAS DENGAN PENAMBAHAN BAHAN ORGANIK PADA MEDIA TANAM DAN PERBEDAAN UMUR BIBIT

Nasrudin Nasrudin, Paozi Fahmi

PDF

EFEKTIVITAS ZAT PENGATUR TUMBUH DALAM MERANGSANG PERTUMBUHAN TUNAS BULBIL PORANG (Amorphophallus muelleri Blume)

Muhamad Khais Prayoga, Heri Syahrian, Tri Maruto Aji, Vitria P. Rahadi

PDF

VIEW ALL ISSUES >

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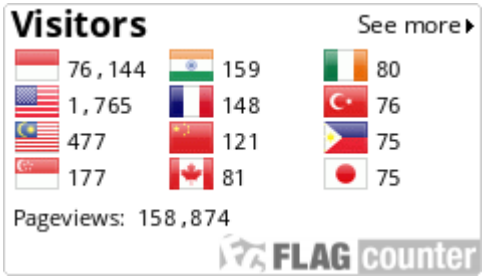

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Penerapan Internet of Things Pada Sistem Deteksi Kesuburan Tanah

Universitas Wiralodra Agro Wiralodra Vol. 6 No. 1 (2023): Jurnal Agro Wiralodra 14-20

2023 DOI: 10.31943/agrowiralodra.v6i1.79 Accred : Unknown

Karakter Morfologi Genotipe Jarak Kepyar (Ricinus communis L.) Tahan Penyakit Layu Fusarium

Universitas Wiralodra Agro Wiralodra Vol. 6 No. 1 (2023): Jurnal Agro Wiralodra 21-27

2023 DOI: 10.31943/agrowiralodra.v6i1.82 Accred : Unknown

Efektivitas Pestisida Nabati Ekstrak Daun Mimba (Azadirachta Indica) Dan Srikaya (Annona Squamosa Linn) Untuk Mengendalikan Hama Belalang Kembara (Locusta Migratiria Minilensis Mayen)

Universitas Wiralodra Agro Wiralodra Vol. 6 No. 1 (2023): Jurnal Agro Wiralodra 9-13

2023 DOI: 10.31943/agrowiralodra.v6i1.83 Accred : Unknown

Uji Media Padat Beauveria Bassiana Terhadap Mortalitas, Pembentukan Pupa Dan Kemunculan Imago Spodoptera litura Fabr.

Universitas Wiralodra Agro Wiralodra Vol. 6 No. 1 (2023): Jurnal Agro Wiralodra 1-8

2023 DOI: 10.31943/agrowiralodra.v6i1.86 Accred : Unknown

Respon Pertumbuhan Dan Hasil Bawang Merah (Allium Ascalonicum L.) Terhadap Inokulasi Fungi Mikoriza Arbuskula (FMA) Dan Pupuk Limbah Baglog

Universitas Wiralodra Agro Wiralodra Vol. 6 No. 1 (2023): Jurnal Agro Wiralodra 28-33

2023 DOI: 10.31943/agrowiralodra.v6i1.87 Accred : Unknown

Eksplorasi Agens Hayati Potensial dari Tanaman Karuk (Piper sarmentosum)

Universitas Wiralodra | Agro Wiralodra Vol 5 No 1 (2022): Jurnal Agro Wiralodra 28-35

2022 | DOI: 10.31943/agrowiralodra.v5i1.75 | Accred : Unknown

Keefektifan Lecanicillium lecanii Mengendalikan Crocidolomia pavonana Pada Skala Laboratorium

Universitas Wiralodra | Agro Wiralodra Vol. 5 No. 1 (2022): Jurnal Agro Wiralodra 15-19

2022 | DOI: 10.31943/agrowiralodra.v5i1.63 | Accred : Unknown

Analisis Molekuler Burkholderia glumae Pada Varietas Padi Ciherang Di Sawah Tadah Hujan Lingkungan Universitas Wiralodra Indramayu

Universitas Wiralodra | Agro Wiralodra Vol. 5 No. 1 (2022): Jurnal Agro Wiralodra 1-5

2022 | DOI: 10.31943/agrowiralodra.v5i1.65 | Accred : Unknown

Pengaruh Pupuk Sampah Kota Dan Pupuk Kandang Sapi Terhadap Pertumbuhan Vegetatif Dan Hasil Panen Pakcoy (Brassica Rapa) Pada Aluvial Di Kabupaten Indramayu

Universitas Wiralodra | Agro Wiralodra Vol. 5 No. 1 (2022): Jurnal Agro Wiralodra 6-14

2022 | DOI: 10.31943/agrowiralodra.v5i1.73 | Accred : Unknown

Penghambatan Berbagai Isolat Trichoderma sp. Terhadap Perkecambahan Spora Colletotrichum sp.

Universitas Wiralodra | Agro Wiralodra Vol. 5 No. 1 (2022): Jurnal Agro Wiralodra 20-27

2022 | DOI: 10.31943/agrowiralodra.v5i1.74 | Accred : Unknown

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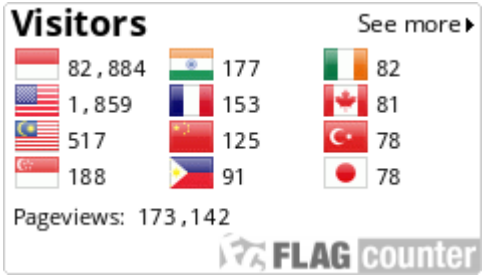

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SUPPRESSION POTENCY OF SECONDARY METABOLITES FROM WEED PATHOGENIC FUNGI TOWARDS NARROW LEAF WEEDS, CORN, AND RICE

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Abstract

This research aimed to determine the effect of secondary metabolites from weed pathogenic fungi on narrow leaf weeds and on cultivated plants. The research was conducted at the Laboratory of Plant Protection and the experimental farm, Faculty of Agriculture, Jenderal Soedirman University for five months. Split plot design was used with main plot consisted of *Fusarium oxysporum*, *Curvularia* sp., and *Chaetomium* sp. secondary metabolites and subplots consisted of *Imperata cylindrica*, *Cyperus kyllingia*, and *Cynodon dactylon*, and maize, and rice. The variables observed were the incubation period, disease intensity, infection rate, area under disease progress curve (AUDPC), plant height, and plant fresh and dry weight. Results showed that the secondary metabolites of three weed pathogenic fungi were able to infect narrow leaf weeds. From the single effect of the pathogen, the secondary metabolites of *Curvularia* sp. were the most virulence against narrow leaf weeds with increasing incubation period, disease intensity, infection rate, and AUDPC value as 79.90, 39.91, 14.4, and 99.69 %, respectively, compared to control. The secondary metabolites decreased plant height, fresh plant weight, dry plant weight as 26.66, 65.03, and 47.23 %, respectively, compared to control. From the single effect of weeds, the most susceptible weed was *Cynodon dactylon* indicated by a disease intensity of 28.08 %. From the combination effect, *Fusarium oxysporum* on *Cynodon dactylon* and *Curvularia* sp. on *Cyperus kyllingia* showed the highest disease intensity, respectively, as 53.08 and 48.14 %. The secondary metabolites of three weed pathogenic fungi were not virulence to rice and corn.

Key words: Secondary metabolites, weed pathogenic fungi, narrow leaf weeds, corn, rice.

Introduction

Increasing crop production, especially maize and rice, is affected by various problems. Some of these problems include land conditions, use of fertilizers, use of seeds, pests and diseases, and disturbance of weeds (Gawaksa *et al.*, 2016). Weed disturbances in maize and rice cropping occur due to competition between plants and weeds in obtaining water, nutrients, and light (Craine and Dybzinski, 2013). According to Rana *et al*. (2016), yield loss due to weeds on average 10% (15% in the tropics) and common weeds reduce yields of 20-100% in maize.

The amount of losses caused by weeds needs control efforts. Weed control can be done mechanically, chemically or biologically. One of the most often weed control is mechanically (Efendy *et al.,* 2020). The limited manpower for weeding weeds causes farmers to switch to using herbicides to control weeds. Weed control with herbicides is very attractive to farmers because it is economical and effective to control weeds in a wide area compared to other methods. Weed control with chemicals will face more and more challenges in the future, especially for the environment (Westwood *et al.*, 2018). Biological weed control by utilizing plant pathogens is an alternative because it is safe, effective, selective, and practical. There are several types of pathogenic fungi that have been formulated into bioherbicides and have been marketed (Chakraborty and Ray, 2021).

The results of previous studies found pathogenic fungi that can be used to control weeds, namely: *Fusarium oxysporum*, *Colletotrichum* sp., and *Cladosporium* sp. (Soesanto *et al.*, 2018; 2020). These pathogenic fungi are capable of infecting weeds with their secondary metabolites, which contain several compounds (Xu *et al*., 2021). Secondary metabolites are metabolites that are not essential for the growth of organisms and are found in unique forms or differ from one species to another (Horak *et al*., 2019).

The obstacle found in the use of weed pathogenic fungal spores in the field is that fungal spores can only grow and develop in a suitable environment so that it takes a long time to infect weeds. Therefore, secondary metabolites of weed pathogenic fungi are used to infect weeds. Because secondary metabolites are produced by weed pathogenic fungi, it is necessary to examine their effects on cultivated plants. The cultivated plants used were rice and maize because they belonged to the same weed family where the pathogen was explored. This study aimed to examine the secondary metabolites of weed pathogenic fungi in some narrow-leaved weeds and cultivated plants, such as maize and rice.

Materials and Methods

The research was carried out at the Plant Protection Laboratory and Experimental Farm, Faculty of Agriculture, Jenderal Sudirman University, Purwokerto for five months.

Preparation of weed pathogenic fungi

Fungal isolates of *F. oxysporum*, *Curvularia* sp., and *Chaetomium* sp. (Soesanto *et al*., 2018, 2020) were prepared on Potato Dextrose Agar media for 7 days at room temperature. Next, five agar cork drills (5 mm diameter) containing pathogenic fungi were put into a 500 ml Erlenmeyer flask containing Potato Dextrose Broth (PDB). Fungal cultures were incubated for 7 days using an orbital shaker (25-28 ^{o}C; 150 rpm) (Landi *et al.*, 2012). The density of fungal conidia was calculated using a haematocytometer.

Production of secondary metabolites from weed pathogenic fungi

Secondary metabolites produced in PDB were separated by centrifugation system. The secondary metabolites were centrifuged at 3000 rpm for 20 minutes then the supernatant was filtered using Whatman No.1 filter paper (Liang *et al.*, 2018).

Preparation of weeds, corn, and rice

The weeds used are narrow-leaved weeds, namely *Imperata cylindrica*, *Kyllinga brevifolia*, and *Cynodon dactylon*; while the maize and rice used were maize hybrid varieties NK 7328 (Sumo) and rice varieties Situ Bagendit. Weeds were prepared from the land homogeneously and planted on planting medium in polybags, while corn and rice seeds were prepared on a planting media mixed with soil and fertilizer (1 : 1, v/v).

Application of the sedondary metabolites

Applications were carried out on weeds, corn seeds, and rice that had grown by spraying a suspension of secondary metabolites of pathogenic fungi from a density of 10^6 conidia ml^{-1} (Chakravarthi *et al*., 2020) evenly on the entire lower surface of the leaves of weeds, corn and rice plants once a week for 5 times starting from the weeds were 14 days old, corn and rice plants were 21 days old. Secondary metabolite application was carried out in the afternoon.

Germination test

Seeds of weeds were germinated in Petri dishes with filter paper as the growth media. Weed seeds and cultivated plants were first soaked in the secondary metabolites for 15 minutes. The experimental unit for weed seeds was filled with 15 seeds, the experimental unit for corn and rice seeds was 5 seeds and replicated five times. After 7 days seed germination in Petri dishes was observed.

Research design

The research design used was a split plot design. The main plot was pathogenic fungi consisting of control, *F. oxysporum*, *Curvularia* sp., and *Chaetomium* sp. The sub-plots were three narrow leaf weeds consisting of *Imperata cylindrica*, *Kyllinga brevifolia*, and *Cynodon dactylon*; and sub-plots of cultivation plants were maize and rice. From the treatments given, there were 12 combinations of narrow leaf weed and 8 combinations of cultivated plant with three replications each. The experimental units contained in this study were 36 experimental units of weeds and 24 experimental units of cultivated plants and each experimental unit consisted of three plants.

Variables observed

Incubation period. Observations were made by recording the time the plants were symptomatic for the first time in units of days after inoculation. Disease symptom was observed macroscopically on weeds and cultivated plants. Disease intensity was observed every week using the following formula (Soesanto *et al.* 2020): DI = $(\sum(n\times v))/(Z\times N) \times 100\%$, where: DI = disease intensity (%),n = Number of plants in each category of damage, v = scale value of each category of damage, Z = Number of plants observed, and N = highest value of damage scale. Disease ranking was carried out using a 0-5 scale (0 = No infected, 1 = 1-20% infected leaf area, 2 = 21-40% infected leaf area, 3 = 41-60% infected leaf area, 4 = 61 -80% infected leaf area and 5 = more than 81% infected leaf area) (Prajapati and Chakraborty, 2017). Infection rate was calculated using the Van der Plank formula (1963): $r= \frac{e}{t} 1\log\frac{1}{1-Xt} - \log\frac{1}{1-Xo}$ where e = conversion result number (2.3), r = infection rate, t = observation time interval, Xt = proportion of sick leaves at time t, Xo = proportion of sick leaves after initial observation. AUDPC (*Area Under Disease Progress Curve)* was calculated by a formula of Jeger and Viljanen-Rollison (2001) as follow:

$$\text{AUDPC} = \sum_{i}^{n-1}\left[\frac{y_i + y_{i+1}}{2}\right](t_{i+1} - t_i)$$

where AUDPC = the disease development curve (%-days), Y_{i+1} = Observation data i+1, Y_i= Observation data i, t_{i+1}= Observation time i+1, t_i= Observation time i. Plant measurement were carried out by measuring plant height (cm) which was carried out a day before destruction using a ruler measured from the soil surface to the point of leaf growth, plant fresh weight (g) which was carried out at the last observation using a scale and plant dry weight (g) which was carried out in the last observation by

weighing the weeds that had been dried in the oven until they reached a constant weight at a temperature of 80^0C for 3 x 24 hours (Sumekar *et al.*, 2017).

Data Analysis

Data were analyzed by F test at 5% error level. If the results of the analysis show a significant and very significant difference, then proceed with the DMRT (Duncan's Multiple Range Test) further test at an error level of 5%.

Result and Discussion

Application of the secondary metabolits towards narrow leaf weeds

1. Pathogen single effect

Based on the results of the analysis (Table 1), the fastest incubation period was caused by the secondary metabolites of *Curvularia* sp. that is 79.9% compared to control. It is suspected that it contains more phytotoxins than the other two fungi, so that it quickly infects the host plant and disrupts the physiological processes of the host plant.

Table 1. Pathosystem and growth components of weed after application of the secondary metabolites

Treatments	Incubation period (dai)	Late Disease intensity (%)	Infection rate (unit/ days)	AUDPC (%-days)	Plant height (cm)	Plant fresh weight (g)	Plant dry weight (g)
Control	42,00 a	0,00 a	0,000 a	0,00 a	54,20 a	275,30 a	58,62 a
F. oxysporum	14,78 b	28,39 b	0,010 b	64,19 b	47,37 ab	144,85 ab	37,38 ab
Curvularia sp.	8,44 c	39,91 c	0,014 c	99,69 c	39,75 b	96,27 b	30,93 b
Chaetomium sp.	13,22 b	18,51 b	0,004 b	76,10 b	45,29 ab	177,53 ab	34,91 ab

Note: Numbers followed by different letters in the same column show a significant difference in DMRT with an error rate of 5%, dai= days after inoculation.

The secondary metabolites of *Curvularia* sp. caused the highest disease intensity as 39.91% (Table 1). This is reinforced by the opinion of Pontes *et al*. (2020), which states that fungal phytotoxins play an important role in the development of plant disease symptoms, incldуing leaf spots, wilting, chlorosis, necrosis, and growth inhibition and promotion. However, the highest infection rate was due to the secondary metabolites of *Curvularia* sp., i.e., 65.97% higher than the secondary metabolite of other fungi. According to Kaaniche *et al*. (2019), *Curvularia* sp. provides a broad variety of bioactive secondary metabolites including polyketides and steroids. The AUDPC value of the secondary metabolite treatment was significantly different from the control. Application of the secondary metabolite from *Curvularia* sp. towards AUDPC was 99.69 % the highest among the others. This means that the secondary metabolites of *Curvularia* sp. more effective in infecting the host according to the incubation period, disease intensity, and infection rate. This is reinforced by the opinion of Jeger and Viljanen-Rollison (2001), that the lower the AUDPC value, the slower the disease progression.

The secondary metabolites of weed pathogenic fungi was significantly different on the variables of plant height, plant fresh weight, and plant dry weight after statistical analysis (Table 1). Control treatment and the secondary metabolites of *Curvularia* sp. was significantly different. The secondary metabolites of *Curvularia* sp. was able to reduce plant height by 26.66%, plant fresh weight by 65.03%, and plant dry weight by 47.23% compared to control. This means that the secondary metabolites of *Curvularia* sp. has the potential to inhibit weed growth which is in line with the high value of the components of the pathosystem. This is in accordance with the opinion of Kaaniche *et al*. (2019).

2. Weed single effect

Based on the results of the analysis, the incubation period of the three types of weeds was significantly different (Table 2). *I. cylindrica* was 20.93% faster than *K. brevifolia*. This is consistent with the data on the effect of a single secondary metabolite of pathogenic fungi. The difference in incubation period occurs because there is different character in weed. Suitable environmental conditions will affect the plant. When the research was conducted, the intensity of sunlight was low; this could affect the stomata in *I. cylindrica* so that fungal secondary metabolites more easily enter. This is supported by Rindyastuti *et al*. (2021), that *I. cylindrica* that gets low light intensity has a higher number of stomata and has thin leaves.

Table 2. Komponen patosistem dan pertumbuhan gulma pada perlakuan jenis gulma

Kind of weeds	Incubation period (dai)	Late Disease intensity (%)	Infection rate (unit/ days)	AUDPC (%-days)	Plant height (cm)	Plant fresh weight (g)	Plant dry weight (g)
Imperata cylindrica	15,75 a	16,35 a	0,004 a	48,82 a	12,16 b	71,34 b	15,95 b
Kyllinga brevifolia	17,91 ab	20,67 ab	0,007 ab	64,89 ab	3,11 c	75,18 b	14,52 b
Cynodon dactylon	19,92 b	28,08 b	0,010 b	66,46 b	124,69 a	373,94 a	90,92 a

Note: Numbers followed by different letters in the same column show a significant difference in DMRT with an error rate of 5%, dai= days after inoculation.

Disease intensity was significantly influenced by weed type (Table 2). Disease intensity in *C. dactylon* was 41.77% and 26.38% higher, respectively, than *I. cylindrica* and *K. brevifolia*. This is because there is a faster inhibition mechanism in *C. dactylon* by secondary metabolites. According to Nitu *et al.* (2021), *C. dactylon* has stomata on both leaf surfaces. Based on this, secondary metabolites of weed pathogenic fungi have a higher chance of entering the leaves. Suitable environmental conditions favor the occurrence of higher disease intensity. The infection rate of Imperata cylindrica and *C. dactylon* weeds was significantly different. The fastest infection rate occurred in *C. dactyl* as 60% and 30% faster, respectively, than *I. cylindrica* and *K. brevifolia*. This is in line with the data on disease intensity. According to Gao *et al*. (2021), the infection rate is influenced by the large increase in the number of diseased plants. The increase in the number of diseased plants in *C. dactylon* was greater than that of *I. cylindrica* and *K. brevifolia*. AUDPC for the weed species were significantly different and *C. dactylon* showed the AUDPC were 26.54% and 2.36%, respectively, compared to *I. cylindrica* and *K. brevifolia*. The resistance of *C. dactylon* can be interpreted as lower than other weeds. This is in line with disease intensity and infection rate. The highest AUDPC indicates faster disease progression.

Plant height showed significant differences in the weed types. This happened because the plant heights of the three types of weeds were genetically different. This was presumably because genetic factors were more dominant in influencing growth. This is reinforced by the opinion of Jelenkovic *et al*. (2016), that plant height is strongly influenced by the genetic nature of the plant. Fresh and dry weight of weeds was a significant difference between *C. dactylon* and two other weeds. The difference in the fresh weight of weeds will affect the dry weight, and determine the resulting photosynthate. This is reinforced by the opinion of Huang *et al*. (2019), that plant fresh and dry weight are influenced by their ability to photosynthesis. The more leaves, the greater the weight of the plant fresh and dry weight.

3. Application of combination between the secondary metabolites and weeds

Incubation period of the control was significantly different for the three types of narrow leaf weeds (Table 3). The secondary metabolites of *Chaetomium* sp. on *I. cylindrica* and secondary metabolites of *Curvularia* sp. on *I. cylindrica*, *K. brevifolia*, and *C. dactylon* gave the highest result. The fastest incubation period occurred in *K. brevifolia* inoculated with the secondary metabolites of *Curvularia* sp. and *I. cylindrica* inoculated with the secondary metabolites of *Chaetomium* sp., i.e., 80.95% compared to control. According to Runge *et al*. (2012), the shorter incubation period indicates a high level of suitability of the pathogen and the host, which is supported by suitable environmental conditions.

Table 3. Pathosystem and growth component of weeds in the combination of the secondary metabolites and the weeds

Treatment combination	Incubation period (dai)	Late Disease intensity (%)	Infection rate (unit/ days)	AUDPC (%-days)	Plant height (cm)	Plant fresh weight (g)	Plant dry weight (g)
Control× *I. cylindrica*	42,00 a	0,00 a	0,000 a	0,00 a	14,11 a	109,26 d	17,59 c
Control× *K. brevifolia*	42,00 a	0,00 a	0,000 a	0,00 a	3,27 a	87,61 d	17,14 c
Control× *C. dactylon*	42,00 a	0,00 a	0,000 a	0,00 a	145,22 b	629,04 a	141,13 a
F. oxysporum × *I. cylindrica*	11,00 bc	13,58 b	0,003 ab	41,35 b	12,56 a	61,46 d	17,55 c
F. oxysporum × *K. brevifolia*	15,67 bc	18,51 bc	0,006 ab	42,59 b	3,00 a	80,71 d	13,62 c

F. oxysporum × *C. dactylon*	17,67 bc	53,08 e	0,021 d	108,64 cd	126,56 b	92,37 bc	80,98 b
Curvularia sp. × *I. cylindrica*	9,00 c	30,86 cd	0,010 bc	101,30 cd	11,11 a	63,90 d	16,41 c
Curvularia sp. × *K. brevifolia*	8,00 c	48,14 e	0,018 d	106,25 cd	2,94 a	53,52 d	14,52 c
Curvularia sp. × *C. dactylon*	8,33 c	40,74 de	0,014 cd	91,51 c	105,22 b	171,39 cd	61,87 b
Chaetomium sp. × *I. cylindrica*	8,00 c	20,98 bc	0,004 ab	131,75 d	10,89 a	50,76 d	12,24 c
Chaetomium sp. × *K. brevifolia*	13,00 bc	16,04 b	0,005 ab	52,64 b	3,22 a	78,88 d	12,80 c
Chaetomium sp. × *C. dactylon*	18,67 b	18,51 bc	0,005 ab	43,90 b	121,78 b	402,96 b	79,69 b

Note: Numbers followed by different letters in the same column show a significant difference in DMRT with an error rate of 5%, dai= days after inoculation.

The intensity of disease in the control of the three weeds types was different from the three secondary metabolites. The highest disease intensity was shown in the secondary metabolites of F. *oxysporum* in *C. dactylon* of 53.08%. The highest intensity occurred in the interaction of secondary metabolites of *F. oxysporum* on *C. dactylon*. This is reinforced by Bengtsson-Palme *et al*. (2018), that plant resistance to disease is influenced by the presence of resistance genes in the host plant, fungal pathogenicity, and environmental factors.

The infection rate of the combination of secondary metabolites on the control of the three types of weeds was significantly different. The secondary metabolites of *F. oxysporum* in *C. dactylon* were 76.19% and 66.67% different from the secondary metabolites of *F. oxysporum* in *I. cylindrica* and *K. brevifolia*, respectively. Secondary metabolites of *Curvularia* sp. in *C. dactylon* was significantly different from the secondary metabolites of *Curvularia* sp. as 97.29 and 83.78% in *I. cylindrica* and *K. brevifolia*, respectively. This happens because the resistance of each weed is different. According to Benítez-Malvido *et al*. (2021), the more virulent a pathogenic pathotype or race and the more susceptible the host plant, the more severe the disease and the faster its development. The severity of the disease is determined by the degree of virulence of the disease, the degree of host resistance and the influence of environmental factors (Bengtsson-Palme *et al*., 2018).

The combination between the secondary metabolites of pathogenic fungi and *C. dactylon* significantly affected plant height (Table 3). This difference is thought to be caused by genetic differences of each weed. This is in accordance with the opinion of Bengtsson-Palme *et al*. (2018) above. The control was higher than the secondary metabolites and *C. dactylon*. This can occur because cell division and metabolic processes are completely inhibited by secondary metabolites of the fungi. This is confirmed by Tsusaka *et al*. (2019), that there are two important factors that influence the growth of a plant, namely genetic factors and environmental factors. Genetic factors are related to the inheritance of the nature/behavior of the plant itself, while environmental factors are related to the environmental conditions in which the plant grows. Each plant has a different ability in growth and to adapt to the surrounding environment (Raza *et al*., 2019). Inhibition of *C. dactylon* height growth by the secondary metabolites occurs through inhibition of cell division and elongation activity (Shi *et al*., 2016).

Application of the secondary metabolits towards cultivated plants

1. Pathogen single effect

The results of variance analysis on the single effect of secondary metabolites from weed pathogenic fungi on the components of the pathosystem and growth of cultivated plants are presented in Table 4.

Table 4. Pathosystem and growth component of culativated plants on application of the secondary metabolites

Treatments	Incubation period (dai)	Disease intensity (%)	Infection rate (unit/ days)	AUDPC (%-days)	Plant height (cm)	Plant fresh weight (g)	Plant dry weight (g)
Control	42,00 a	0,00 a	0,00 a	0,00 a	43,86 a	72,51a	19,51 a
F. oxysporum	42,00 a	0,00 a	0,00 a	0,00 a	49,72 a	81,61 a	35,57 a
Curvularia sp.	42,00 a	0,00 a	0,00 a	0,00 a	44,05 a	75,29 a	27,72 a
Chaetomium sp.	42,00 a	0,00 a	0,00 a	0,00 a	40,11 a	81,59 a	31,58 a

Note: Numbers followed by different letters in the same column show a significant difference in DMRT with an error rate of 5%, dai = days after inoculation. The incubation period has a number to indicate the end of the research there are no symptoms of the disease.

The secondary metabolites of pathogenic fungi on the components of the pathosystem were not significantly different; at the time of observation the cultivated plants did not show symptoms until the end of observation (Table 4). This happens because the secondary metabolites are not toxic to cultivated plants and inhibit the growth of cultivated plants. This is reinforced by the opinion of van de Wouw and Howlett (2010), that pathogenicity genes regulate the formation of pathogenicity factors, such as infection structure, enzyme production, secondary metabolites, and toxins.

2. Cultivated plant single effect

The results of the variance analysis on the single influence of cultivated plants are presented in Table 5 below.

Table 5. Pathosystem and growth component of cultivated plants on the type of cultivated plants

Type of plants	Incubation period (dai)	Disease intensity (%)	Infection rate (unit/ days)	AUDPC (%-days)	Plant height (cm)	Plant fresh weight (g)	Plant dry weight (g)
Jagung	42,00a	0,00 a	0,00 a	0,00 a	67,01a	130,50a	50,61,a
Padi	42,00a	0,00 a	0,00 a	0,00 a	21,86b	26,50b	6,59b

Note: Numbers followed by different letters in the same column show a significant difference in DMRT with an error rate of 5%, dai = days after inoculation. The incubation period has a number to indicate the end of the research there are no symptoms of the disease.

The types of cultivated plants were significantly different in terms of growth components (Table 5). This can happen because each plant has a different shape and size character, which is very dependent on plant genetics (Bengtsson-Palme *et al*., 2018). Another factor that is the secondary metabolites do not infect cultivated plants so that the growth of cultivated plants is unimpeded. Starting from the existence of external resistance which can be in the form of physical resistance from the buds or the chemical that occurs in the shoots such as the formation of lignin (Elhiti and Stasolla, 2022).

3. Combination effect of the secondary metabolites and the cultivated plants

The secondary metabolites and types of cultivated plants did not show an interaction (Table 6). Pathosystem components were not significantly different because at the time of observation the cultivated plants did not show symptoms. Non-host plants are highly resistant to other plant pathogens, even though environmental conditions strongly support the development of these pathogens. This is confirmed by Kambakam *et al.* (2021), that plants that do not produce symptoms are suspected because the plant is resistant to pathogen attack or this plant is not a host plant.

Table 6. Pathosystem and growth component of cultivated plants on the combination of the secondary metabolites and the cultivated plants

Treatment combination	Incubation period (dai)	Late Disease intensity (%)	Infection rate (unit/ days)	AUDPC (%-days)	Plant height (cm)	Plant fresh weight (g)	Plant dry weight (g)
Control × corn	42,00 a	0 a	0 a	0 a	64,83 a	121,35 a	33,38 a
Control × rice	42,00 a	0 a	0 a	0 a	22,88 b	23,67 b	5,64 b
F. oxysporum × corn	42,00 a	0 a	0 a	0 a	76,00 a	131,92 a	60,86 a
F. oxysporum × rice	42,00 a	0 a	0 a	0 a	23,44b	31,29 b	10,29 b
Curvularia sp. × corn	42,00 a	0 a	0 a	0 a	67,78 a	123,68 a	50,32 a
Curvularia sp. × rice	42,00 a	0 a	0 a	0 a	21,33 b	26,91 b	5,12 b
Chaetomium sp. × corn	42,00 a	0 a	0 a	0 a	60,44 a	145,03 a	57,86 a
Chaetomium sp. × raice	42,00 a	0 a	0 a	0 a	19,78 b	18,15 b	5,31 b

Note: Numbers followed by different letters in the same column show a significant difference in DMRT with an error rate of 5%, dai = days after inoculation. The incubation period has a number to indicate the end of the research there are no symptoms of the disease.

Conclusion

As conclusion, secondary metabolites of three weed pathogenic fungi were able to infect narrow leaf weeds. Under the influence of a single pathogen, the secondary metabolites of *Curvularia* sp. virulent to narrow leaf weeds with 79.90% faster incubation period, 39.91% greater disease intensity, 0.0144% higher infection rate, and

99.69% higher AUDPC value than control. Secondary metabolites of three weed pathogenic fungi decreased plant height by 26.66%, fresh plant weight to 65.03%, and dry plant weight to 47.23% compared to control. The single effect of weeds showed that the most susceptible weed was *C. dactylon* which was indicated by a disease intensity of 28.08%. Based on the effect of secondary metabolites combination on narrow leaf weeds, it was shown that *F. oxysporum* on *C. dactylon* and *Curvularia* sp. in *K. kyllingia*, the highest disease intensity was 53.08 and 48.14%, respectively. Secondary metabolites of weed pathogenic fungi (*F. oxysporum*, *Curvularia* sp., and *Chaetomium* sp.) were not virulent to maize and rice plants.

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