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Curcuma (*Curcuma xanthorrhiza* Roxb) diseases in different composition of fertilizer

Penyakit temulawak (*Curcuma xanthorrhiza* Roxb) pada komposisi pemupukan yang berbeda

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ABSTRACT

Curcuma or Java Turmeric as traditional medicine has given significant contribution in industrial empowerment. The demand increased, following the increase of food and drink industry based on curcuma. Therefore, extensification and intensification in curcuma cultivation was developed, included variety and fertilizer composition. Combination of chemical and organic fertilizer was used to increase the yield. However, the effect of fertilizer to plant disease intensity should be determined. Based on the observation at month 6th, the dominant diseases were Fusarium wilt, leaf spots caused by Phyllosticta sp.*, Colletotrichum* sp. *and Gloeosporium* sp*. The greatest percentage of Fusarium wilt (11.11%) was found in variety Cursina 1 that received organic fertilizer 10 ton/ha, with disease intensity 60.52%; whilst the lowest percentage (0%) was found in Cursina 2 that received organic fertilizer. The greatest percentage of leaf spot was seen in Cursina 2 that was given organic fertilizer, with disease intensity 41.67%; whilst the lowest percentage was found in Cursina 1 that received the combination of organic fertilizer 10 ton/ha, 100 kg/ha urea, 100 kg/ha KCl, and 100 kg/ha SP-36, with disease intensity 18.06%.*

Keywords: curcuma, disease, fertilizer

ABSTRAK

Temulawak merupakan bahan baku obat tradisional maupun fitofarmaka yang memberikan peranan cukup berarti dalam penyerapan tenaga kerja. Volume permintaannya terus meningkat seiring dengan permintaan produk temulawak serta makin berkembangnya industri makanan dan minuman yang menggunakan bahan baku temulawak. Kondisi ini direspon dengan makin berkembangnya areal penanaman dan perbaikan sistem budidaya, antara lain pemupukan. Selain penggunaan varietas unggul yang biasanya mempunyai potensi hasil tinggi, pemupukan juga berpengaruh pada peningkatan hasil panen dan ketahanan tanaman terhadap penyakit. Pemupukan yang diharapkan mampu meningkatkan hasil adalah memadukan pupuk organik dan pupuk kimia dengan dosis yang tepat. Namun salah satu hal yang perlu dipertimbangkan adalah pengaruhnya terhadap keberagaman penyakit dan tingkat keparahannya. Dari hasil pengamatan saat tanaman berumur 6 bulan, penyakit yang dominan adalah layu Fusarium, bercak daun yang disebabkan oleh Phyllosticta sp.*, Colletotrichum* sp. *dan Gloeosporium* sp*. Persentase tanaman bergejala layu Fusarium tertinggi yaitu 11,11% terdapat pada varietas Cursina 1 yang dipupuk organik 10 ton/ha, dengan intensitas penyakit 60,52%, sedangkan persentase terendah yaitu 0% terdapat pada varietas Cursina 2 yang dipupuk organik, dengan intensitas penyakit 0%. Penyakit bercak daun*

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dengan persentase tanaman bergejala bercak tertinggi ditemukan pada varietas Cursina 2 yang dipupuk organik, dengan intensitas penyakit 41,67%, sedangkan persentase terendah ditemukan pada varietas Cursina 1 yang diberi kombinasi pupuk organik 10 ton/ha, serta urea, KCl dan SP-36 sebanyak masing-masing 100 kg/ha, dengan intensitas penyakit 18.06%.

Kata kunci: temulawak, penyakit, pemupukan.

Introduction

Curcuma (*Curcuma xanthorrhiza* ROXB) or Java turmeric is one of fitofarmaka plants that have been widespread in many areas in Indonesia. Its common name is temulawak. Prana (1985) reported that temulawak is originated from Indonesia, then named as *Curcuma javanica* (Badan POM, 2004). In West Java, it is called koneng gede, whilst in Madura curcuma is popular as temu lobak. In Indonesia, curcuma tuber was used as traditional medicine called jamu. It has been claimed as traditional medicine for up to 24 kinds of diseases. The tuber consists of atsiri oil, curcumin, resin, fat, kamfer, crude fiber, and calcium chloride (Quissumbing in Agusta and Chaerul, 1994). Curcumin and xanthorrhizol are the main component of atsiri oil (Oie Ban Liang in Sidik *et al*., 1997). It has been used as anti-acne, anti-cholesterol, anti-inflamation, antioxidant, anti-cancer, reducing anemia, increasing appetite, anti hepatotoxic, increasing liver function, triggering milk production, anti bacterial, as postpartum tonic, and as cosmetic material (Hadi, 1985; Agusta and Chairul, 1994; Suksamrarn *et al*., 1994; Direktorat Aneka Tanaman, 2000). Therefore in 2004, the government of Indonesia proclaimed curcuma as a National Healthy Drink.

The functions of *Curcuma xanthorriza* mainly produced by two groups of main chemical components that is curcuminoid and essential oils. Curcuminoids in *Curcuma xanthorriza* consists of two compounds that is curcumin and demetoxincurcumin. Curcumin has activity as antiinflammation, antiviral, anti tumor, anti hepatotoxic and hypocholeste-rolemic (Paryanto & Srijanto, 2006). According Rismunandar (1988), rhizome of *C. xanthorriza* contains curcumin from 1,4 to 4%, while Suwiah (1991) concluded that curcumins in rhizome of *C. xanthorriza* were 1,93%.

Curcuma grows naturally below bamboo tree or teak tree, as intercrop plants. For that reason, it was usually not cultivated optimally and not fertilized. Farmers also cultivate only the local varieties. At the other site, the demand was increased, following the increase of food and drink industry based on curcuma. It has given significant contribution in industrial empowerment. The need of curcuma in the industry of traditional medicine (Industri Obat Tradisional) and small industry of traditional medicine (Industri Kecil Obat Tradisional) in East Java was 3,140.18 tons of fresh tuber per year, while in Central Java was 361.80 tons of fresh tuber per year (Kemala *et al*., 2003). Answering the demand, extensification and intensification in curcuma cultivation should be improved. Good cultivation should be developed in farmers, includes enhancement of superior varieties and the use of chemical fertilizers. In contrast, the use of chemical fertilizer, particularly nitrogen was reported affecting diseases intensity in many plants, i.e. Phytopthora blight in potato leaf and blast or bacterial leaf blight in rice. The resistance of potato plants fell sharply on increasing the dose of NPK and with excessive N (Stroikov *et al*, 1980), whilst damage by bacterial leaf blight is greater where excessive N fertilizer and insufficient potassium (K) have been used in rice crops (Witt *et al*, 2011). Hence, recommendation of optimal fertilizer composition should be obtained. In this research, combination among chemical fertilizer, organic fertilizer, and superior varieties was advanced due to increase the yield.

Method

Research was conducted in Hargorejo Village, Kokap District, Kulonprogo Regency, Yogyakarta Special Province, from September 2010 to June 2011. The research was arranged in Randomized Completely Block Design with four treatments as follows: 1). Cursina 1 that received organic fertilizer 10 tone/hectare, 2). Cursina 2 that received organic fertilizer 10 tone/hectare, 3). Cursina 1 that received the combination of organic fertilizer 10 tone/hectare, 100 kg/ha urea, 100 kg/ha KCl, and 100 kg/ha SP-36, 4). Cursina 2 that received the combination of organic fertilizer 10 tone/hectare, 100 kg/ha urea, 100 kg/ha KCl, and 100 kg/ha SP-36. Each treatment was replicated three times. There were 30 plants per plot which planted in 60cm x 60cm plant spacing.

Visual observation was conducted in six months age of curcuma plants to four sample plants per plot. The samples were randomly selected. Symptom severity of fusarium wilt disease was determined from all leaves of each plant. All leaves were assessed for chlorosis and wilt symptom (Table 1). To determine leaf spot disease intensity, disease severity rating scale in Table 2 was used to assess the symptoms. Symptom severity of the disease was determined from all leaves of each plant. Symptom severity for each plant was calculated using the formula described by McKinney (1923).

To verify the pathogen of the leaf spot diseases, microscopic observation was conducted by direct isolation from symptomatic part of diseased plant. To ascertain Fusarium as the pathogen of plant wilt, PDA (Potato Dextrose Agar) was used for the isolation.

The means were compared by analysis of variance and by using Duncan's Multiple Range Test at P=0.05. All the statistical analysis was done using SPSS® version: 10.0.5 (SPSS, 1999).

Result and discussion

Based on the observation, the dominant diseases of Curcuma (*Curcuma xanthorrhiza* ROXB) in Hargorejo Village, Kokap District, Kulonprogo Regency, Yogyakarta Special Province, were wilt and leaf spots. Wilt symptom was caused by *Fusarium* sp. (Fig. 1A). *Fusarium* spp. are higher fungi whose sexual stage is unknown (Agrios, 1988). Due to the great variabilty within this genus, it is one of the most difficult of all fungal groups to distinguish taxonomically (Alexopoulus and Mims, 1979). However, after the isolation of symptomatic sample in PDA for two weeks, white-purple mycelium was appeared (Fig. 1B) and macro-conidia of *Fusarium* sp. was determined in the week fourth (Fig. 1C). Conida are hyaline and can be divided into three groups: macroconidia, microconida, and chlamydospores. Macroconidia are several-celled, crescent or canoe-shaped spores. Their ends vary in that some species produce sharply pointed macroconidia, while others produce spores with rounder ends. The shape of these spores are used to differentiate between the different species (Toussoun and Nelson, 1968). The majority of Fusarium species isolated produce their macroconidia on sporodochia. However, macroconidia can also be found throughout the aerial mycelium. Microconidia are one or two-celled, ovoid or oblong, and borne singly or in chains. These spores are found scattered throughout the aerial mycelium. Since the microconidia are either one- or two-celled, they are usually smaller than the macroconidia. Both macroconida and microconidia are produced from phialides. Chlamydospores are round,

Table 1. Disease severity rating scale used to assess the symptom of *Fusarium* wilt

Severity rating	Description
0%	All leaves in plant were asymptomatic
1%-20%	One to twenty percent of leaves in plant were chlorosis or wilt
21%-40%	Twenty one to forty percent of leaves in plant were chlorosis or wilt
41%-60%	Forty one to sixty percent of leaves in plant were chlorosis or wilt
61%-80%	Sixty one to eighty percent of leaves in plant were chlorosis or wilt
81%-99%	Eighty one to ninety nine percent of leaves in plant were chlorosis or wilt
100%	All leaves in plants were chlorosis or wilt

Table 2. Disease severity rating scale used to assess the symptoms of leaf spot

Severity rating	Description
0	All leaves in plants asymptomatic
1	One to twenty percent of leaves in plant were spotted
2	Twenty one to forty percent of leaves in plant were spotted
3	Forty one to sixty percent of leaves in plant were spotted
4	Sixty one to eighty percent of leaves in plant were spotted
5	Eighty one to ninety nine percent of leaves in plant were spotted
6	All leaves in plants were spotted

one- or two-celled, thick-walled spores produced terminally or intercalary on older mycelium (Agrios, 1988).

On the other hand, after conducting direct isolation from symptomatic part of spotted leaf, combination of three fungi, i.e. *Phyllosticta* sp., *Cercospora* sp. and *Colletotrichum* sp. was obtained (Figure 2). A leaf spot disease caused by Phyllosticta is common in Curcuma. Spots with whitish centre develop on the leaves and pycnidia of the fungus are formed in these (Ramakrishnan, 1942).

It was very interesting that the symptoms of leaf spot were varies (Figure 3). It is suggested that the combination of pathogens causing varies symptom. It was also expected that specific type of appeared symptom was affected by particular pathogen that was dominant in causing the symptoms. However, in general, leaf spots are first visible on older leaves at the bottom of the plant then spread upward toward the top of the plant. Initial spots are purple and small with a circular shape. As spots enlarge, they often become irregular or angular in shape and develop a tan or gray center surrounded by a purple or brown border. Leaves that are severely spotted often become a yellow-green color (Semangun, 1981).

Results of Fusarium wilt observation of each variety with particular fertilizer treatment was shown in Table 3. The *Fusarium* spp. that cause vascular wilts can be spread in soil, dust, and irrigation water (Smith et al., 1988). Wind, rain, farm equipment, and decaying plant tissue can also help to spread the fungus. It can remain in the soil for long periods of time, including fallow periods. Healthy plants can become infected through their root tips; either directly, through wounds, or at the point of formation of lateral roots (Agrios, 1988). The fungus grows as mycelium through the root cortex intercellularly, ultimately advancing to the vascular tissue. As the mycelium continues to grow - usually upward toward the stem and crown - it branches and produces microconidia. The proliferation of fungal growth in the plant's vascular tissue eventually causes the plant to wilt and die. The fungus can continue to grow on the decaying tissue where it can sporulate profusely. At this point, the spores can be spread to other plants or

Table 3. Mean (n = 3) of *Fusarium* wilt symptom expressed by six month age of Curcuma plants in various fertilizer composition

Treatment	Percentage of symptomatic plants per plot	Disease Intensity (%)
Cursina 1 with organic fertilizer	11.11 c	60.52 b
Cursina 1 with the combination of organic fertilizer and NPK	6.25 b	21.67 ab
Cursina 2 with organic fertilizer	0.00 a	0.00 a
Cursina 2 with the combination of organic fertilizer and NPK	8.33 bc	35.83 ab

Means followed by the same letter in the same column are not significantly different according to Duncan's multiple range test at *P*=0.05

Table 4. Mean (n = 3) of leaf spot symptom expressed by six month age of Curcuma plants in various fertilizer composition

Treatment	Percentage of symptomatic plants per plot	Disease Intensity (%)
Cursina 1 with organic fertilizer	58.33 c	38.89 b
Cursina 1 with the combination of organic fertilizer and NPK	20.83 a	18.06 a
Cursina 2 with organic fertilizer	31.94 ab	41.67 b
Cursina 2 with the combination of organic fertilizer and NPK	40.28 bc	23.61 ab

Means followed by the same letter are not significantly different according to Duncan's multiple range test at *P*=0.05

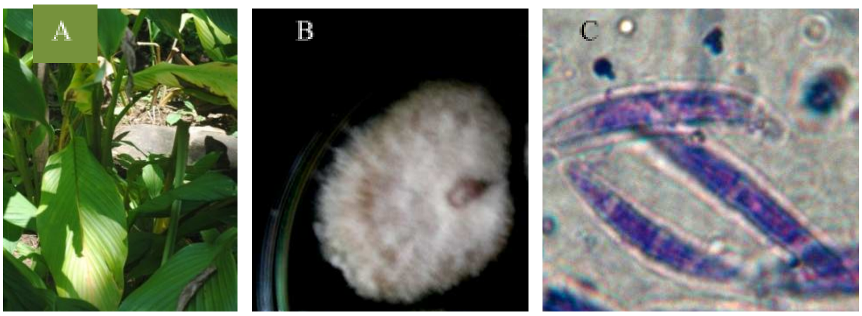

Fig. 1. Wilt symptom on curcuma plants (A), Mycelium of *Fusarium* sp., the causing pathogen (B). Macro-conidia of *Fusarium* sp. (C).

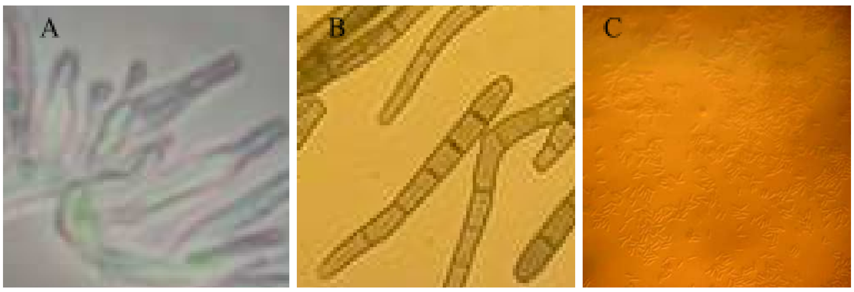

Fig. 2. *Phyllosticta* sp. (A), Cercospora sp. (B), and *Colletotrichum* sp. (C).

Fig. 3. Leaf spot symptoms in various type

areas by wind, water, or through the movement of soil (Agrios, 1988). On occasion, the fungus can reach the fruit and contaminate the seed. This occurs when the soil moisture is high and the temperature is relatively low (Agrios, 1988). In addition the vascular wilting, the fungus can infect other parts of the plant close to the soil to induce root, stem, and corm rots. When seedlings are infected by Fusarium, damping-off may occur. If harvested fruits are contaminated with the fungus, postharvest diseases such as "pink or yellow molds" on vegetables and ornamentals can develop. This is especially important on root crops (tubers and bulbs), as well as on low-lying crops like cucurbits and tomatoes (Agrios, 1988).

The results showed that the greatest percentage of symptomatic plants per plot was found in variety Cursina 1 that received organic fertilizer 10 ton/ha. In Cursina 1, there were 3.33 of 30 plants (11.11% plants) which showed Fusarium wilt. Meanwhile, the disease intensity of each plant was 60.52%. On the other hand, Fusarium wilt could not be found in Cursina 2 that received organic fertilizer. It was expected that Cursina 1 was relatively more susceptible to Fusarium wilt than Cursina 2. When Cursina 1 and Cursina 2 received organic fertilizer, Cursina 2 was significantly more resistance than Cursina 1. Conversely, when Cursina 1 and Cursina 2 received the combination of organic fertilizer and NPK, there was no different between both. Similar results were seen on the effect of fertilizers to disease intensity. Organic fertilizer resulted higher disease intensity in Cursina 1 than Cursina 2, whilst the combination of organic fertilizer and NPK made Cursina 1 not different from Cursina 2.

In leaf spot symptom observation, disease performance of each variety with particular fertilizer treatment was shown in Table 4. The greatest percentage of symptomatic plants per plot was seen in Cursina 1 that received organic fertilizer. There were 58.33% of all plants in the plot showed leaf spot symptom, whereas each symptomatic plant showed 38.89% disease intensity. Similar results were found in Cursina 2 that received the combination of organic fertilizer and NPK. 40.28% of all plants in the plot showed leaf spot with disease severity 23.61%. Quite the reverse, the lowest percentage of plants per plot was seen in Cursina 1 that received the combination of organic fertilizer and NPK. In the plot, 20.83% of all plants showed leaf spot symptom, while the disease intensity was 18.06%. It is likely that the symptom of leaf spot disease in Cursina 1 was affected by fertilizer. Cursina 1 that received only organic fertilizer was more resistance against leaf spot than Cursina 1 that received organic fertilizer and NPK. While in Cursina 2, leaf spot disease was not affected by fertilizer application. The percentage of symptomatic plants per plot and the disease intensity was not difference between Cursina 2 that received only organic fertilizer and Cursina 2 that received the combination of organic fertilizer and NPK. In Cursina 2 that received only organic fertilizer, 31.94% of plants in plot were showing symptom with disease intensity per plant was 41.67%. Despite the fact, 40.28% of Cursina 2 in plot of combination between organic fertilizer and NPK showed leaf spot, whereas the disease intensity was 23.61%.

Conclusion

1. By adding organic fertilizer 10 ton/ha without NPK, Cursina 2 was more resistance to Fusarium wilt than Cursina 1.
2. Leaf spot diseases in Cursina 1 was affected by fertilizer, whilst in Cursina 2 was not.
3. Cursina 1 that received only organic fertilizer had higher disease intensity and percentage of symptomatic plants per plot than Cursina 1 that received combination of organic fertilizer and NPK.

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