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# Indonesian red chilli (*Capsicum annuum* L.) capsaicin and its correlation with their responses to pathogenic *Fusarium oxysporum*

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A B S T R A C T

Red chili is a commercial crop for the food industry in Indonesia. There are some categories of red chili based on their pungency. The hot chili usually has more capsaicin than the sweet chili. Some cultivars may have more resistance to pathogen infection than the others. This research aimed to analyze the disease resistance of red chili cultivars from Indonesia against pathogenic *Fusariumoxysporum* and the correlation with capsaicin contents. Disease resistance was examined by determination of the Disease Severity Index (DSI) 15 dpi (days post inoculation). The correlation was analyzed by the regression coefficient. The result showed that the most resistance cultivar against *F. oxysporum* was Branang, while Lembang-1displayed the contrary. There was not a correlation of capsaicin content with the chili resistance to *F. oxysporum*.

*Keywords: capsaicin, disease severity index, chili*

## I. Introduction

Chilli (*Capsicum*) is one of the family Solanaceae. It is from South America (7.500 BC) which have about 25 wild species as the progenitor (Perry et al., 2007). Now there are five species domesticated, includes *C. annuum, C. frutescens, C. chinense, C. baccatum, and C. pubescens* (Pickersgill, 1997). The domesticated species came to Asia by Portugal and Spain trading and were dispersed mainly to Philippine, India, China, Indonesia, Korea, and Japan (Perry et al., 2007).

Indonesia has domesticated many cultivars of *C. annuum* that known as red chili or big chili. Indonesian used the chili as a spice of their food. The food industry uses the red chili as a raw material for chili sauce and chili-powder products. The medical industry uses red chili as a capsaicin source for pain treatment. The *C. annuum* was categorized into two varieties, namely as *C. annuum* variety longum and *C. annuum* variety grossum. Indonesian mostly define *C. annuum* variety as longum. The *C. annuum* variety grossum was recognized as “paprika” and just found in the high and cold area (Djarwaningsih, 2005). The red chili was cultivated from the landrace to the mountain as an annual crop (Setiadi, 2011). There are big red chili and curly-red chili based on the difference in fruit surface. The big red chili has a smooth surface, while the curly-red chili has a wrinkled surface of the fruit. There were 86 cultivars of big-red chili and 87 cultivars of curly-red chili that registered in the Agriculture Ministry of Indonesia by 2011. This research aimed to analyze the disease resistance of red chili cultivars from Indonesia against pathogenic *Fusarium oxysporum* and the correlation with capsaicin contents.

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## II. Material and Methods

### Fungal and Plant materials

Pathogenic *Fusariumoxysporum* was isolated from wilting fusarium chili in Tawangmangu, Karanganyar Indonesia (Ferniah, *et al*., 2014). The fungi were grown in Potato Dextrose Agar and Broth for the cultivation before inoculated to plants. This research used local Indonesian red-chili cultivars. Branang, Gantari, and Cipanas were open-pollinated cultivars produced by Indonesian Breeding Centers. Lembang-1 andKencana were open-pollinated cultivars produced by Indonesian Vegetable Research Centre.

### Methods

Capsaicin content was analyzed for each cultivar of chili. The analysis was done by research service center (LPPT) of Gadjah Mada University, Yogyakarta Indonesia, using thin layer chromatography.

Seeds were spread in a tray and grown under plastic canopy, one tray to one cultivar. After 7 – 10 days the seedlings started to grow. Then the seedlings were planted into small polybag (3 x 5 cm) contains topsoil and maintained under plastic canopy. On 30 days after planting (dap), each cultivar was grown in 30 x 30 cm polybag contained topsoil and maintained carefully. The experiment was completely randomized design with ten replicates of each cultivar.

*Fusarium oxysporum* was grown in Potato Dextrose Broth (PDB) for four daysand incubated up to $10^6$ conidia/mL. The conidia were inoculated on 30-day-old chili plants by the root dip method (Herman & Perl-Treves, 2007; Karimi *et al.*, 2010). Disease symptoms were observed every other day post-inoculation (dpi) for 15 dpi. Symptoms were recorded using the following system: Score 0 = no symptom, 1 = lower height compared to control, 2 = lower height and chlorosis, 3 = 10% chlorosis and/or 10% wilting, 4 = 11–25% wilting, 5 = 26–50% wilting, 6 = 51–100% wilting and dead. The disease severity index (DSI) was determined by the following equation (Wongpia & Lomthaisong, 2010):

$$\text{DSI} = \sum \frac{\text{(Disease severity scale x number of plants in each scale)}}{\text{(Highest numerical scale index x total number of plants)}} \text{ x } 100\%$$

Based on their DSI, plants were categorized as highly resistant (HR) if $0\% < \text{DSI} \leq 2\%$, resistant (R) if $2\% < \text{DSI} \leq 10\%$, susceptible (S) if $10\% < \text{DSI} \leq 30\%$, and highly susceptible (HS) if $30\% < \text{DSI} \leq 100\%$ (modified from Nsabiyera *et al*., 2012).

Correlation of the capsaicin content and disease severity index was analyzed by correlation curve.

## III. Results and Discussion

Capsaicin content of Indonesian red chili showed the variable amount. It is accordance with Nwokem *et al*. (2010) that determine many variable capsaicin contents from Nigerian chili. Table 1 showed Indonesian red chili capsaicin content.

**Table 1**. Capsaicin content of Indonesian red chilli cultivars

| Cultivar | Capsaicin content (mg/100 g) |
|---|---|
| Cipanas | 0.923 |
| Lembang-1 | 0.779 |
| Branang | 0.744 |
| Gantari | 0.712 |
| Kencana | 0.430 |

The table showed that Indonesian red chili has more capsaicin content (0.430 – 0.923 mg/g) than Nigerian chili (0.116 – 0.810 mg/g) based on Nwokem *et al*. (2010) research. Usually, the capsaicin content is correlated with the pungency. In Nigerian chili, the most pungent chili has the most capsaicin, and the less pungent chili has the less capsaicin. So, it is possible for Indonesian red chili to have more pungency than the Nigerian chili.

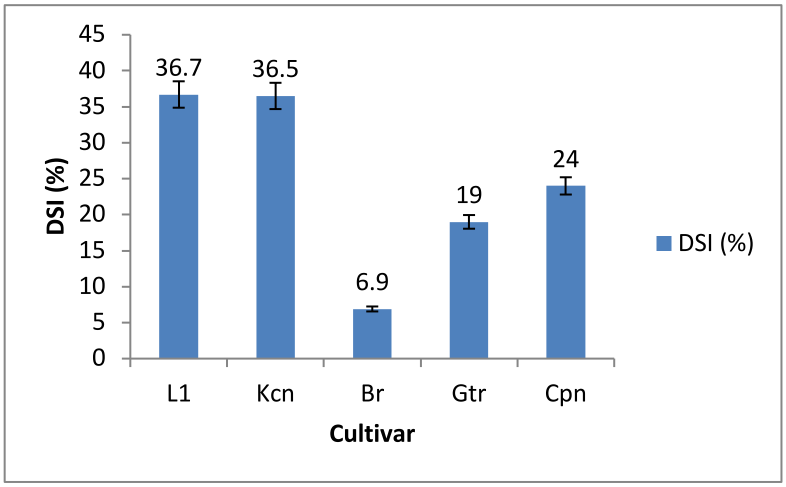


**Figure 1.** Disease Severity Index of Indonesian red chili cultivars inoculated with pathogenic *Fusarium oxysporum* at nine dpi (days post inoculation)

The resistance testing showed that Branang has the highest resistance to *F. oxysporum* infection. This is indicated by the smallest value of the Disease Severity Index (6.9%) compared to other chili cultivars. DSI values are shown in Figure 1. Based on the DSI values of each cultivar, Branang is categorized as resistant, Gantari and Cipanas are categorized as susceptible, while Lembang-1 and Kencana are classified as highly susceptible. The value of DSI and the resistance of chili plants is in accordance with the previous research indicating that Branang was a resistant cultivar and Lembang-1 was a cultivar of Highly Susceptible (Ferniah et al., 2014). Plant resistance is determined by the genetic differences of each cultivar and its adaptability to the environment.

The relationship between capsaicin content and DSI value can be seen from the regression correlation graph. Figure 2 shows that the regression coefficient (R2) is 0.128, which means that there is no good correlation between capsaicin content and DSI.

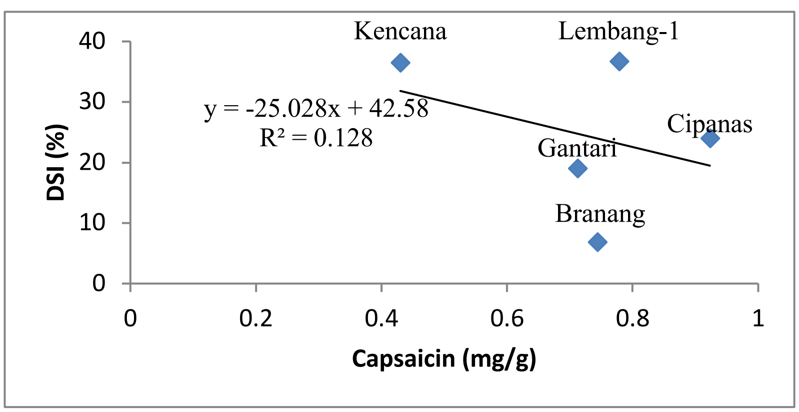


**Figure 2.** Capsaicin and DSI correlation of Indonesian red chilli

## IV. Conclusion

The most resistant cultivar against *F. oxysporum* was Branang, while Lembang-1 displayed the contrary. There was not a correlation of capsaicin content with the chili resistance to *F. oxysporum*.

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