

EFFECT OF CAPTAN AND CARBOFURAN ON SPORES PRODUCTION OF *Entrophospora* sp.

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ABSTRACT

The effects of pesticides captan, carbofuran and mixed of the two pesticides were studied on fungal development and spore production of AM fungi *Entrophospora* sp. associated with sorghum plant. Three pesticides application were carried out, namely before planting, 5, and 10 weeks after planting. All pesticides treatment had an effect on both fungal development within the root and spore production in the soil except captan application at five weeks.

Keywords : captan, carbofuran, spores production, *Entrophospora* sp.

Pesticides are commonly used to reduced pathogenic organism in both field crop and arbuscular mycorrhizal fungi inoculum production. Arbuscular mycorrhizal fungi inoculum contained plant pathogens, it will act as not only source arbuscular mycorrhizal fungi inoculum but also the plant pathogens. Many pesticides had been studied for their effects on arbuscular mycorrhizal symbiosis. The result showed that most of pesticides studied have deleterious effects (Sukarno, 1993; 1996) and some of them were compatible with the arbuscular mycorrhizal fungi (Dehne, 1981). Most studies were used temperate arbuscular mycorrhizal fungi. There was no sufficient information of pesticides effects on tropical arbuscular mycorrhizal fungi. Therefore, the present study was carried out to study the effects of two pesticides, captan and carbofuran, on the spores production of arbuscular mycorrhizal fungus.

METHODS

Arbuscular mycorrhizal fungus used in this experiment was *Entrophospora* sp. which kindly supplied by Research Institute for Food Crops Biotechnology, Bogor. Spore was used as inoculum. The spores were collected using wet sieving and decanting method (Gerdemann & Nicolson, 1963). Zeolit was used as growth medium and sorghum (*Sorghum bicolor* L.) was as a host plant. Sorghum seeds were germinated on sterile zeolit. After the seedlings reaching 5-6 days they were transferred into pot contained 200 g of sterile zeolit. Filty spores were inoculated and placed under the seedling roots.

There were three treatment of pesticide applications and two types of pesticides, captan and carbofuran. They were applied individually. Pesticides application were before planting, 5, and 10 weeks after inoculation. The concentration used were 10 mg captan (orliocide 50 W) 11.56 mg carbofuran (furan 3 G) and mixed captan (7.50 mg) and carbofuran (5.78 mg). In each treatment, pesticide was diluted in 15 ml aquadest before applied then poured individually into each pot. Control treatment was watered with 15 ml aquadest without any pesticide. Plants were grown in a glass house. Plants were fertilized by Johnson's nutrient solution four times a week and watered with aquadest daily.

Single harvest was conducted at 12 weeks after planting. After the plants reached 12 weeks age, watering was stopped and left the plant dry for about six weeks. To measure root colonization, root samples were taken randomly from the pot and cleared and stained using the method of Koske & Gemma (1989). Determination of total and infected root lengths was followed the method of Giovannetti & Mosse (1980). The number of spores obtained from the pot was from each treatment were recorded. Spores extraction used wet sieving and decanting method (Gerdemann & Nicolson 1963). The grams of zeolit collected randomly from dried pot were sieved to collect spores.

Data were analyzed using completely randomized design with two treatment factors. First factor was name of fungicides with four levels treatment, they were control, captan, carbofuran, and mixed of half concentration of both pesticides. The second factor was pesticide application, c.i., before planting, 5, and 10 weeks after planting.

RESULTS AND DISCUSSION

Root Colonization

All plants were highly colonized by the *Entrophospora* sp. (Table 1). Inoculated control treatment was colonized over than 95%. Pesticides reduced root colonization, but on significant statistically except for captan applied at 5 weeks after planting. Application of captan at 5 weeks after planting reduced the root colonization into two third of that of the inoculated control treatment. Even though root colonization was reduced by the application of captan, carbofuran, and mixed of both pesticides but the value of percentage infection in general still over than 75%.

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Table 1. Percentage root colonization of *Entrophospora* sp. with pesticides application.

Pesticides	No pesticide	Time of pesticide applications (weeks after planting)		
		0	5	10
	95.7a	-	-	-
Captan	-	90.0ab	69.3b	92.0ab
Carbofuran	-	91.3ab	84.7ab	76.3ab
Mix*	-	92.3ab	80.3ab	88.0ab

* Mixed of half concentration of captan and carbofuran

Figures in the same column followed by the same letter are not significantly different ($P < 0.05$)

Spores Production

Production of spores per 10 g of medium in inoculated control treatment was reasonably high (Table 2). There was no effect of pesticide application observed. There was a high variation in the number of spores amongst the treatments, however, the difference was not statistically significant (Table 2). The higher number of spores was recorded at mixed fungicide treatment applied before planting whereas the lowest value was observed at captan treatment applied at five weeks after planting.

Table 2. Spores production of *Entrophospora* sp. with pesticide applications.

Pesticides	No pesticide	Time of pesticide applications (weeks after planting)		
		0	5	10
	189a	-	-	-
Captan	-	160ab	51a	190a
Carbofuran	-	218a	116a	156a
Mix*	-	233a	191a	196a

* Mixed of half concentration of captan and carbofuran

Figures in the same column followed by the same letter are not significantly different ($P < 0.05$)

Field Application

In general application of pesticide captan, carbofuran and the mixer of the two pesticide has no effect on both production of spores and root colonization except for captan at five weeks application which reduced the percentage of root colonization significantly. It seems that captan had more severe effect on *Entrophospora* sp. than carbofuran at five weeks application.

Application of pesticide before planting had no effect on fungal development in the root and spore production. This may due to the thick wall of *Entrophospora* sp. can protect the spore from pesticide effect. *Entrophospora* cell wall has similar characteristic with *Acaulospora laevis* which required incubation time for germination for about 11 days (Brundrett & Juniper 1995). It is assumed that *Entrophospora* sp. has the same period of time to germinate. Captan and carbofuran degraded in the soil for 3-4 and 30 days, respectively.

Therefore, when the spores germinated the effect of pesticides was not severe particularly for captan which already degraded fully in the soil. Less effect of pesticide on spore germination will minimized the effect on fungal development with in the root and consequently has minimum effect on spore production. The effect of pesticides in plant growth independently from the *Entrophospora* sp., however, was not determined in this experiment. Therefore, what mechanism of the pesticides tested can not be concluded.

Application of captan at five weeks reduced root colonization and spore production into one third of that of the inoculated untreated control value even though the reduction was not statistically significant. This negative effect may due to the detrimental effect of the pesticide on the stage of active growth of the fungi.

There was no synergism effect of mixed captan and carbofuran application on fungal development and spore production observed. This may cause by the lower concentration of each pesticide used. Similarly, application of pesticides 10 weeks after planting had no effect on fungal development. At 10 weeks time after planting, plants had been highly colonized by the fungi, therefore pesticide application had less effect compare to that of five weeks application. In addition, pesticide tested in this experiment were non-systemic so that fungi inside the root was less influenced by the application of pesticide compare with systemic ones.

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