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Effect of systemic fungicides on *in-vitro* growth of *Pythium aphanidermatum*, the rhizome rot pathogen of ginger

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The rhizome rot of ginger (*Zingiber officinale* Rose.) caused by the fungus *Pythium* spp. is a major problem in all the ginger growing areas. Reports on *in-vitro* and *in-vivo* efficacy of many conventional fungicides (1,9,11,12) on *P. aphanidermatum* are available, yet information with regard to the newer anti-pythiaceous systemic fungicides is either inadequate or lacking. We evaluated five chemicals representing four different groups of fuingicides for their efficacy on mycelial growth of the fungus.

The systemic fungicides used in this study included two phenylamides [metalaxyl technical 95.9 per cent, Hindustan Ciba-Geigy Ltd.; oxadixyl 25 W.P. Sandoz (India) Ltd.,]; one alkyl phosphonate [aliette 80 W.P. (fosetyl-Al) Rhone-Poulene Agrochemicals (India) Ltd.]; one carbamate [previcur-N 72.2 per cent (propamocarb) Schering AG] and ethazole [terrazole 35 W.P. (Olin Corporation)]. The stock solutions of the fungicides were prepared in sterile distilled water and then incorporated in required quantities to cornmeal agar medium before dispensing into petri plates. The concentration ranges tested were 0.01–10 μg/ml of metalaxyl and ethazole; 100–1000 μg/ml of fosetyl-Al and 0.01–100 μg/ml of oxadixyl and propamocarb. The water content of the cornmeal agar was so adjusted as to get a final volume of 50 ml for each concentration after adding the fungicide solution. This was uniformly distributed into three 100 × 15 mm petri plates which served as replicates. Three plates containing unamended cornmeal agar were maintained as control.

P. aphanidermatum isolated from the collar regions of infected pseudostems of ginger and maintained in carrot agar slants was used in the studies. The petri plates were inoculated with 3 mm discs cut from advancing margins of a 3-day old culture grown on carrot agar. Because of the fast growth of the fungus the inoculum discs were kept towards the periphery of the plates in order to allow a longer incubation period. The inoculated plates were incubated at 25 ± 1°C for 48 h. The radial growth of the fungal colonies were measured as distance from the edge of the inoculum disc to the margins of the colonies extending through the centre of the plates. Linear regression analysis of the probit values of inhibition percentages and the log values of 100 × concentrations was carried out to obtain the ED_{50} and ED_{90} values (Table 1).

TABLE 1 : *In-vitro* effect of systemic fungicides on mycelial growth of *Pythium aphanidermatum* on cornmeal agar expressed as ED_{50} and ED_{90} (μg/ml).

Fungicides	ED_{50}	ED_{90}
Fosetyl-Al	293.70	934.10
Metalaxyl	0.74	9.50
Oxadixyl	27.18	179.60
Propamocarb	4.44	305.56
Ethazole	0.25	1.14

Ethazole was most toxic of all the fungicides tested and had the lowest ED_{50} and ED_{90} values (Table 1) followed by metalaxyl. The slope values of these fungicides were 1.94 and 1.15 respectively. Fosetyl-Al with a slope value of 2.55 had a low *in-vitro* toxicity against *P. aphanidermatum*. An indirect mode of action through modified host defence was attributed to fosetyl-Al earlier (2,7) but it is now reported to have a direct mode of action on the fungus (4,5,6,8). Propamocarb has a lower ED_{50} (4.4 μg/ml) but a higher ED_{90} value (305.56 μg/ml) compared to oxadixyl whose ED_{50} and ED_{90} values are 27.18 and 179.6 μg/ml respectively. The correlation coefficients of the fungicides varied from 0.91 to 0.99. Though ethazole showed very high *in-vitro* toxicity, its low water solubility may influence its systemicity in plants because water solubility is considered to be an important attribute of fungicides with selective action against oomycetes which usually thrive in aqueous environments (3,10).

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