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EFFECT OF ZINC ON *TRICHODERMA HARZIANUM* AND SHEATH BLIGHT OF RICE IN NURSERY

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ABSTRACT

This study was aimed to know the effect of zinc on Trichoderma harzianum and sheath blight of rice in nursery. Soil application of T. harzianum significantly increased seedling emergence. Maximum seedling emergence (92.67%) was observed in zinc treated soil. Maximum reduction in disease severity (50.67%) and incidence (44.66%) was observed with the soil without zinc and Rhizoctonia solani. However, disease severity of sheath blight was minimum (31.38%) with soil application of zinc followed by the treatment foliar application of zinc (34.31%). Disease incidence was maximum (65.98%) in zinc deficient soil and minimum (39.10%) with soil treated with zinc sulphate.

Keywords: Rice, sheath blight, *Trichodrma harzianum, Rhizoctonia solani*, zinc

Among the rice diseases sheath blight caused by *Rhizoctonia solani* Kuhn [*Thanatephoruscucumeris* (Frank) Donk] is regarded as an internationally important disease, particularly since the introduction of high yielding varieties since 1900s. In India intensive and extensive cultivation system especially under rice-wheat cropping systems have resulted in occurrence of sheath blight in epiphytotic proportions hitherto considered as minor disease. Losses usually range from negligible to 50% depending on the extent of severity of the disease and the crop stages at which the disease appears and the environmental conditions. The disease has reported to cause loss up to 69% (Naidu, 1992). The loss is closely correlated with the number of hills affected. The pathogen is soil borne and remains viable in soil for several months (Ou, 1985). The sclerotia of *R. solani* in soil play a significant role in perpetuation and spread of the disease in rice fields under water logged conditions (Kannaiyan and Prasad, 1978). The management of sheath blight by the use of resistant cultivars has not been successful because an adequate level of host resistant has not been found (Mew and Rosals, 1986). In the absence of desired host resistance the disease is currently managed through fungicides but their use is limited to the more affluent countries. In recent years, the increasing use of pesticides in agriculture has been the subject of growing concern for both environmentalists and public health authorities. Besides their non-target effects and hazardous nature, they are becoming more expensive and some are losing their effectiveness due to development of resistant strains. For disease management biological control is eco-friendly, environment conscious and an alternative method to chemical control. Reports are available indicating *T. harzianum* as a highly effective biocontrol agent against sheath blight. The bioagent inhibits the pathogen by competition, antibiosis, induced resistance, siderophore production or by plant growth promotion (Weller, 1988). There are only few reports providing information on the role of soil and nutritional factors on the effectiveness of bioagents (Meena and Muthusamy, 1998; Gnanamnickam *et al*., 1992). In the present study, experiments were conducted in nursery to assess the effect of zinc on *T. harzianum* and sheath blight.

MATERIALS AND METHODS

Sheath blight pathogen (*R. solani*) isolated from naturally infected rice plants was mass culturedon sorghum grain medium (Whitehead, 1957). *T. harzianum* which was found effective against *R. solani in vitro* conditions was multiplied on Jhingoragrains and bioagent was added in sterilized Talc + Carboxy methyl cellulose (4:1) powder to obtain 10^8/g and mixed well under aseptic conditions. This experiment was conducted to determine the effect of soil application/foliar spray of zinc on *T. harzianum*. Treatments were soil application of zinc at 25 kg/ha, foliar spray of urea + zinc (2 kg zinc + 200 gm urea/ha) and a control without zinc. The experiment was conducted by using natural clay loam soil filled in plastic pots of 15 cm size. In plastic pots, upper 2-3 cm soil was thoroughly mixed with the mass culture of *R. solani* at 2g/kg soil and covered with transparent polythene. After 4 days, talc + carboxymethyal

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cellulose formulation of *T. harzianum* was added to the soil @ 2g/kg in each pot and mixed thoroughly with top 2-3 cm soil of the pots. Subsequently, pots were watered lightly. The pots without antagonist were maintained as check. Three replications were maintained for each treatment. Twenty seeds of rice cultivar Pant Dhan-4 were sown in each plot. Watering of pot was done at the optimum level. Data on seedling emergence and number of infected seedlings (disease incidence), lesion length (disease severity) were recorded 10 and 25 days after sowing, respectively (IRRI, 1996). Per cent increase in germination, reduction in disease incidence and per cent disease control were calculated using the following formula:

$$\%\ Germination = \frac{No.\ of\ seed\ germinated\ in\ a\ pot}{Total\ no.\ of\ seeds\ sown\ in\ a\ pot} \times 100$$

$$\%\ increase\ in\ germination = \frac{No.\ of\ seedlings\ in\ treatment - No.\ of\ seedlings\ in\ check}{No.\ of\ seedlings\ in\ check} \times 100$$

$$\%\ disease\ incidence = \frac{Number\ of\ infected\ plants\ hill\ in\ a\ pot}{Total\ number\ of\ plant\ hill\ in\ a\ pot} \times 100$$

$$\%\ reduction\ in\ disease\ incidence = \frac{No.\ of\ infected\ tillers\ in\ check - No.\ of\ infected\ tillers\ in\ treatment}{No.\ of\ infected\ tillers\ in\ check} \times 100$$

$$\%\ disease\ severity = \frac{Lesion\ height\ (cm)}{Total\ height\ of\ the\ same\ plant\ (cm)} \times 100$$

$$\%\ reduction\ in\ disease\ severity = \frac{Lesion\ height\ in\ check\ plants\ (cm) - Lesion\ height\ in\ treatment\ plants\ (cm)}{Lesion\ height\ in\ check\ plants\ (cm)} \times 100$$

RESULTS AND DISCUSSION

Table-1: Effect of zinc on the efficacy of *T. harzianum* against sheath blight which applied as soil treatment in rice nursery

Treatments	Seedlings emergence (%)			Disease severity (%)			Disease incidence (%)		
	Treated* (with TH)	Untreated*	Reduction in seedling emergence (%)	Treated* (with TH)	Untreated*	Reduction in disease severity (%)	Treated* (with TH)	Untreated*	Reduction in disease incidence (%)
Soil application of zinc + RS	92.67 (74.23)	79.33 (62.92)	16.81	12.35 (20.43)	18.00 (24.30)	31.38	27.75 (31.81)	39.10 (38.71)	29.02
Foliar application of zinc + RS	86.00 (68.00)	67.67 (54.45)	27.09	15.60 (23.22)	23.75 (29.08)	34.31	34.42 (35.90)	56.68 (48.87)	39.27
Without zinc + RS	85.33 (67.40)	68.00 (55.60)	25.48	17.05 (24.31)	34.56 (35.97)	50.67	36.51 (37.25)	65.98 (54.30)	44.66
CD at 5%									
TH	3.61			3.01			3.38		
Zinc	2.94			2.65			2.76		
Interaction	5.10			5.60			4.78		

*Figures in parentheses are angular transformed value.
TH = *Trichodermaharzianum*, RS = *Rhizoctoniasolani*

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Khaira disease is one of the most important diseases of rice in several rice growing areas. It is a nutritional disorder caused by non availability of zinc to the plant in an otherwise normal soil. Application of zinc sulphate in soil or foliar spray is the common method to control the disease. This experiment was conducted to see the effect of zinc on the efficacy of *T. harzianum* and on sheath blight. It is evident from the data presented in Table-1 that soil application of the antagonists significantly increased seedling emergence. Maximum seedling emergence (92.67%) was observed in zinc treated soil. Maximum reduction in disease severity (50.67%) and incidence (44.66%) was observed with the soil without zinc and *R. solani* agent. However, disease severity of sheath blight was minimum (31.38%) with soil application of zinc followed by the treatment foliar application of zinc (34.31%). Disease incidence was maximum (65.98%) in zinc deficient soil and minimum (39.10%) with soil treated with zinc sulphate.

It has been observed that the soil/foliar application of zinc had adverse effect on *R. solani* as well as on *T. harzianum*. Effectiveness of *T. harzianum* was more in zinc deficient soil. Disease severity was also high in zinc deficient soil when it was not treated with *T. harzianum*. Babich and Stotzky (1978) reported that a 10 mM concentration of Zn^{2+} completely inhibited growth of *R. solani* and significantly decreased the mycelial growth of *T. viride*. Differential sensitivities to Zn^{2+} were also noted with fungi, the sequence of sensitivity being *R. solani*> *F. solani*> *A. niger*> *T. viride* (Kiremidijian and Stotzky, 1976). Bhattacharya and Roy (1998) observed strong inhibitory effect on lesion size (sheath blight) with sodium selenate (10^{-5}M) which was followed by zinc sulphate (10^{-4}M) and calcium nitrate (10^{-2}M). The addition of zinc to zinc deficient soils resulted in reduce yield loss in the presence of *R. solani*, a reduction in disease score were also reported (Streeter *et al*., 2001). Suppression of sheath blight at higher concentrations of zinc sulphate and calcium nitrate has been reported by Kannainyan and Prasad (1979) and Baruah (1991), respectively. Prasad *et al*. (2010) reported that maximum disease severity of sheath blight was where zinc was not applied. Dłużniewska (2008) observed that foliar application of micronutrients (N, Ca, K, B, Cu, Fe, Mn, Mo and Zn) reduced mycelial growth, spore germination and antagonism of *Trichoderma* isolates. *T. harzianum*may enhance plant growth by increasing the solubility of zinc, copper, iron and manganese ions, all plant nutrients with low solubility (Yedidia *et al.,* 2001). Altomar e*t al.* (1999) reported that *T. harzianum* increases plant nitrogen efficiency and also solubilize phosphate and micronutrients that could be made available to provide plant growth. They also concluded that the improvement of plant nutritional level might be directly related to a general beneficial growth effect of the root system following *T. harzianum* inoculation. Esfahani (2014) observed that increased biomass in rice by using zinc.

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