



Control of Rhizome Rot Disease of Ginger (*Zingiber officinale* Rose) by Chemicals, Soil Amendments and Soil Antagonist

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Abstract

Two field experiments were conducted at domar and sadar upzilla of Nilphamari district to find out an effective control measure against rhizome rot (*Pythium aphanidermatum*) disease of ginger (*Zingiber officinale* Rose). Each experiment consisted of nine treatments, where three fungicides (Ridomil, Metataf and Secure), three organic amendments (poultry refuse, mustard oilcake and saw dust burning) and two bio control agents (*Trichoderma harzianum* and *T. viride*) were tested. Fungicides were used as seed treatment and soil drenching and organic materials and bio control agents were used as pre plant soil amendments. All the treatments significantly decreased the incidence and severity of the diseases and increased germination, tiller number and rhizome yield. The most effective treatment was seed treatment (0.2%) and soil drenching (0.2%) with Ridomil gold. Seed treatment and soil drenching with Secure (0.1%) and soil amendment with poultry refuse (10 t/ha) were also found to be effective to control the diseases and to increase rhizome yield.

Keyword: Rhizome rot, *Pythium aphanidermatum*, fungicides, organic amendment, control, *Trichoderma*.

1. Introduction

Ginger (*Zingiber officinale* Rose) is one of the most important spices crops in Bangladesh. It is grown throughout the country. In northern part of the country, the farmers cultivate it as a cash crop. Ginger has special significance for tropical countries, where it is produced and consumed in large quantities (Rahim, 1992). It has medicinal value too. At present ginger is also being used for chewing purpose. According to Bangladesh Bureau of Statistics (Anon, 1999), Bangladesh produces 38,000 metric tons of ginger yearly.

Ginger is affected by a number of diseases. Of them, rhizome rot caused by *Pythium aphanidermatum* is the most prevalent and damaging one. The pathogen of the disease is both seed and soil-borne and causes huge damage if congenial condition prevails during the growing period. The tip of the leaves turns

yellow and the chlorosis proceeds downwards ultimately resulting in withering and death of the leaf. The foot of the plant and the rhizomes turn pale. Watery and soft appearance becomes evident on just above the ground level. The rhizomes gradually decompose turning into a decoying mass of tissues enclosed by the comparatively tough rind (Singh, 1978), which causes serious yield reduction.

Literatures indicate that the disease can be managed by adopting organic amendments, fungicides and using antagonist in abroad (Sharma and Dohroo, 1998; Kim *et al.*, 1998, Ram *et al.*, 1999, Ram *et al.*, 2000 and Mathur *et al.*, 2002). In Bangladesh available information on control of rhizome rot disease of ginger by different method is scanty and the works so far done are preliminary in nature and nonconclusive. Under the above circumstances

an attempt was made to identify a suitable control method against rhizome rot of zinger using fungicides, antagonist and organic amendments.

2. Materials and Methods

Two independent experiments were carried out at the farmer's field of Sadar and Domar upazillas of Nilphamari district during 2005. Farmer's field were selected where previously ginger was infected severely. Nine treatments were tested in the experiments: T₁ = Seed treatment + Soil drenching with Secure (mancozeb+ phenamedon); T₂ = Seed treatment + Soil drenching with Ridomil gold (mancozeb + metalaxyl); T₃ = Seed treatment + Soil drenching with Metataf (25% metalaxyl); T₄ = *Trichoderma harzianum* (60 g/m²); T₅ = *T. viride* (60 g/m²); T₆ = Mustard oil cake (MOC 1 ton/ha); T₇ = Poultry refuse (10 tons/ha); T₈ = Soil burning with sawdust (15 tons/ha) and T₉ = Control.

Poultry refuse and mustard oil cake (MOC) were incorporated in to the soil 21 days before sowing rhizome. *Trichoderma* was added 7 days before and sawdust was burned one day before sowing. The experiments were laid out in RCBD with four replications. Local ginger variety was used and sown on 26th April. The unit plot size was 2 X 2 m². Row to row distance was 50 cm and rhizome to rhizome distance was 25 cm. Each plot had four rows and in each row eight seed rhizomes were sown. Apparently healthy rhizomes were treated with fungicide before sowing. Rhizomes were dipped in solution of Ridomil gold or Secure or Metalyxil for 30 minutes and then dried in shade and sown in the field. In control plots non treated seeds were sown. Soil drenching was started 60 days after planting at the time of diseases initiation and successive soil drenching was applied 6 times at 30 days interval.

Data on germination(s), number of tillers per plant, plant infection (%), disease severity (0-5 scale) and yield were recorded. Cumulative data of two locations are presented. Germination was

recorded after 30 days of planting. Number of tillers per plant was recorded from 10 randomly selected plants from each plot. Number of rhizome rot infected plant per plot was recorded after 100 days of sowing and continued up to maturity at 20 days interval. Disease severity was recorded using a 0-5 scale where, 0 = No infection on rhizome; 1 = 0.1 -5.0% rotting of rhizome; 2 = 5.1-15.0% rotting of rhizome; 3 = 15.1-30.0% rotting of rhizome; 4 = 30.1-60.0% rotting of rhizome; 5 = More than 60% rotting of rhizome. The weight of rhizome per plot was recorded and converted into per hectare yield.

The data were analyzed statistically for ANOVA and treatment means were compared by Duncan's Multiple Range Test (DMRT).

3. Results and Discussion

Except mustard oil cake (MOC) at only Sadar Upzilla, all treatments gave significant decrease in incidence and severity of the disease and increase in germination, tiller number and rhizome yield as compared to control (Tables 1 and 2). At Domar, the highest increase in germination was obtained with Ridomil gold, which was statistically similar to Secure but significantly higher than those in other treatments. Efficacy of Metataf, poultry refuse and MOC, sawdust, *T. harzianum* and *T. viridie* to increase rhizome germination was statistically similar and significantly lower as compared to Ridomil gold and Secure. The highest number of tillers per plant was found under the treatment with Ridomil gold, which was followed by Metataf, Secure and Sawdust. The differences in the parameter under those four treatments were not significant. Maximum of 40.46% plants were infected with rhizome rot under control. The lowest percentage of infected plants was found under the treatments with Ridomil gold, which was followed by Secure and Sawdust. The efficacy of Sawdust and *T. harzianum* was identical. The second highest percentage of infected plants was found under the treatments with MOC, which was followed by Metataf and *T. viridie*.

Table 1. Effectiveness of fungicides, three organic soil amendments and two antagonists against rhizome rot (*pythium aphanidermatum*) of ginger in Domar upazila of Nilphamari district, Bangladesh during 2005.

| Treatment | Rhizome germination (%) | No. of tillers /plant | Plant infected (%) | Disease severity (0-5scale) | Yield(t/ha) |
|-----------------------|-------------------------|-----------------------|--------------------|-----------------------------|-------------|
| Ridomil gold | 84.37 a | 20.47 a | 15.63 f | 1 | 18.48 a |
| Metataf | 71.87 c | 19.60 ab | 28.13 c | 2 | 15.40 d |
| Secure | 81.25 ab | 19.06 abc | 18.75 e | 1 | 17.84 ab |
| Poultry Refuse | 72.90 bc | 17.13 bcd | 27.09 cd | 1 | 16.59 bcd |
| Mustard oilcake (MOC) | 68.75 cd | 16.37 cd | 31.25 b | 2 | 16.11 cd |
| Sawdust | 75.00 bc | 18.73 abc | 25.00 d | 2 | 17.23 abc |
| <i>T.harzianum</i> | 75.00 bc | 15.27 d | 25.00 d | 2 | 15.62 cd |
| <i>T.viridie</i> | 73.94 bc | 14.30 d | 26.04 cd | 3 | 15.08 d |
| Control | 63.53 d | 11.30 e | 40.46 a | 4 | 12.74 e |

Means within the same column bearing a common letter (S) do not differ significantly (P=0.05)

The disease severity index values ranged from 1-4 (Tables 1 and 2). It was 1 under the treatments with Ridomil gold, Secure and poultry refuse; 2 under Metataf, mustard oil cake, sawdust and *T. harzianum*, 3 under *T. viridie* and 4 under control. The lowest rhizome yield of 12.74 t/ha was found under control (Table 1). The highest rhizome yield of 18.54 t/ha was obtained with Ridomil gold, which was statistically similar to Secure and Sawdust. The lowest yield increase was obtained with *T. viridie*, which was followed by Metataf, *T. harzianum*, MOC and poultry refuse. Efficacy of the five treatments to increase rhizome yield was statistically similar (Table 1).

Similar results were observed at Sadar Upzilla of Nilphamari district. Except MOC, all other treatments gave significant increase in germination over control (Table 2). The highest rhizome germination was obtained with Ridomeil gold. The second highest germination was obtained with Secure, which was statistically similar to Metataf; Poultry refuse, Sawdust and *T. harzianum*. The least effective treatment to increase germination was *T. viridie*. The highest number of tillers was recorded under the treatment with Ridomil gold, which was

followed by Secure, Sawdust, Poultry refuse, Metataf and MOC. The least effective treatments were *T. harzianum* and *T. viridie*. The maximum of 35.42% infected plants was found under control. The minimum of 18.75% infected plants were obtained with Ridomil gold, which was the most effective treatment to reduce infection. The second most effective material was Poultry refuse, which was statistically similar to Secure and sawdust. The least effective materials to reduce incidence of infected plants was MOC, which was followed by *T. viridie*, Metataf and *T. harzianum*. However, the efficacy of the three treatments was significantly different. The maximum disease severity index value of 4 was found under control. The index value was reduced to 3 under two biocontrol agents. The disease severity index value under Ridomil gold and Poultry refuse was 1. Rest of the treatments showed disease index value of 2. The highest rhizome yield was obtained with Ridomil gold. The second highest yield was found under the treatment with Secure, which as statistically similar to Metataf, Sawdust and Poultry refuse. The lowest yield increase was found under *T. harzianum*, which was followed by *T. viridie* (Table 2).

Table 2. Effectiveness of three fungicides, three organic soil amendments and two antagonists against rhizome rot (*pythium aphanidermatum*) of ginger in Sadar upazila of Nilphamari district, Bangladesh during 2005.

| Treatment | Rhizome germination | No. of tillers /plant | Plant infected (%) | Disease severity (0-5 scale) | Yield (t/ha) |
|----------------------|---------------------|-----------------------|--------------------|------------------------------|--------------|
| Ridomil gold | 81.25 a | 20.76 a | 18.75 g | 1 | 18.54 a |
| Metataf | 72.90 bc | 16.70 c | 27.08 d | 2 | 16.63 b |
| Secure | 77.09 b | 18.80 b | 22.92 f | 2 | 17.16 b |
| Poultry Refuse | 73.97 bc | 16.90 c | 21.88 f | 1 | 16.34 bcb |
| Mustard oilcake(MOC) | 67.72 de | 16.26 c | 32.39 b | 2 | 15.54 c |
| Sawdust | 75.00 b | 18.53 b | 22.93 f | 2 | 16.61 b |
| <i>T.harzianum</i> | 72.90 bc | 15.10 d | 25.0 e | 3 | 14.41 d |
| <i>T.viridie</i> | 69.78 cd | 14.17 d | 30.21 c | 3 | 15.47 c |
| Control | 64.56 e | 10.30 e | 35.42 a | 4 | 11.92 e |

Means within the same column bearing a common letter (S) do not differ significantly (P=0.05)

Results of the present investigation showed that seed treatment (0.2%) and soil drenching (0.2%) with Ridomil gold are the most effective treatments to control rhizome rot and to increase rhizome yield of ginger. Seed treatment (0.1 %) and soil drenching (0.1 %) with Secure, soil amendment with Poultry refuse (10 t/ha) and soil burning with Sawdust (15 t/ha) also gave effective control of the disease and increased rhizome yield. The effectiveness of fungicides used as seed treatment and soil drenching to control the disease have been reported by other investigators (Dohroo and Sharma, 1983; Ramachandran *et al.*, 1989; Chauhan and Patel, 1990; Das *et al.*, 1990; Choe *et al.*, 1996; Kim *et al.*, 1998; Ram *et al.* 1999 and Mathur *et al.*, 2002). Two antagonists *T. harzianum* and *T. viridie* appeared to be moderately effective to control the disease. More or less similar findings have also been reported by Dohroo and Sharma (1983), Sharma and Dohroo (1991), Ram *et al.* (1997), Sharma (1998) and Ram *et al.* (1999). They tested different species of *Trichoderma* against wide range of soil borne fungal pathogens including *Pythium* spp.

4. Conclusions

Seed treatment (0.2%) and soil drenching (0.2%) with Ridomil gold are the most effective treatments followed by Seed treatment (0.1 %) and soil drenching (0.1 %) with Secure, soil amendment with Poultry refuse (10 t/ha) and soil burning with Sawdust (15 t/ha) to control rhizome rot disease and to increase rhizome yield of ginger.

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