

Full Length Research Paper

Efficacy of fungicides for the control of leaf spot disease of ginger under the field conditions of Chhattisgarh (India)

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Leaf spot of ginger caused by *Phyllosticta zingiberi* is a very serious phytopathological constraint in the cultivation of ginger in India. Among the five fungicides (Copper-Oxy-Chloride, Mancozeb, Thiophanate Methyl, Metalaxyl, and Carbendazim), tested for the control of *Phyllosticta* leaf spot of ginger, Carbendazim (0.1%) three sprays, starting with the first symptoms appearance in the field followed by two more sprays at monthly interval, was found more effective in reducing the severity of the diseases (21.3%) that consequently increased the fresh rhizome yield (173.0 q/ha) significantly, followed by Metalaxyl (118.0 q/ha) and Thiophanate Methyl (116.0 q/ha), respectively. Mean apparent rate of infection (ARI) was also the lowest in Carbendazim (0.1%) spray.

Key words: *Ginger officinales*, *Phyllosticta zingiberi*, leaf spot, fungicidal control.

INTRODUCTION

Ginger (*Ginger officinales*) is an important spice crop commercially grown in Kerala, Karnataka Tamil Nadu, West Bengal, Bihar, Orissa, Madhya Pradesh, Uttar Pradesh, Himanchal Pradesh, Meghalaya and Sikkim (Dake, 1995; Spices Board, 2009) with an area of 155000 ha having production of 756000 t, with average productivity of 4900 kg ha⁻¹ (NHB, 2012). India stands at second position next to China regarding ginger production and productivity (Abubacker, 2011).

Ginger is affected by many diseases but rhizome rot (*Pythium* spp.) and leaf spot (*Phyllosticta zingiberi*) are the main constraints which cause economic loss to this crop (Iyer, 1988). It has been reported in Himanchal Pradesh (Sohi et al., 1973), Maharashtra (Kanware,

1947), Kerala (Anonymous, 1974) and also a serious problem in Chhattisgarh (Singh, 1998). Symptoms are observed on leaves as oval to elongated spots that later turn to whitish spots surrounded by dark-brown margin with yellowish halo (Brahma and Nambiar, 1982; 1984). The pathogen *P. zingiberi*, survives through matured pycnidia even up to 14 months through the lesions on the leaves fallen in the soil as plant debris (Brahma and Nambiar, 1982). The spores ooze out into water droplets on the leaves and get dispersed through rain splashes (Brahma and Nambiar, 1984). Continuous cultivation of ginger in the same field(s) helps in the buildup of higher concentrations of inoculum and early infection of the plant fails the vigor leading to drastic reduction in the rhizome

yield (personal observation).

Till date, not even a single variety/cultivar is reported as a source of resistance but few moderate resistant sources has been identified (Kanware, 1974; Nybe and Nair, 1979; Premnathan et al., 1980; Dohroo et al., 1986 and Rao et al., 1995). Partial shade (30-40%), up to only initial three months, significantly reduces the disease without affecting yield potential (Nizam and Jayachandran, 1997; Singh et al., 2004). Thus, only fungicides remain an open option towards managing this disease. Partial management of this disease has been reported with the two spray of Bordeaux mixture (1%) (Ramakrishnan, 1942; Sohi et al., 1973) and Mancozeb (0.3%) (NRCS, 1989); Prochloraz, Tebuconazole, Chlorothalonil, Mancozeb, Captan and Chlorothalonil + Copper (Nazareno, 1995) and Captan (0.3%) (Das and Senapati, 1998). However, very scanty information is available on the control of leaf spot through fungicidal sprays. Hence, an attempt was made to control this disease with other fungicides which were not evaluated against this disease.

MATERIALS AND METHODS

A field experiment was conducted at Regional Agricultural Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raigarh (Chhattisgarh), in Randomized Block Design with five different fungicides alongwith one check as treatments and four replications, to control the leaf spot disease with fungicidal sprays. Fungicides were Copper-Oxy-Chloride (local action), Mancozeb (local action), Thiophanate Methyl (systemic action), Metalaxyl (systemic action) and Carbendazim (systemic action). Planting of rhizome was done at 20 X 30 cm in each plot and fertilizers, at the rate of 150:100:100 kg nitrogen, phosphorus and potash per ha, respectively along with all other recommended package of practices, were applied to raise good crops. First spray, as per the treatment of each fungicide, was started as the first symptoms appeared in the experimental field followed by two more sprays at monthly intervals. Disease severity was recorded, on 20 randomly selected leaves in each plot, just one day before each spraying and one month after the last spraying, on 1-9 point disease rating scale (Singh et al., 2000). Disease index, in each replication, was worked out by using the following formula (Ayyangar, 1928):

$$\text{Disease Index} = \frac{\text{Sum of all ratings}}{\text{Total number of rating} \times \text{Maximum disease grade}} \times 100$$

Fresh rhizome per plot yield was recorded at the time of digging. Disease severity and yield data were analyzed through analysis of variance (ANOVA). Apparent rate of infection (r) was worked out by the following formula (Vanderplank, 1963):

1. When the disease severity was less than 5% (logarithmic infection rate)

$$r = \frac{2.3}{t_2 - t_1} \log_{10} \frac{X_2}{X_1}$$

2. When the disease severity was more than 5% (non-logarithmic infection rate)

$$r = \frac{2.3}{t_2 - t_1} \log_{10} \frac{X_2 (1 - X_1)}{X_1 (1 - X_2)}$$

Where r = apparent rate of infection, X_1 = disease severity at the first observation (t_1), X_2 = disease severity at the second observation (t_2), t_1 = time of first observation and t_2 = time of second observation.

RESULTS AND DISCUSSION

Data depicted through Figure 1, reveals all the fungicides, tested in the present investigation, reduced the disease severity significantly. The lowest disease severity was achieved in spraying of Carbendazim (21.3%) followed by Mancozeb (22.9%), Thiophanate Methyl (24.2%) and Metalaxyl (24.6%), respectively. Maximum disease severity was recorded in Copper-Oxy-Chloride spraying. Among all the tested fungicides, none was found statistically significantly effective in comparison to the other. Effectiveness of Copper-Oxy-Chloride (Copper fungicide) and Mancozeb (Dithane M-45), for the reduction of the disease severity, confirms the results of Sohi et al. (1973) and NRCS (1989), that *Phyllosticta* leaf spot can be managed by one and two sprays of Bordeaux mixture (Copper fungicide) and Dithane M-45, respectively. But in the present investigations, Carbendazim followed by Thiophanate Methyl showed better performance in comparison to the above reported effective fungicides.

Effective fungicide(s) increase(s) crop yield through the reduction in disease severity in cases of fungal diseases. In this study, higher fresh rhizome yield was recorded in the case of all fungicidal spray but significantly higher, and with maximum yield in Carbendazim (0.1%) followed by Metalaxyl (0.05%) and Thiophanate Methyl (0.1%), respectively. Here, fresh rhizome yield of ginger remained unaffected statistically in Mancozeb (0.3%) and Copper-Oxy-Chloride (0.3%), in comparison to control, though the disease severity was significantly reduced in these fungicides. This may be attributed to local but not systemic, action of the fungicides. This study on the effectiveness of Mancozeb (0.3%) for the reduction of leaf spot of ginger is in affirmation with the findings of NRCS (1989), but differs regarding the significant increase in the yield of fresh rhizome of ginger (Figures 2 and 3).

Study on the effect of different fungicidal spray on the apparent rate of infection (ARI), data depicted through Table 1 and Figure 4, reveals that mean apparent rate of infection was significantly reduced in all the fungicidal, spray over control, with lowest in Carbendazim (0.1%) followed by Mancozeb (0.3%) and Thiophanate Methyl (0.1%), respectively. Though, this is the first study in ginger to record the ARI in a case of leaf spot disease, this may be attributed to the higher yield of fresh rhizome of ginger because of low apparent rate of infection that delayed the spread of the pathogen, consequently

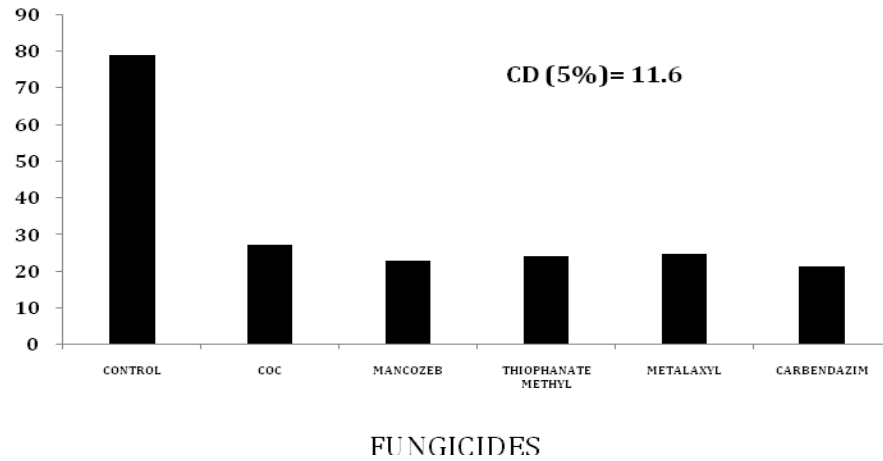


Figure 1. Effect of fungicidal spray on the disease severity of leaf spot on ginger.

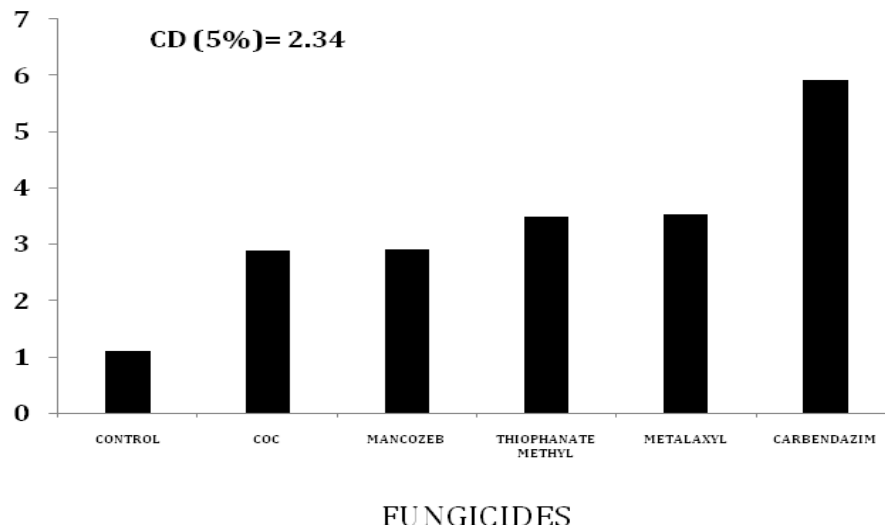


Figure 2. Effect of fungicidal spray on the ginger fresh rhizome yield kg/3 m².

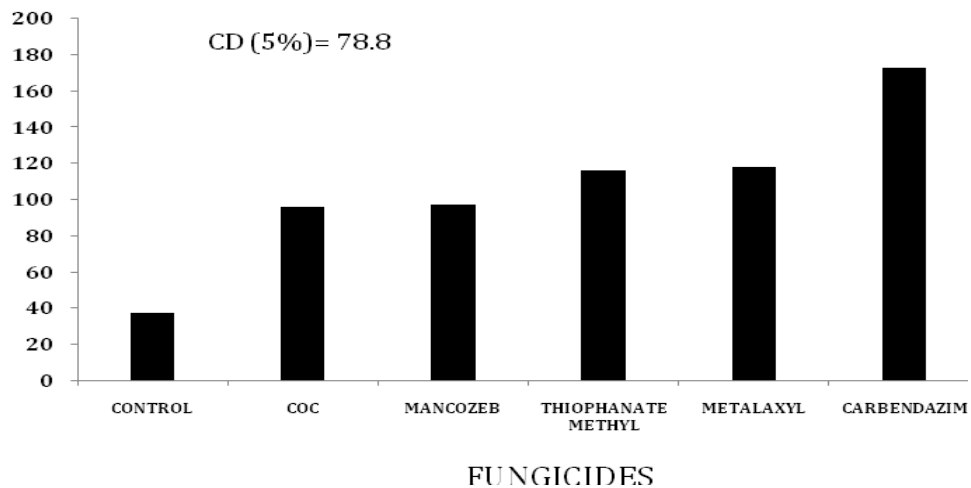
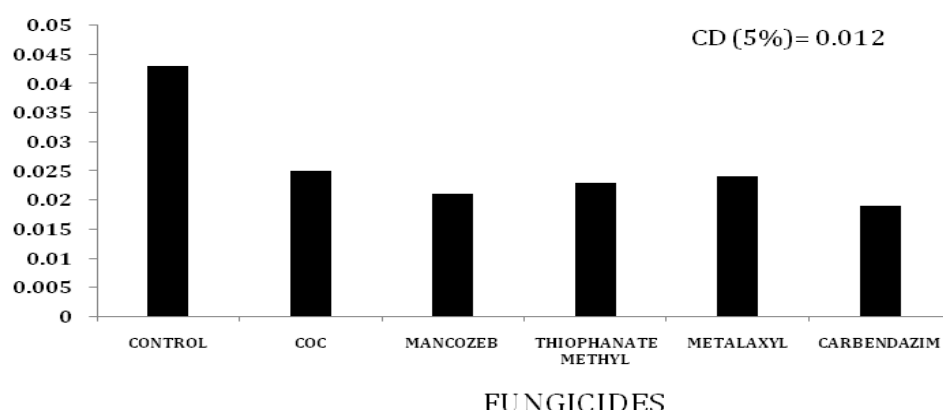


Figure 3. Effect of rhizome yield (Q/Ha) as affected by different fungicidal spray.

Table 1. Effect of different fungicides on the apparent rate of infection at different interval of different fungicidal spraying under field conditions.

Serial Number	Treatment	Apparent rate of infection (ARI) during different spraying interval			Mean ARI
		70-105 DAS	106-136 DAS	137-167 DAS	
1	Control (No spray)	0.079	0.030	0.019	0.043
2	Copper-Oxy-Chloride (0.3%)	0.059	0.011	0.005	0.025
3	Mancozeb (0.3%)	0.054	0.005	0.003	0.021
4	Thiophanate Methyl (0.1%)	0.055	0.011	0.005	0.023
5	Metalaxyl (0.05%)	0.056	0.011	0.066	0.024
6	Carbendazim (0.1%)	0.053	0.054	0.002	0.019
CD (5%)		-	-	-	0.012

DAS= Days after sowing, ARI= Apparent rate of infection.

**Figure 4.** Effect of different fungicidal spray on the mean ARI of leaf spot on ginger.

resulting in the development of lowest disease severity in the case of Carbendazim (0.1%) spraying.

Thus, considering all the parameters studied and already proven facts by other researchers (Brahma and Nambiar, 1982), three spraying of Carbendazim (0.1%), at monthly interval, starting with the appearance of first symptoms in the field, may be integrated with crop rotation, collection and destruction of plant debris, partial shade (Singh et al, 2004) and use of moderately resistant cultivar(s) (Kanware, 1974; Nybe and Nair, 1979; Premnathan et al., 1980; Dohroo et al., 1986 and Rao et al., 1995) for the harvest of higher yield of ginger in endemic areas of its cultivation.

Conflict of Interest

The author(s) have not declared any conflict of interest.

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