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EFFICIENCY OF DIFFERENT FUNGICIDES AGAINST LEAF SPOT DISEASE OF GINGER

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ABSTRACT
Leaf spot of ginger caused by *Phyllosticta zingiberi* has become a serious phytopathological constraint now in cultivation in the ginger growing areas of India. Among the different fungicides and fungicides combination tested including control for management of *Phyllosticta* leaf spot disease of ginger, Hexaconazole (0.1%) first at disease appearance and then 2 times at 20 days interval produced the lowest leaf spot disease severity (PDI 12.12) followed by spray with 0.1% Propiconazole (PDI 12.95) and spray with mixture of Carbendazim and Mancozeb@ 0.1% first at disease appearance and then 2 times at 20 days interval (PDI 16.83). The highest yield of 6.42 kg/plot (12.94 t/ha) was obtained by 0.1% Propiconazole spray which is very closely followed by spraying with Hexaconazole @ 0.1% with a yield of 6.40 Kg/plot (12.90 t/ha). So, it can be concluded that spraying with Hexaconazole or Propiconzole @ 0.1% for 3 times is highly effective against leaf spot disease of ginger.

INTRODUCTION

Ginger (*Gingiber officinale*) is one of the most important spice crops traded internationally and domestically for spices, medicine, food like salted ginger and beverage. India is a leading producer of ginger in the world (Medhi *et al*., 2012). The major ginger producing states are Kerala, Meghalaya, Arunachal Pradesh, Mizoram, Orissa, Sikkim and West Bengal (Shadap *et al*., 2013).The National productivity of the crop is 4.9 t/ha whereas the productivity of West Bengal is only 2.17 t/ha in 2013-14 (Anonymous, 2014). Ginger suffers from wide variety of diseases caused by fungi, bacteria and nematode. Ginger is affected by many diseases like soft rot, bacterial wilt, leaf spot etc. Among that, leaf spot caused by *Phyllosticta zingiberi* is becoming a serious problem recently. During the recent years the disease has become significantly important due to its severe leaf spotting which destroys the chlorophyllous tissues which, in turn, leads to significant reduction in yield and for this reason is considered as a destructive foliar disease of ginger (Iyer, 1988; Singh *et al*., 2000). The recorded yield indicated 48.3 percent loss in mother rhizome and 65.9 percent in yield of fresh rhizome when the severity of the *P. zingiberi* was 58.3 percent (Sood and Dohroo, 2005). Symptoms are observed as oval to elongated spots surrounded by dark brown margin with yellow halo (Brahma and Nambiar, 1982, 1984). The pathogen survives through pycnidia even upto 14 months (Brahma and Nambiar, 1982). Continuous cultivation of ginger in the same field help in build-up of higher concentration of inoculum. Early infection of the plant leads to drastic reduction in rhizome yield (Singh, 2015). The disease causes severe leaf blight and results in significant reduction in the number and size of rhizomes thereby resulting 13 to 66 percent yield losses (Sarma *et al*., 1994). Partial management of the disease reported with Bordeaux mixture 0.1% (Ramakrishnan, 1942; Sohi *et al*., 1973), mixture of Benomyl (0.1%), Mancozeb (0.2%) and soluble boron (0.1%) and Iprodione alone (Grech and Frean,1988), Chlorothalonil (Cerezine *et al*., 1995), Carbendazim (0.15%) and Mancozeb (0.3%) (Varma and Vyas, 1978), Mancozeb (0.25%) (NRCS, 1989), Procloraz, Tebuconazole, Chorothalonil, Mancozeb, Captan and Chorothalonil + Copper (Nazareno, 1995) and Captan 0.3% (Das and Senapati, 1998). But the above mentioned molecules are old one and the pathogen is getting resistance against these molecules due to its repeated use. Again the old molecules are required in high dose. In contrast the new molecules are required in very low dose and as they are very new to the pathogen the immediate chance of resistant is low and thus they are very effective. So, the main objective is to reduce this newly growing disease of ginger (leaf spot) using different chemicals including some newer molecules.

MATERIALS AND METHODS

Field experiment was conducted in the year 2012-13, 2013-14 and 2014-15 in the experimental field of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal in Randomized Block Design with 7 fungicidal treatments along with a control in four replications. Planting of rhizome was done at 3m × 1m raised bed/plot with 30cm × 20 cm spacing and fertilizer rate of 60:60:60 kg Nitrogen, Phosphorus, Potash per ha. Dried and well decomposed FYM at the rate of 10 – 15 Kg / plot were applied. Other intercultural operations were

practiced as par recommended for commercial cultivation of ginger. Disease severity was recorded at 90 days, 120 days and 150 days after sowing on fifteen randomly selected leaves from each plot by using 1-9 point scale as 1 = no symptom, 2 = 1-5 spot/leaf, 3 = 6-10 spots/leaf, 5 = 20-25 per cent area covered, 7 = 26-50 per cent area covered and 9 = more than 50 per cent area covered followed by drying of leaf (Singh *et al.*, 2000).

PDI was calculated using the following formula (Ayyangar, 1928):

$$\text{Disease index} = \frac{\text{Sum of all rating}}{\text{Total number of rating} \times \text{Maximum disease scale}} \times 100$$

The last date of disease scoring was taken into consideration. Fresh rhizome yield per plot was recorded at the time of harvesting and then it was converted into projected yield in t/ha.

Treatment Details

T_1 = Foliar spray with Mancozeb (0.3%) first at disease appearance and then 2 times at 20 days interval, T_2 = Foliar spray with Carbendazim (0.1%) first at disease appearance and then 2 times at 20 days interval, T_3 = Foliar spray with Carbendazim + Mancozeb (0.1%) first at disease appearance and then 2 times at 20 days interval, T_4 = Foliar spray with Blitox (0.4%) first at disease appearance and then 2 times at 20 days interval, T_5 = Foliar spray with Propiconazole (0.1%) first at disease appearance and then 2 times at 20 days interval, T_6 = Foliar spray with Tricyclazole (0.1%) first at disease appearance and then 2 times at 20 days interval, T_7 = Foliar spray with Hexaconazole (0.1%) first at disease appearance and then 2 times at 20 days interval and T_8 = Control

The replicated data generated from different experiments were analysed statistically using statistical package of INDOSTAT and the ANOVA determined the probability for significant variation among the treatments.

RESULTS AND DISCUSSION

From the above pooled results of 3 years (Table 1), it is found that foliar spray with Hexaconazole (0.1%) first at disease appearance and then 2 times at 20 days interval (T_7) produced the lowest leaf spot disease severity (PDI 12.12). Hexaconazole is very effective against the disease because this is a potent ergosterol biosynthesis inhibitor in the fungal cell. The fungal cell wall is affected by it, it can not synthesize sterol and thus it becomes porous and the fungus gets killed easily by losing the inner cell components. This treatment is closely followed by foliar spray with Propiconazole (0.1%) first at disease appearance and then 2 times at 20 days interval (T_5) and foliar spray with Carbendazim + Mancozeb (0.1%) first at disease appearance and then 2 times at 20 days interval (T_3) which recorded leaf spot PDI of 12.95 and 16.83, respectively (Fig. 1). Similar result like three sprays of carbendazim (0.1%) starting with the first symptom appearance in the field followed by 2 more sprays at monthly interval, was found very effective in reducing the severity of the disease (21.3%) which is reported by Singh (2015). Same type of results was also reported by Sood and Dohroo (2005) as they found that rhizome treatment

Table 1: Effect of different treatments on Germination, Percent Disease Index of leaf spot disease of ginger

Treatments	Germination (%)				PDI				% reduction over check			
	2012-13	2013-14	2014-15	Pooled	2012-13	2013-14	2014-15	Pooled	2012-13	2013-14	2014-15	Pooled
T_1	91.88	96.25(78.83)	96.00(78.46)	93.74(75.51)	20.00(26.57)	19.44(26.17)	24.95(29.97)	21.46(27.60)	48.57	40.70	19.65	37.32
T_2	91.25	91.88(73.44)	92.25(73.57)	93.04(74.70)	17.78(24.94)	15.00(22.79)	21.60(27.69)	18.13(25.20)	54.28	54.24	30.43	47.05
T_3	92.50	95.63(77.93)	96.00(78.46)	94.71(76.70)	10.00(18.43)	14.44(22.34)	27.70(31.76)	17.38(24.64)	74.29	55.94	10.78	49.24
T_4	93.75	94.38(76.28)	94.00(75.82)	94.04(75.87)	16.67(24.10)	24.44(29.63)	24.4(29.60)	21.84(27.86)	57.14	25.43	21.42	36.21
T_5	94.38	92.50(74.11)	92.25(73.84)	93.04(74.70)	7.22(15.59)	13.89(21.88)	17.73(24.90)	12.95(21.09)	81.43	57.63	42.90	62.18
T_6	95.63	93.13(74.80)	93.00(74.66)	93.92(75.72)	12.22(20.46)	21.11(27.35)	23.85(29.23)	19.06(25.89)	68.58	35.60	23.19	44.33
T_7	95.00	95.00(77.08)	94.75(76.75)	94.92(76.97)	8.89(17.35)	10.00(18.43)	17.48(24.64)	12.12(20.37)	77.14	69.49	43.70	64.60
T_8	92.50	94.38(76.28)	94.50(76.44)	93.79(75.57)	38.89(38.58)	32.78(34.93)	31.05(33.86)	34.24(35.81)	-	-	-	-
SEm (±)	2.138	4.084	4.1545	2.6756	1.829	1.814	3.5223	1.6889	-	-	-	-
CD (at 5%)	6.286	12.01	8.6400	5.3278	5.378	5.333	7.3249	3.3749	-	-	-	-
CV	-	10.485	7.645	8.862	-	14.342	17.356	15.8447	-	-	-	-

(Figures in parenthesis are angular transformed value)

Table 2: Effect of different treatments on yield of ginger

Treatments	Yield (kg/plot, 3m × 1m)				Projected yield (ton/ha)				C:B Ratio
	2012-13	2013-14	2014-15	Pooled	2012-13	2013-14	2014-15	Pooled	
T_1	4.65	5.73	4.00	4.79	9.37	11.54	8.06	9.66	1:1.15
T_2	5.80	6.10	4.11	5.34	11.69	12.30	8.29	10.77	1:1.56
T_3	7.25	6.45	3.86	5.85	14.62	13.00	7.78	11.79	1:1.80
T_4	5.40	5.60	3.80	4.93	10.89	11.29	7.66	9.94	1:1.35
T_5	8.80	6.53	3.93	6.42	17.74	13.15	7.92	12.94	1:2.07
T_6	6.70	5.63	3.89	5.41	13.51	11.34	7.84	10.89	1:1.56
T_7	7.50	7.58	4.13	6.40	15.12	15.27	8.33	12.90	1:2.07
T_8	3.65	4.20	3.11	3.65	7.36	8.47	6.27	7.36	1:0.76
SEm (±)	0.868	0.680	0.2499	0.6621	-	-	-	-	-
CD (at 5%)	2.552	2.000	0.7348	1.4201	-	-	-	-	-
CV	-	22.763	12.865	15.158	-	-	-	-	-

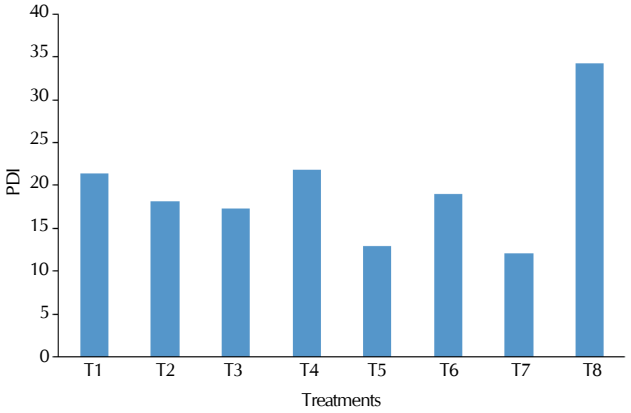

Figure 1: PDI of leaf spot disease of ginger for different treatments

as well as foliar sprays with Bordeaux mixture (1%), companion (0.2%), Indofil M-45 (0.25%), Unilax (0.2%) and Baycor (0.05%) were found effective in checking the disease severity. However, the highest yield (pooled) of 6.42 kg/plot (12.94 t/ha) was obtained by T_5 which is very closely followed by T_7 with a yield of 6.40 Kg/plot (12.90 t/ha) and next followed by T_3 (5.85 Kg/plot, 11.79 t/ha) (Table 2). There is no significant difference between these three treatments in respect of germination and yield. T_5 and T_7 reduced disease by 62.18% and 64.60% respectively over control. Highest cost: benefit ratio of 1:2.07 was found in both spraying with Hexaconazole (T_7) and spraying with Propiconazole (T_5). So, it can be concluded that any one of Hexaconazole or Propiconazole at the rate 0.1% can be used for the effective management of leaf spot disease of ginger.

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