REACTION OF GINGER CULTIVARS AGAINST PHYLLOSTICTA ZINGIBERI CAUSING LEAF SPOT AND ITS MANAGEMENT

K. T. ARUNAKUMARA* AND C. SATYANARAYANA
Department of Plant Protection,
College of Horticulture, Bidar - 585 403, Karnataka, INDIA
e-mail: arunakumarak@gmail.com

INTRODUCTION
Ginger (Zingiber officinale Rosc.) is a herbaceous perennial, the rhizomes are used as a spice and it has medicinal value against Diabetes disease in animals (Shanmugam et al., 2009). During 2012-13 the country produced 7.45 lakh tonnes of the spice from an area of 1.58 lakh hectares (Anonymous, 2014). India is the largest producer of ginger accounting for about one third of total world output so it is basic need to develop high yielding varieties with better quality to increase the production and productivity of ginger in India (Ravishanker et al., 2014). The major constraints that limit production of ginger are soft rot, yellows, rhizome rot complex, leaf spot and storage rots. Leaf spot caused by Phyllosticta zingiberi is one of the most threatening foliar disease, first time reported in India by Ramakrishnan (1942). Later, it was reported from Himachal Pradesh (Sohi et al., 1973) and Maharashtra (Kanware, 1974). Leaf spot disease of ginger leads to heavy reduction in rhizome yield through the destruction of chlorophyll tissue (Ramakrishnan, 1942). Symptoms are observed on leaves as oval to elongated spots that later turn to whitish surrounded by brown margin with yellow halo. Knowledge on the reaction of various ginger germplasm to leaf spot disease is very scanty. In earlier studies, Nybe and Nair (1979), Premanathan et al. (1980) and Dohroo et al. (1986) were reported the screening of some cultivars to locate the tolerance and resistant types. In the present studies, an attempt has been made to test ginger cultivars against Phyllosticta leaf spot and also to manage the disease. Spraying of broad spectrum fungicides like Mancozeb 75 WP, Bordeaux mixture, Chlorothalonil 75 WP and Captan 50 WP has been recommended for control of leaf spot of ginger by several workers (Sohi et al., 1973; Nazareno, 1995; Das and Senapati, 1998). Control achieved by these chemicals was inadequate. Therefore, it is thought worthwhile to test the efficacy of more promising chemicals like Propineb 50 WP, SAAF 75 WP (Mancozeb 75 WP and Carbendazim 50 WP), Propiconazole 25 EC, Hexaconazole 5 EC, Azoxyostrobin 25 EC, Benomyl 50 WP against fungus. Not much light has been shed on biological control, botanicals which are effective against Phyllosticta zingiberi. Hence, an attempt has been made to test commonly available botanicals and bio agents against the pathogen.

MATERIALS AND METHODS
Reaction of Ginger cultivars
An experiment was conducted at College of Horticulture, Bidar, Karnataka during Kharif 2013 and 2014 in Randomized Complete Block Design with a plot size of 3m x 1m. Ten cultivars viz., Humnabad Local, Himagiri, Maran, Suprabha, Himachal, Suruchi, Suravi, ISSR-Vartha, ISSR- Mahima and ISSR-Rejitha were planted at a spacing of 20cm x 30cm (rhizome to rhizome x row to row) and all the recommended agronomic practices were followed to raise crop except fungicidal spray to avoid the killing of fungal pathogen (Anonymous, 2013). As there was heavy incidence of Phyllosticta leaf spot during both the years, the cultivars were scored for the disease incidence under natural field conditions without artificial inoculation. Disease score was measured,

ABSTRACT
Ten Ginger cultivars were tested, during Kharif 2013 and 2014 for their reaction to Phyllosticta zingiberi under field conditions. Humnabad local and Maran cultivars were found moderately resistant and none of them were free from the disease. Among 10 fungicides, 10 botanicals and 6 bio-agents evaluated in in vitro condition against Phyllosticta zingiberi Ramkr, Propiconazole 25 EC (92.30%) followed by Azoxystrobin 25 EC (91.70%), SAAF 75 WP (Mancozeb and Carbendazim) (89.30%), Allium sativum (75.70%) and Trichoderma harzianum (78.80%) recorded the highest inhibition of mycelial growth of Phyllosticta zingiberi. The field evaluation of different fungicides and botanicals during Kharif-2014 indicated that Propiconazole-25EC was recorded minimum PDI of 36.00 and yield of 202q/ha. Azoxyostrobin-25EC,Hexaconazole-5EC,SAAF-75WP (Mancozeb-63WP and Carbendazim-12WP),Mancozeb-75WP,Propineb-50WP and Allium sativum cloves extract were next best treatments by recording a PDI of 40.00,45.00,46.00,50.00,55.00 and 60.00 and a yield of 185q/ha,180q/ha,179q/ha,175q/ha,173q/ha and 169q/ha respectively.Again during Kharif 2015, Propiconazole 25 EC was significantly superior over other treatment and similar trend was observed for other treatments also.

KEYWORDS
Bio-agents, Fungicides, Ginger, Management, Phyllosticta Zingiberi

Received on : 17.09.2015
Accepted on : 20.11.2015
*Corresponding author
on fifteen randomly selected leaves from each plot, by using 1-5 point rate scale (Dohroo et al., 1986).

In vitro evaluation of fungicides

Ten different fungicides with different modes of action were evaluated in the laboratory for their efficacy against *Phyllosticta zingiberi* by the poisoned food technique (Nene and Thapliyal, 1979). The each treatment was replicated 3 times. The molten sterilized PDA was used as nutrient medium and required quantity of each fungicide was added separately so as to get a required concentration of that fungicide. The fungicides were thoroughly mixed by stirring and about 15ml poisoned medium was poured to each of the 90mm petri dishes and allowed for solidification. The actively growing periphery of 9 day old culture of *Phyllosticta zingiberi* was carefully cut by using a gel cutter and transferred aseptically to centre of each petri dish containing the poisoned solid medium. Suitable control was maintained by growing the cultures on PDA without the fungicides. The plates were incubated at 27 ± 1ºC for 9 days and the colony diameter was recorded 9 days after growth (Table 2). The percent inhibition of mycelial growth over control was calculated using the formula of Vincent (1947)

\[
I = \frac{C - T}{C}
\]

\[I = \text{per cent inhibition of mycelial growth}
\]

\[C = \text{radial growth of fungus in control}
\]

\[T = \text{radial growth of fungus in treatment.}
\]

In vitro evaluation of botanicals

Healthy plants were selected from which the fresh leaves and other parts were obtained and thoroughly washed with tap water then air dried. Aqueous plant extract was prepared by grinding 100g leaves/other parts with 100ml distilled water using a blender and filtrate was collected by passing through double layered muslin cloth. The supernatant was taken as standard plant extract solution (100%). All the extracts obtained were passed through filter paper used for assay. The poisoned food technique (Nene and Thapliyal, 1979) was followed to evaluate the efficacy of botanicals in laboratory against *Phyllosticta zingiberi* at 15% concentration (Table-3). The each treatment was replicated 3 times. The method followed for conducting the experiment was same as that used for fungicide evaluation.

In vitro evaluation of bio-agents

Dual culture technique was followed to study interaction of six antagonists in the laboratory. Six bio-agents with a control treatment were used for evaluation (Table-4). Pour 20ml of PDA into 90mm petri dishes and allowed for solidification. Discs measuring 5mm of *Phyllosticta zingiberi* was taken from 9 day old culture and was placed at one end of the petri dish then respective antagonistic organisms were inoculated at the opposite side. A control was maintained by inoculating only *Phyllosticta zingiberi* at one end in case of fungal antagonist. In case of bacterial antagonist *Phyllosticta zingiberi* was placed at both ends of petri plates and bacterial culture was inoculated at centre of the petri plate, control was maintained by inoculating *Phyllosticta zingiberi* at the both the ends of the petri plates. Each treatment was replicated 4 times and incubated for 6 days at 27 ± 1ºC. The activity of antagonistic organisms were recorded by measuring the colony diameter of *Phyllosticta zingiberi* in each treatment and compared with control.

Management of leaf spot, *Phyllosticta zingiberi*

The field experiment was laid out in RCBD with 13 treatments and 3 replications during Khari ‘14 and 2015 at College of Horticulture, Bidar, Karnataka. Healthy Humnaboad local Ginger seed rhizome suitable to this area (Shadap et al., 2013) were planted in the field with 30cm X 20cm (row to row X rhizome to rhizome) spacing in plots size of 3m X 1m. All other cultural practices and pest control practices were followed as recommended in package of practices (Anonymous, 2013). The first spray was carried out as soon as first symptom of disease was noticed in the field. 4 sequential sprays of fungicides and botanicals were taken at an interval of 15 days (Table 5 and 6). Disease severity was recorded on fifteen randomly selected leaves in each plot, just one day before each spraying and fifteen days after last spraying. Observations on severity of disease on foliage was recorded by using 1-5 point scale and PDI was worked out as follows.

\[
\text{Percent Disease} = \frac{\text{Sum of individual rating} \times 100}{\text{Number of plants or leaves} \times \text{maximum disease grade}}
\]

\[
\text{Index(PDI)} = \frac{\text{Number of plants or leaves} \times \text{maximum disease grade}}{100}
\]

\[Yield in treatment \] \[= \frac{\text{Yield in control}}{\text{control}} \times 100\]

RESULTS AND DISCUSSION

Reaction of Ginger cultivars

Ten cultivars were tested during Khari ‘2013 and 2014 none of them were found free from the disease. All the cultivars were categorized into five different groups based on disease severity. The Humnabad local and Maran cultivars were moderately resistant and others were susceptible (Table1). At the time of harvest, rhizome yield was recorded and computed to hectare basis, the percent increase over control was computed as follows.

\[
\text{Yield increase over control(%) = Yield in treatment/ \text{Yield in control} \times 100}
\]

In vitro evaluation of Fungicides

The results indicated that significant difference among fungicides in inhibiting the growth of the *Phyllosticta zingiberi*. Among fungicides evaluated, Propiconazole-25EC recorded maximum inhibition of mycelial growth (92.30%) followed by Azoxystrobin 25 EC (91.70%), SAAF 75 WP (89.30%), Copper oxy chloride 50 WP (88.00%) and least inhibition was observed in Chlorothalonil 75 WP (51.70%) (Table-2).
In vitro evaluation of botanicals

The results revealed that effect of plant extracts on the fungal growth was significant. The *Allium sativum* cloves extract was found effective in inhibiting the mycelia growth (75.70%) followed by *Aloe vera* (67.00%), *Eucalyptus globes* (65.00%) and least inhibition was observed in *Glyricidia maculata* (30.00%) (Table-3).

In vitro evaluation of antagonists against *Phyllosticta zingiberi*

All the *Trichoderma* sp inhibited the growth of *Phyllosticta zingiberi* effectively. Among these antagonists *Trichoderma harzianum* showed highest inhibition (78.80%). Both bacterial...
antagonists used in the study viz., Bacillus subtilis (32.80%) and Pseudomonas fluorescens (18.80%) were moderate in controlling Phyllosticta zingiberi (Table 4).

Management of leaf spot, Phyllosticta zingiberi

In subsequent sprays all the fungicides and botanicals treated plots recorded significantly less disease index over control. During Kharif-2014, among fungicides 0.1% Propiconazole-25EC was significantly effective in reducing the disease by recording a PDI of 36.00 and a yield of 202q/ha (Table-5). 0.1% Azoxystrobin-25EC, 0.2% Mancozeb-75 WP and 0.2% Propineb-50 WP were next best treatments found effective in reducing the disease intensity by recording a PDI of 176Æ, 175Æ and 173Æ respectively. Among botanicals tested, minimum PDI of 167Æ and yield of 180Æ was recorded in Allium sativum clove extract and  maximum PDI of 144Æ and yield of 169Æ was recorded in the control plot (Table-5). Again during Kharif 2015, Propiconazole 25 EC was significantly superior over other treatment and similar trend was observed for other treatments also (Table-6). Sohi et al., 1973 reported that Copper oxy chloride 50 WP and Mancozeb 75 WP were effective against Phyllosticta zingiberi and gave maximum yield per ha.

ACKNOWLEDGEMENT

We thank College of Horticulture, Bidar and University of Horticultural Sciences, Bagalkot, India for their provisions to this study.

REFERENCES


