ISSN: 2224-0616
Int. J. Agril. Res. Innov. Tech. 12(2): 134-137, Dec 2022
DOI: https://doi.org/10.3329/ijarit.v12i2.64099
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Available online at https://ijarit.webs.com
https://www.banglajol.info/index.php/IJARIT

Evaluation of efficacy of fungicides against ginger leaf spot (*Phyllosticta zingiberi*) disease epidemics at Tepi Southwestern Ethiopia

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Received 9 June 2022, Revised 10 December 2022, Accepted 22 December 2022, Published online 31 December 2022

A B S T R A C T

The most devastating disease that affects ginger production and productivity in Southwestern Ethiopia and lowers qualitative and quantitative rhizome yields is ginger leaf spot, which is caused by the pathogen *Phyllosticta zingiberi*. In Tepi, Southwestern Ethiopia, during the main cropping seasons of 2020 and 2021, a field experiment was carried out to assess the efficacy of several fungicides in managing epidemics of ginger leaf spot disease. The fungicides evaluated were Ridomil Gold MZ 68 WG (Metalaxyl-M), Ethiozeb 80% WP (Mancozeb), Shega 50 WP (Copper oxychloride), and Matico (Metalaxyl 8% + Mancozeb 64% WP). While the plot without spray is used as control. The results of the experiment indicated that among the different fungicides tested four times spray of Matico (Metalaxyl 8% + Mancozeb 64% WP) starting from the appearance of the disease on the field within 15 days intervals produced the lowest leaf spot disease severity of 10.2% followed by foliar spray with Mancozeb (Ethiozeb 80% WP) 16.2% first at disease appearance and then 3 times at 15 days intervals. Similarly, the highest yield of 16.3 t ha^{-1} was also obtained by foliar from the plot foliar spray of Matico (Metalaxyl 8% + Mancozeb 64% WP) which is followed by spraying with Mancozeb (Ethiozeb 80% WP) with a yield of 12.56 t ha^{-1}. Therefore, four times foliar spray of Matico @ 2.5 kg ha^{-1} is highly effective against leaf spot disease of ginger in southwestern Ethiopia.

Keywords: Epidemics, Fungicide, Ginger, leaf spot, *Phyllosticta*, Yield

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Cite this article as: Jibat, M. and Getu, A. 2022. Evaluation of efficacy of fungicides against ginger leaf spot (*Phyllosticta zingiberi*) disease epidemics at Tepi Southwestern Ethiopia *Int. J. Agril. Res. Innov. Tech.* 12(2): 134-137. https://doi.org/10.3329/ijarit.v12i2.64099

Introduction

Ginger (*Gingiber officinale* Rosc.) is an important spice crop cultivated in Ethiopia. It is one of the most important crops used to make spices that are traded both domestically and globally for use in food, medicine, spices, and beverages. However, bacterial wilt (*Ralstonia solanacearum*), leaf spot (*Phyllosticta zingiberi*), and yellows (*Fusarium* spp.) are the main problems that lead to the economic loss of this crop in Ethiopia (Habetewold *et al*., 2015; Guji *et al*., 2019). Among these, leaf spot caused by *Phyllosticta zingiberi* is becoming a serious problem recently in southwestern Ethiopia. Due to its severe leaf spotting that kills the chlorophyllous tissues and causes a significant reduction in yield, leaf spot disease is currently becoming more important in Ethiopia's major ginger-producing regions. For this reason, it is considered as a destructive foliar disease of ginger (Singh *et al*., 2000, Guji *et al*., 2019). According to Sood and Dohroo's (2005) report, *Phyllosticta zingiberi* caused yield losses of 48.3% in mother rhizomes and 65.9% in fresh finger rhizomes in India. Disease symptoms include oval to elongated patches with a dark brown border and a yellow halo (Brahma and Nambiar, 1982a; Brahma and Nambiar, 1982b).

A higher concentration of inoculum can be built up by growing ginger continuously in the same field. Early plant infection causes a significant decrease in rhizome yield (Singh, 2015). The disease causes severe leaf blight and significantly reduces the size and number of rhizomes, which results in yield losses of 13 to 66% (Sarma *et al*., 1994). No variety or cultivar has been reported as a source of resistance, however a few sources with

moderate resistance have been found in various parts of the world (Rao *et al*., 1995). Partial shade also reduces epidemics (30–40%), but only for the initial three months, without reducing crop yield (Singh *et al*., 2000). Sprays of a Bordeaux mixture (1%) and Mancozeb (3%) have been found to manage this disease to some extent (Das and Senapati, 1998). Because of this, fungicides are the only effective remedy for this disease. However, very little or no study has been done, on the use of fungicides in Ethiopia to manage ginger leaf spot disease. Therefore, there is a need to investigate the efficacy of fungicides in reducing the spread of the epidemic of ginger leaf spot disease in southwestern Ethiopia's ginger-producing regions.

Therefore, the objectives of the current study were:

- To assess the efficacy of fungicide spray on the epidemics of leaf spot disease of ginger.
- To assess the impact of fungicide spray on ginger rhizome yield and its components.

Materials and Methods

During the main cropping seasons of 2020 and 2021, the field experiment was carried out at Tepi Agricultural Research Center under field conditions. The trial was laid out in randomized block design with three replications. Fungicide sprays were used to treat ginger leaf spot disease epidemics using four different fungicides, together with control and four times application frequency. The fungicides used were Ridomil Gold MZ 68 WG (Metalaxyl-M), Ethiozeb 80% WP (Mancozeb), Shega 50 WP (Copper oxychloride), Matco (Metalaxyl 8% + Mancozeb 64% WP), Ethiozeb 80% WP (Mancozeb), and control without spray. On raised beds of 3 x 4 meters, ginger rhizomes were planted with a spacing of 0.15 meters between plants, 0.3 meters between plots, and 2 meters between adjacent blocks. Additionally, all other usual agronomic practices for growing ginger were applied uniformly across all treatments.

Disease assessment

Every fifteen (15) days following the onset of the disease in the field, the severity of the disease in the experimental plots was measured. On 15 (fifteen) randomly selected, pre-tagged ginger plants in a row from the replications for each treatment, the severity of the disease was recorded. Only one day before each spraying and 15 days after the last spraying, disease severity was recorded in each plot using a 0–4 grade scale (Erpelding and Prom, 2004), with 0 represent no symptoms (spot on the leaves) and 4 represent the presence of more than 75% of spots on the leaves and dead plants as a result of infection. The severity scores were then transformed into the percentage severity index (PSI) for analysis.

$$PSI = \frac{\text{Sum of numerical ratings}}{\text{No.of plants scored X maximum score on scale}} \times 100$$

The progression of the disease was shown by plotting the disease severity against time. At the time of harvest, the yield of fresh rhizomes per plot was recorded and the yield was converted to tons per hectare.

Data analysis

Analysis of variance was performed for disease severity and yield to determine the effect of treatments. Least significant difference (LSD at 5% probability level) was used for mean separation.

Results and Discussion

The lowest leaf spot disease severity (10.2%) was obtained by foliar spraying Matico (metalaxyl 8% + mancozeb 64%WP) three times at a 15-day interval starting at the time the disease first appeared. This treatment is closely followed by foliar sprays with Mancozeb (Ethiozeb 80% WP), applied first at disease onset and then three times at 15-day intervals, and foliar sprays with Ridomil Gold MZ 68 WG (metalaxyl-M), applied first at disease onset and three times at 15-day intervals, both of which recorded leaf spot severity measurements of 16.2 and 24.3%, respectively (Figure 1). Similar results were reported by Singh (2015), who reported that three applications of the fungicide carbendazim, beginning with the onset of the initial symptoms in the field and followed by two further sprays spaced one month interval, were very effective in reducing the severity of the disease. Similar findings were made by Sood and Dohroo (2005), who discovered that rhizome treatment and foliar sprays with Bordeaux mixture (1%), companion (0.2%), Indofil M-45 (0.25%), Unilax (0.2%), and Baycor (0.05%) were effective in reducing the severity of the disease. Similar to this, foliar spraying of Matico (metalaxyl 8% + mancozeb 64% WP) produced the maximum yield of 16.3 t ha^{-1}, which was closely followed by Mancozeb (Ethiozeb 80% WP), with a yield of 12.56 t ha^{-1} (Figure 2). Matico and Mancozeb foliar sprays decreased disease severity by 71.3% and 54.4%, respectively in comparison to controls.

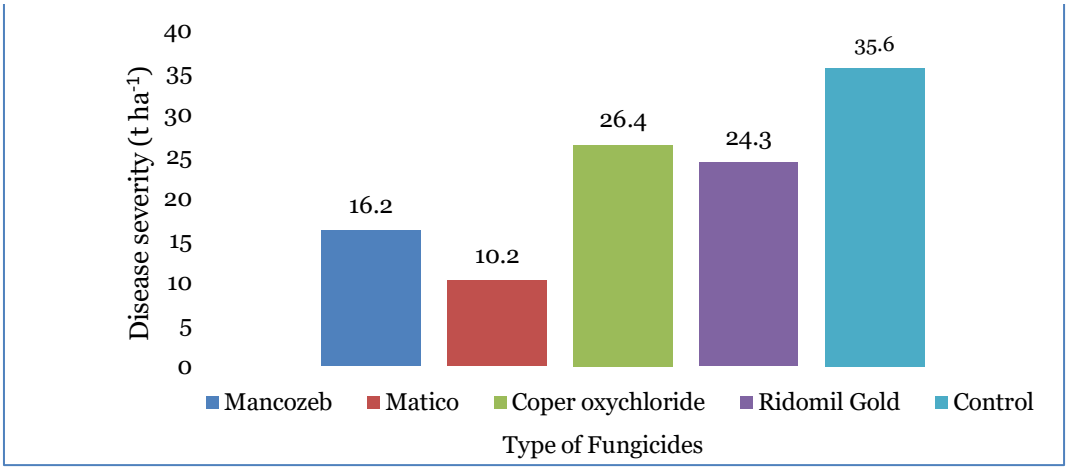

Figure 1. Effect of fungicide spray on ginger leaf spot disease severity.

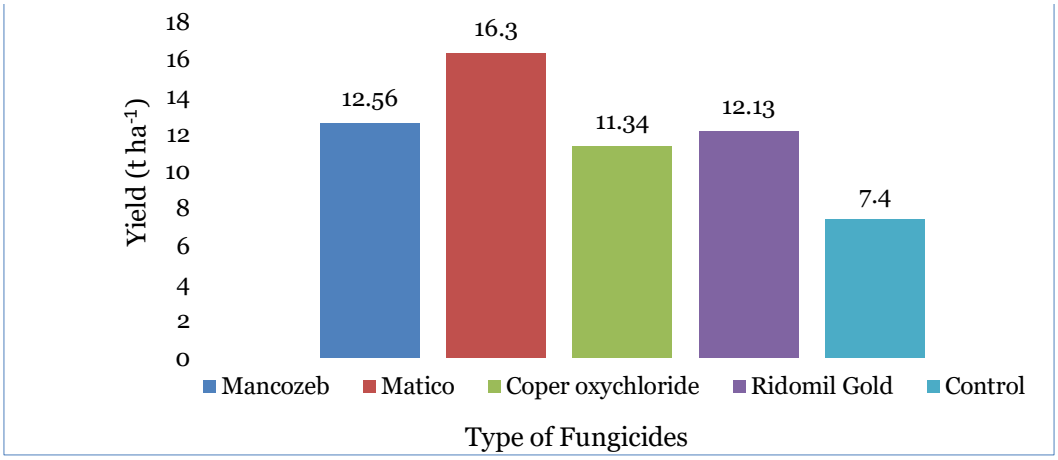

Figure 2. Effect of several fungicide sprays on ginger's fresh rhizome yield (t ha-1).

Disease progress curve

For different fungicides, the disease development curves for ginger leaf spot (severity versus days after planting) were drawn (Figure 3). The graph showed that from the time of disease beginning to the final severity recorded during the study periods, disease severity increased. The disease progression curve also showed that the disease progression was not uniform across all fungicides tested. Leaf spot severity peaked in control plots, when disease severity followed relatively high progressive curves. Disease progression curves of plots sprayed with Matico (Metalaxyl 8% + Mancozeb 64% WP) showed the lowest level of leaf spot severity at various days after planting. This could be due to a fungicide contains active components for both protectant and systemic fungicides may have less severe leaf spots than other fungicides. This result is in line with the findings that the severity of potato late blight in fungicide-treated plots was relatively low (Olanya *et al.*, 2001).

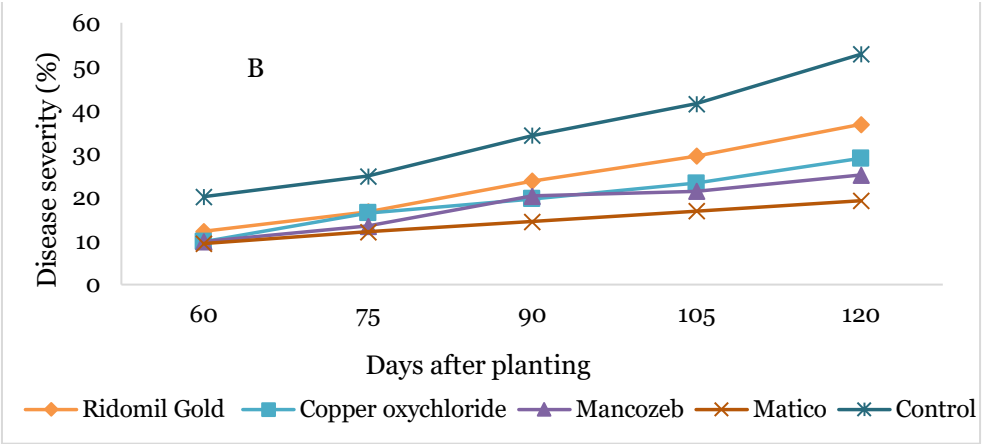

Figure 3. The progression curves of ginger leaf spot (*Phyllosticta zingiberi*) disease tested in Tepi in the main cropping seasons of 2020 and 2021.

Conclusion

One of the most difficult problems for the cultivation of ginger in southwestern Ethiopia is the ginger leaf spot caused by *Phyllosticta zingiberi*. Fungicide spraying helps to decrease epidemics of leaf spots. The most effective measure is chemical control, and *Phyllosticta zingiberi* can be controlled with fungicide treatments (contact or systemic agents) that weaken or eliminate the pathogen during the crop cycle. In conclusion, foliar spray of Matico (Metalaxyl 8% + Mancozeb 64%WP) is suggested for the control of ginger leaf spot disease since it helped to prevent outbreaks of the disease. The foliar spray of Mancozeb (Ethiozeb 80% WP) is also very important in combating ginger leaf spot disease. In order to manage ginger leaf spot disease in Southwestern Ethiopia, it is therefore promising to grow ginger using foliar sprays of Matico (Metalaxyl 8% + Mancozeb 64%WP) at the beginning of disease occurrence as well as three times by 15-day intervals. To develop integrated disease management in the future, more research is required.

Acknowledgement

The authors are grateful for Ethiopian Institute of Agricultural Research for provides financial support.

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