Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2023i1.225
*Biol. Clin. Sci. Res. J., Volume, **2023**: 225*
Original Research Article

CHEMICAL CONTROL OF SOUTHERN LEAF BLIGHT OF MAIZE CAUSED BY *HELMINTHOSPORIUM MAYDIS*

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(Received, 20th November 2022, Revised 1stMarch 2023, Published 9th March 2023)

Abstract: *Southern leaf blight of maize (SLBM) is a severe disease affecting maize crop in Pakistan. This disease causes considerable losses in maize crop every year. To overcome the loss, a study was conducted to check the efficacy of four fungicides and one control, tested against maize variety Malka-2016. The experiment was conducted at Plant Pathology Research Area, Ayub Agriculture Research Institute, Faisalabad, during 2021-22. The results showed that Propiconazole (Tilt 25% WP) was found to be the most effective fungicide to control the leaf blight of maize followed by Dithane M-45 (Mancozeb 80% WP) and Kavach (Chlorothalonil 75% WP). The Blitox-50 (Copper oxychloride 50% WP) was the least effective against the disease. The Propiconazole (Tilt 25% WP) control the disease 80% over the check. Similarly, Dithane M-45 (Mancozeb 80%) controls the disease 70.83% and Chlorothalonil by 59%. The least effective fungicide was Blitox-50 (Copper oxychloride 50%) which controls the disease 42.5% over the check.*

Keywords: Maize, Southern leaf blight, Mancozeb, Tilt, Fungicides, Blitox-50%

Introduction

Maize is an important crop belongs to *Gramineae* family, is grown in 166 countries worldwide (Mihalcea & Amariei, 2022; Mir et al., 2019). It is the most versatile crop because it can grow in various weather conditions and agricultural ecosystems. It yields more grains than other cereals and is often referred as the "Queen of Cereals" (Saritha et al., 2020). Ten thousand years ago, maize was not introduced as a significant grain crop for human use. Moreover, now it is consumed by both people and animals as a source of nutrition (Mir et al., 2019). Its raw material is used in industry. It is essential in food processing, ethanol production, poultry and dairy industries. It is a good source of producing dextrose, starch, syrups, oils and linoleic acid (Saritha et al., 2020). It quickly becomes one of the highest yielding cash crop (Ali et al., 2014; Ali et al., 2016; Ali et al., 2013; Andorf et al., 2019; Erenstein et al., 2022). Rice and wheat are Pakistan's most valuable agricultural commodities. Maize is the third most significant crop after wheat and rice. The maize production during 2022-2023 is estimated 9.5 million tons from an area of 1.6 million hectares (Rehman et al., 2020).

Maize crop is infected by many viruses, bacteria and fungi. Different fungal diseases like rust, smut, downy mildew, stalk rot and southern leaf blight attack the maize crop. Southern leaf blight (*Helminthosporium maydis)* is very devastating fungal disease that affects the maize crop at all stages (Atif et al., 2019; Rehman et al., 2021). Under the severe condition, crop losses may reach up to 60% in Pakistan. The disease first appears on leaves in the form of lesions. The lesions are surrounded by brownish color margins (Fig. 1). The spores of *Helminthosporium maydis* under microscope is shown in (Fig. 2). There are two types of races of fungi, O and T. Ninety nine (99%) infection is caused by race T of *H. maydis*. The other race, O is seed born. The race is derived from endosperm, pericarp and seeds of maize (Pavan & Shete, 2021). The disease is most serious in wet and warm regions, and causes yield losses up to 70%. In 1970, Race T caused the outbreak of disease that quickly spread in maize growing areas of the United

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State of America (USA). The disease incidence was first reported in 1925. Infection occurs before silking and reproductive stages with favorable weather conditions aid the disease development at critical damage level (Kumar et al., 2019). Maize crop can be protected from damage caused by southern leaf blight by using resistant cultivars and foliar fungicide sprays. It can prevent fungus from growing on seeds by coating them with fungicides and applying them to treated seeds (Mahapatra & Das, 2022). A field trial showed that fungicide seed treatment with SAAF and two sprays of Mancozeb at 30 and 45 days after sowing (DAS) were more effective than a control plot in warding off the diseases (Pavan & Shete, 2021). Keeping in view the above fact, a study was carried out to investigate the efficacy of fungicides to protect the maize from the southern leaf blight in the field. The fungicides used in the experiment are given below (Table 1).

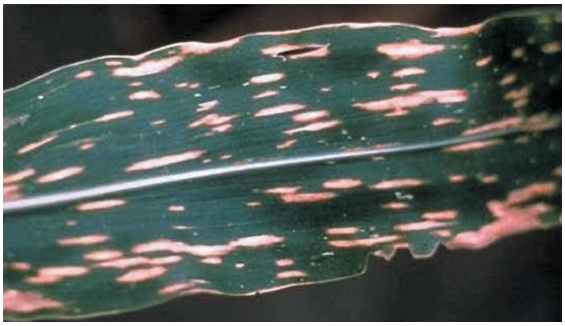

Fig. 1: ***Symptoms of Helminthosporium maydis***

Fig. 2: ***Spores of Helminthosporium maydis***

Table 1: Different fungicides used in the experiment

S. No.	Trade Name	Common name	Active Ingredients (%)	Formulation
1.	Tilt	Propiconazole	25	EC
2.	Dithane M-45	Mancozeb	75	WP
3.	Kavach	Chlorothalonil	70	WP
4.	Blitox-50	CopperOxychloride	50	WP

Material and Methods

Isolation and purification of pathogen *H. maydis*

During the Kharif season of 2021–2022, maize plants that showing the symptoms of SLBM were collected in paper bags from the Plant Pathology Research Institute, AARI, Faisalabad. The infected samples were brought to laboratory and washed with water to remove the impurities.

The samples were cut into approximately 2-3 mm size pieces and surface sterile with 0.1% mercuric chloride solution for 30 seconds followed by a subsequent washing with sterilized water. These samples were placed on PDA slants/plates using sterilized needles/forceps. Six days after the initial inoculation, fungus growth was appeared by placing the slants/plates in incubator at 25±2ºC. Purification of the pathogen was done by using "Hyphal Tip Technique" to obtain the pure culture. After the development of the pathogen growth; fungus was identified following mycological descriptions of fungal growth (Koneman & Roberts, 1985). Pure culture was stored in refrigerator for further processing.

Artificial inoculation of fungus *H. maydis*

The pure culture of *H. maydis* was obtained from Potato Dextrose Agar (PDA) media slants/plates that were inoculated with *H. maydis* by placing in incubator at 25±2ºC. Twenty petri of fully growing culture were grinded for 15-20 seconds with sterile water to make the spore suspension of 4-5 litter solution. The suspension was applied to the field with a compressed air sprayer. After the plants reached a height of 35cm, the fungal suspension was applied twice weekly. Petri dishes (120) of pure culture can be used on one thousand plants. At the first indication of disease, fungicides were applied to check their effect on infected plants.

Effect of fungicides against *H. maydis* under field condition

The field trial was conducted during Kharif season 2022-23 at Plant Pathology Research Institute, AARI, Faisalabad using Randomized Complete Block

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Design (RCBD) with three replications and five treatments with one check. The Malka-2016 was used in the experiment. The plot size was 4 meters with four rows. The inoculum of *H. maydis* was sprayed on all replications for the development of disease. The plots were sprayed with different fungicides twice at 15 days intervals 40-50 days after sowing (DAS). Ten plants were randomly selected from each treatment to record disease incidence (DI) and disease severity (DS). Disease incidence (DI) was recorded according to the formula given below and disease severity (DS) data was recorded by using scale in Table 2.

$$\text{Disease incidence (\%)} = \frac{\text{No. of diseased plants X 100}}{\text{Total no. of plants}}$$

Table No. 2 Observation on the severity of disease was recorded on 1-9 scale (Wheeler, 1969)

Scale	Disease Infection	% Plant Disease Incidence	Reaction of Disease
1.0	Very slight or nil infection	>11.11	**Resistant (R)**
2.0	Some lesions appeared on two lower leaves of Maize	22.22	
3.0	Moderate number of lesions or light infection appeared on four lower leaves	33.33	
4.0	Moderate number of lesions or light infection appeared on lower leaves, a few lesions scattered on middle leaves below the cob.	44.44	**Moderately resistant (MR)**
5.0	Abundant number of lesions or Moderate infection appeared on lower leaves, moderate number of lesions appeared on middle leaves below the cob.	55.55	
6.0	Abundant number of lesions or heavy infection appeared on lower leaves, moderate infection on middle leaves and a few lesions on two leaves above the cob.	66.66	**Moderately susceptible (MS)**
7.0	Abundant number of lesions or heavy Infection appeared on lower leaves, and middle leaves and moderate number of lesions on two to four leaves above the cob (60.1-70%)	77.77	
8.0	Lesions abundant or very heavy infection appeared on lower and middle leaves and spreading up to the flag leaves.	88.88	**Susceptible(S)**
9.0	Lesions abundant or very heavy infection appeared almost all the leaves, plants prematurely dried and killed.	99.99	

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Results and Discussion

Due to the lack of resistant varieties, use of fungicides is essential to control the plant diseases. The results showed that all the fungicides significantly reduced the percentage (%) disease over control except check (Untreated plots). Among all the four fungicides, Tilt 25% EC was found to be most effective in controlling southern leaf blight of maize by 80% over check followed by Mancozeb 75% WP control the disease by 70.83%. Similarly, Chlorothalonil 70% WP controls the disease by 59%. The least effective fungicide was Copper Oxychloride 50% WP control the disease by 42.5 %, as shown in (Table 3a). The efficacy of different fungicides to control the disease can be seen in graph given below (Fig No. 3b). These results are resembled with Sanjeev et al. (2009) reported that Tilt 25% EC was found best fungicide against leaf blight of maize.

Bhavani et al. (2016) also reported that Tilt 25% EC was highly effective and showed maximum percentage disease over control followed by Chlorothalonil. Jha et al. (2004) also studied 9 fungicides against leaf blight of maize and evaluated Tilt 25 % EC (0.1%) was highly effective in controlling disease and avoiding yield loss. Bharti et al. (2020) reported that five fungicides, Bavistin, Tilt, Dithane M-45, Blitox-50 and Kavach effectively control the maize leaf blight disease. Kumar et al. (2019) also studied that Tilt 25 EC @ 0.1% and Mancozeb 75% WP @ 0.2% effectively reduced the southern leaf blight (PDI 18.51% and 29.6%) as compared to control 85.17% PDI. But the results of Naz et al. (2013) were contrasting the study in his research reported that twelve different fungicides were tested against leaf blight of maize and concluded that Ridomil Gold and Mancozeb were effective fungicides inhibiting the colony growth of the fungus under field conditions at National Agricultural Research Center (NARC), Islamabad.

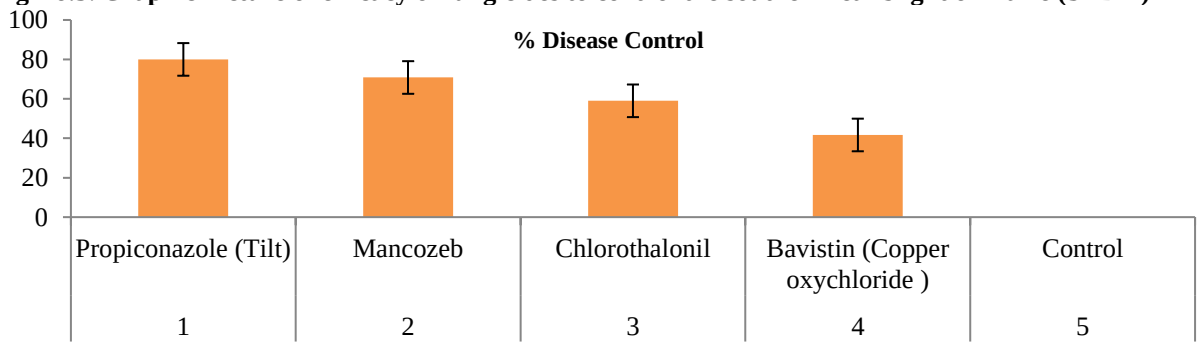
In-vitro evaluation of fungicides is most effective method to determine the effectiveness of fungicides in the suppression of disease (Kumar et al., 2019). The efficacy of five different systemic fungicides to inhibit the growth of *H. maydis* mycelium growth at any concentration was shown to be most effective with Tilt 25% EC (50, 100 and 200 ppm). At a concentration of 200 ppm, it has been proven that Carboxyne and Propiconazole are more efficient than Carbendazim. Hexaconazole (50ppm) had the least impact on the mycelial growth. According to studies by Sanjeev et al. (2009), Copper Oxycholoride (Blitox-50), Mancozeb (Dithane M-45) and Propiconazole (Tilt) at doses of 50, 500 and 1000 ppm were found to inhibit the growth of *H. maydis*. Harlapur and associates found that Carboxin and Mancozeb were equally efficient against *E. turcium* causing northern leaf blight of maize. The effectiveness of systemic fungicides such as Bavistin, Tilt and Vitavax was first time reported by Jha et al., 2004. Mancozeb is the most efficient non-systemic fungicide followed by Thiram and Chlorothalonil in results respectively. In a research conducted by Naz et al. (2013), Mancozeb was proven effective against the condition. The 200ppm concentration was more effective to prevent the growth of fungus than the 100ppm and 50ppm concentrations. Similar, findings were also evaluated by Prasanna & John (2022) and Soumya & Ramachandra (2019).

Table No. 3a Disease data recorded after the application of fungicides

Sr. No.	Name of Fungicide	R1	R2	R3	Mean	%Disease over control
		Disease %age	Disease %age	Disease %age	Disease %age	
1	Propiconazole (Tilt)	12	20	15	16	80 a
2	Mancozeb	20	20	30	23.33	70.83b
3	Chlorothalonil	35	28	36	33	59c
4	Blitox-50(Copper Oxychloride)	50	40	50	46.	42.5d
5	Control	80	90	70	80	-

CV 16.10, 0.05 Standard Error for Comparison 3.89

Fig No.3. Graphic Picture of efficacy of fungicides to control the southern leaf blight of maize (SLBM)



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Conclusion

Propiconazole (Tilt 25% WP) was the most effective fungicide for southern leaf blight of maize. Blitox-50 (Copper oxychloride 50%WP) was the least effective to control the disease.

Conflict of interest

Authors declared no conflict of interest.

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