International Journal of Environment and Climate Change

Volume 14, Issue 1, Page 496-501, 2024; Article no.IJECC.111851
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Bio-Assay of Fungicides against the *Neovossia indica* Inciting Karnal Bunt of Wheat

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2024/v14i13861

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/111851

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Original Research Article

Received: 08/11/2023
Accepted: 14/01/2024
Published: 18/01/2024

ABSTRACT

When it comes to its use in various food and feed applications, wheat is the cereal that is farmed most frequently worldwide. It is utilized for feedstock and grain production in both developed and developing nations. In 2020–21, India is predicted to produce a record 109.24 MT of wheat, up from 107.86 MT in 2019–20. The illness has been continuously controlled with the use of chemical treatments, resistant cultivars, and cultural practices. Fungicides significantly improved seed germination in one year, with Tilt 250 EC and Folicur being most effective, with other fungicides also showing consistent efficacy. The study examined wheat seed that had been administered with different fungicides to prevent disease. The results showed that all fungicides significantly boosted seed germination in a single year, with Folicur and Tilt 250 EC showing the highest efficacy. The trend of efficacy remained unchanged.

Keywords: Fungicides; karnal bunt; Neovossia indica; Tilt 250 EC; folicur.

1. INTRODUCTION

Wheat is the most frequently farmed cereal in the world when it comes to its use in different forms of food and feed. It is used in both developed and developing countries for both grain production and feedstock. India is expected to produce a record 109.24 MT of wheat in 2020–21, up from 107.86 MT the previous year (2019–20). India is the world's second-largest producer of wheat, after China, with a record average productivity of 337 kg/ha. About 30 million hectares, or 14% of the world's total area, have been used to cultivate the crop, which has produced the largest output of 99.70 million tons of wheat, or 13.64% of global production, which has been used since prehistoric times in various processed farms. India can produce more wheat and now has an oversupply of it on hand. From a farmed area of 29.58 mha, India produced 99.70 million tons of wheat in 2017–18. *Tilletia indica*, a heterothallic fungus also called Neovossia indica, is capa`ble of causing partial or karnal bunt in wheat. Mitra first recorded it in Karnal, Haryana [1]. Karnal bunt (KB) of wheat incited by *Tilletia indica* Mitra is now gaining importance from the last few years due to its increasing incidence [2]. It is the most significant disease affecting wheat seed and grain in northwest Mexico (Fuentes-Dávila, 1997), with reports from at least nine countries [3,4]. The majority of the endosperm along the longitudinal axis, together with the scutellum, are destroyed in severely afflicted kernels, leaving just the pericarp and the aleuronic layer, which gives the grains a "boat"-like look. This is most likely the reason the illness was given the moniker "bunt" [5]. A bad odor is released by recently harvested contaminated bread wheat grains, which is thought to be caused by trimethylamine [6]. An integrated disease management (IDM) system that manages wheat disease by integrating host resistance, chemical measures, cultural practices, regulatory measures, and biosuppression approaches as its sub-systems. As was also shown during the current experiment, the folicur at 0.20%, contaf at 0.10%, and tilt at 0.10% produced more than 90% Karnal bunt control [7]. It has been found that folicur, tilt, and Score 10 (prifenoconazole) decrease in vitro sporidial development [8].

2. MATERIALS AND METHODS

2.1 Bio-Assay of Fungicides

Eight fungicides viz. Tilt 250, Folicur, Bavistin, Thiram, Vitavax, Contof, Benlate and Dithane m-45 were assessed for their efficacy against Neovossia indica.

2.2 In vitro Test

The experiment used the poison-food technique, incorporating fungicides in potato dextrose agar medium. A disc from a 7-day-old *N indica* culture was placed in petriplates containing the fungicides. Three replications were kept for each treatment, and the radial growth diameter and percent inhibition were calculated.

2.3 Screening of Fungicides for Controlling Seed Borne Infestation

Plot culture was utilized to set up a seed treatment study. The efficiency of different fungicides against *Neovossia indica* infection of Karnal bunt of wheat was evaluated using naturally infected seeds. Untreated seeds were utilized as a control. On a plot filled with sterile soil, the fungicide-treated seed was sown after five minutes of vigorous shaking and mixing. There were six rows in each plot for each treatment. The percentage of seeds that germinated was recorded.

2.3.1 Screening of fungicides for controlling the disease under plot experiment

In the experiment, susceptible wheat variety K 9465 surface-sterilized seeds were sowed in autoclaved soil, fungus was injected into plants, and different fungicides were sprayed. The initial spray was applied 24 hours after the inoculation, then every 15 days until the crop reached immaturity. Ten days later, the severity of the disease was assessed.

3. RESULTS AND DISCUSSION

3.1 Bio-Assay of Fungicides against the *N. indica (In-vitro)*

Using the food poisoning approach, the efficacy of eight fungicides from different groups was assessed in vitro against *N. indica*. Each Petridish chemically impregnated PDA was then filled with a five-millimeter fungal disc when it had solidified. Three repetitions of each treatment, including the control, were conducted. The radial growth of the fungus was measured five days after it was cultured at 28+1°C. Table 1 presents the results, which reveal that all eight fungicides were found to be successful in suppressing *N. indica* mycelial growth. Tilt 250EL and Folicur, on the other hand, were the most effective in entirely inhibiting fungal growth. The residual substances shown varied degrees of inhibition against *N. indica* and were classified as partially effective. Benlate, Dithane M-45, Thiram, Vitavax, and Contaf. But Thiram and Bavistin were on par.

3.2 Screening of Fungicides for Controlling the Disease (in field)

The fungicides that were successful in combating the pathogen in vitro underwent additional testing to determine whether they could be applied topically or as seed treatments to manage the disease in the field. Tables 2 and 3 provide a summary of the outcomes for foliar spray and seed treatment, respectively.

3.2.1 Control of the disease by spray of fungicides

The study examined wheat seed that had been administered with different fungicides to prevent disease. The findings demonstrated that, in a single year, all fungicides considerably increased seed germination, with Folicur and Tilt 250 EC demonstrating the greatest efficacy. The effectiveness trend did not change.

3.2.2 Disease control by seed treatment

Several fungicides were used to treat wheat seed from sick crops, with Folicur and Tilt 250 EC proving to be the most successful. Bavistin, Thiram, Vitavax, Contaf, Benlate, and DithaneM-45 were additional fungicides. These treatments continued to be effective.

Table 1. Effect of eight fumigates on the growth of N.*indica* *In vitro*

Sl. No.	Fungi toxicants	Dose in PPM	Av. Radial growth in mm.
1	Tilt 250 EC	3000	0
2	Folicur	2000	0
3	Bavistin	1000	2.62
4	Thiram	2800	2.66
5	Vitavax	1500	6.3
6	Contaf	2000	7.0
7	Benlate	2000	8.0
8	Bithane M-45	2500	15.6
9	Control	-	98.00
10	CD at 5% level	-	2.13

Table 2. Effect of spray fungicides in controlling karnal bunt disease on wheat in field during 2020-21

S. No	Treatment	Disease Intensity (%)2020-21	Percent in disease intensity over control 2020-21
1-	Tilt 250 EC	18.17	25.70
2-	Folicur	19.75	22.32
3-	Bavistin	21.25	19.16
4-	Thiram	22.38	16.87
5-	Vitavax	25.27	11.16
6-	Contaf	31.22	12.39
7-	Benlate	35.23	18.00
8-	Dithane M45	41.37	10.9
9-	Control	49.22	----

Table 3. Effect of seed treatment with chemical on the germination of wheat seeds under plant condition during 2020-21

S.No.	Treatment	Dose%	2020-21 Average Seed Germination
1.	Tilt 250 EL	0.2	80.16 (63.15)
2.	Folicure	0.2	78.85 (62.62)
3.	Bavistin	0.2	76.56 (61.04)
4.	Thiram	0.2	75.82 (60.55)
5.	Vitavax	0.1	71.12 (57.49)
6.	Contaf	0.05	68.52 (55.87)
7.	Benlate	0.2	56.22 (48.57)
8.	Dithane M-45	0.2	52.68(46.54)
9.	Control	-	43.32(41.16)

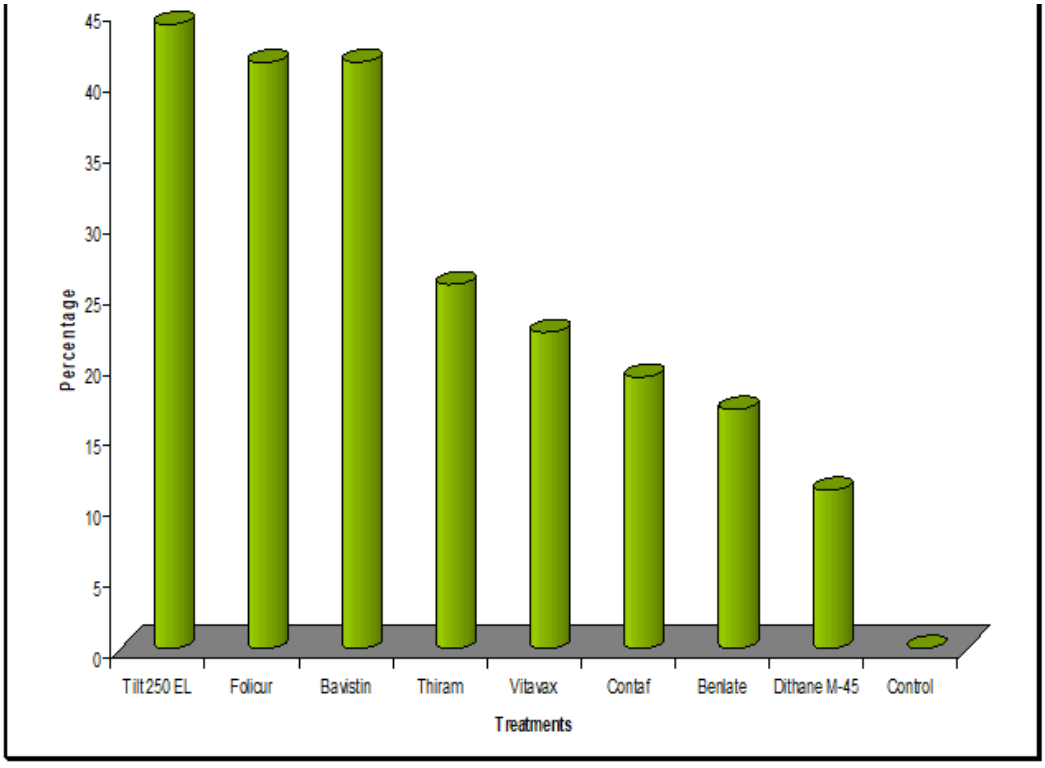

Fig. 1. Effect of spray fungicides in controlling Kama! bunt disease on wheatin field during 2020-21

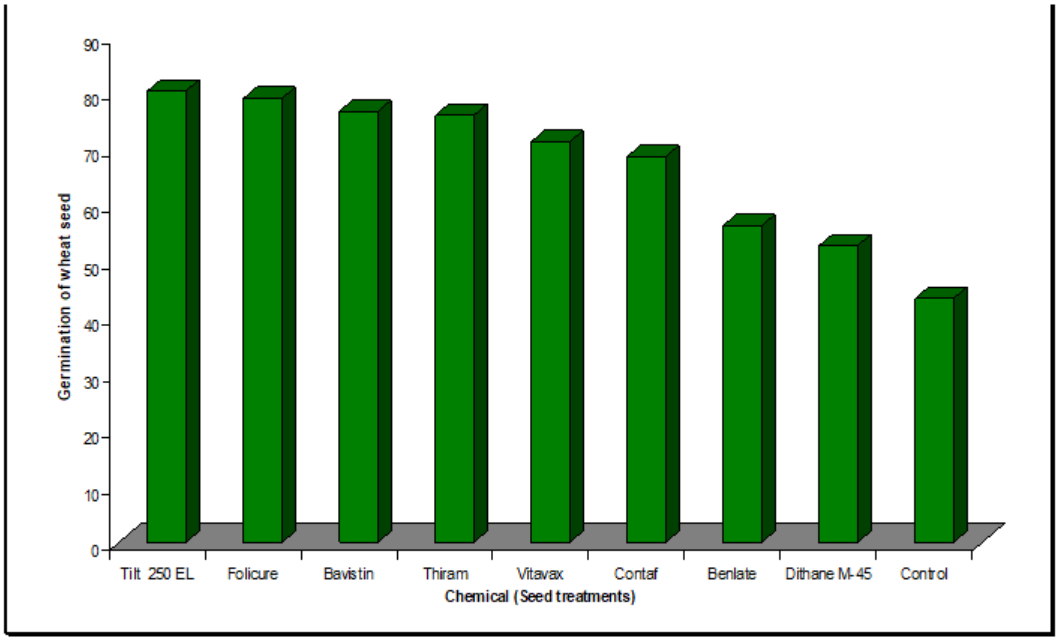

Fig. 2. Effect of seed treatment with chemical on the germination of wheat seeds under pot conditions during 2020-21

Five fungicides were used: corboxin (Vitavax 75WP), propiconozole (Tilt 20EC), Subeej (Bavistin 25SD), Carbendazim (Bavistin 50WP), and Vitavax power (Cromp. Uni. Royal). One untreated control was also included in the study. For each of these five fungicides, three concentrations (0.1%, 1.0%, and 2.5%) were investigated. The radial growth was evaluated and the percentage of inhibited radial growth was calculated after 15 days. The most successful radial growth inhibitor was found to be propiconazole (Tilt 20EC) [9].

The biological efficacy of commercial fungicides Rango, Tacora, Velficur, and Opus in controlling karnal bunt (*Tilletia indica*) in wheat was assessed in the field. The biological effectiveness of the products evaluated were Opus 91.6, Velficur 83.2, Tacora 80.2, and Rango 70.3%. The untreated inoculated check had a mean of 18.6% infection [10].

Muniraju et al., [11] evaluated nine fungicides in kharif 2016 to combat the false smut disease that affects rice. Among the several fungicides that were evaluated, metiram (55%) WG + pyraclostrobin (5%) WG @ 0.1 percent and azoxystrobin (18.2%) SC + difenconozole (11.4%) SC indicated the least amount of disease severity, 1.85 and 2.52 percent, respectively. Propiconazole 25 EC, Azoxystrobin 25 % SC, Difenconazole 25 % EC, Tebuconozole 250 EC, and flusilazole (25 %) SE + carbendazim (12.5 %) were the next in line. When applied in field conditions, SE increased the paddy yield and shown improved efficacy at 0.1% [12].

4. CONCLUSION

Among all the treatments evaluated Folicur and Tilt 250 EC were most successful against *Neovossia indica* in both *In vitro* and *In vivo* tests. The remaining compounds were deemed to be only marginally effective against N. indica, exhibiting varying degrees of inhibition. Benlate, Contaf, Vitavax, Dithane M-45, and Thiram. However, Thiram and Bavistin were similar. Wheat seed from sick crops was treated with a number of fungicides, the most effective being Folicur and Tilt 250 EC in seed treatment also. Other fungicides were Benlate, DithaneM-45, Thiram, Vitavax, Bavistin, and Contaf. These therapies remained successful.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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