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Evaluation of bio-assay of fungicides against Karnal bunt (*Neovossia indica*) (Mitra) Mundkur of wheat *in-vitro* and *in-vivo*

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Abstract
Wheat is the prime most staple harvest, placed next only to rice. Decreased production of wheat in the major wheat growing countries may be accredited to pervasiveness of Karnal Bunt disease. The major impact of Karnal Bunt is yield reduction and decrease in quality of grain and makes it inedible. Karnal Bunt is difficult to control due to its intermittent nature. The incidence of disease can be effectively reduced by the application of foliar fungicides. The present study highlights a brief outline of the fungicidal application for control of Karnal Bunt disease. The efficacy of seven fungicides *viz*; Tilt 250, Folicur, Bavistin, Thiram, Vitavax, Benlate and Dithane M-75 of different groups tested *in-vitro* against *Neovossia indica* following the food poison technique, out of seven, two fungicides *viz*; Tilt 250EL and Folicur to be the most effective as they have inhibited the fungal growth completely. The fungicides found effective against the pathogen *in-vitro*, were further tested for controlling the disease under field conditions by foliar application. Results revealed that the tilt 250 EL (0.2%) most effective followed by folicur and Bavistin although at par.

Keywords: *Neovossia indica*, kernel, bioassay, fungicide

Introduction
Wheat (*Triticum aestivum*) is an essential food crop of India which play important role in human diet besides, its straw is used as an animal feed. It is rich source of protein, carbohydrate, vitamins and minerals contributing about 27 percent of total food production. It is grown all over the country from sea level of the elevation of 3,685 meter in the Himalayas.
India is the second largest wheat growing county in the world after China. It contributes ¼ of the worldwide wheat production and covers 1/5 of the total cropped area of the world. There has been marvelous increase in both production and productivity in India after independence which has gone up from 5.6 million metric tonnes to 98.61 million metric tonnes (D.W.R. Report) 2017-18.
Consequently the productivity of wheat per hectare was gone up from 8.87 quintals in the 1966-67 to 33.18 quintal in 2017-18.
Karnal bunt of wheat caused by *Neovossia indica* has become a potential menace to wheat production in our country. Grain lots having more than 0.25 percent Karnal bunt infection, irrespective grades of infection, were not accepted by the agencies as seed due to contamination in the soil, subsequently increasing the rate of infection in the soil Anonymous (2017-18).
In severely affected kernels, most of the endosperm along the longitudinal axis, together with scutellum is destroyed leaving only the pericarp and the aleuronic layer giving the grains a "boat" like appearance. It is probably due to this reason the disease got the name bunt (Bedi and Dhiman, 1982) [3]. Freshly collected infected grains of bread wheat emit a foul smell believed to presence of Trimethylamine (Joshi *et al.*, 1980) [4].
Present study evaluated the activity of seven fungicides against Karnal bunt (*Neovossia indica) in vitro* and *in vivo*.

Material & Methods
Seven fungicides viz. Tilt 250, Folicur, Bovistin, Thiram, Vitavax, Benlate and Dithane M-75 were assessed for their efficacy against *Neovossia indica.*

***In vitro* test**

The experiment was carried out by use of poison-food technique (Schmitz, 1930) [5]. Requisite quantity of fungicides was incorporated in 2 percent potato dextrose agar medium which was shaken well to make in homogenous. The medium was then poured in to 90mm Petridish. A disc of 5mm diameter was taken from 7 day old culture of *N. indica* by cutting with sterilized cork borer and place at the centre of each petriplate containing solidified fungicides mixed medium. A petriplate without adding any fungicides serve as control three replications were kept for each treatment. All the Petriplates were then incubated at 25+ 1 ^{0}C for 7 days. The redial growth of the colony diameter in mm and interpreted in percent inhibition over control was calculated by following formula:

$$\text{Percentage inhibition} = \frac{\text{Colony diameter (mm in check)} - \text{Colony diameter (mm in treatment)}}{\text{Colony diameter (mm in check)}} \text{ X } 100$$

Screening of fungicides for controlling the disease (*in vivo*):

For this trial, surface sterilized seeds of susceptible wheat variety WL 711, were sown in 30 cm. diameter of earthen pots filled with autoclaved soil. Ten seeds in each pot and 3 pots for each treatment were used. The fungicides used for spray were Tilt 250, Folicur, Bavistin, Thiram, Vitavax, Benlate and Dithane M-75. The plants were inoculated one month after sowing by culture glass house. The first fungicidal spray was given after 24 hours of inoculation and repeated at 15-day-interval till maturity of crop. Control plants were sprayed with distilled water only. Disease intensity was determined 10 days after the last spray of test fungicides by using following formula.

$$\text{Disease intensity} = \frac{\text{Sum total of numerical rating x 100}}{\text{Total No. of plants examined x 4}}$$

Results and Discussion

Bio-assay of fungicides against Neovossia *indica* (*in-vitro*):

The efficacy of seven fungicides of different group of tested *in-vitro* against *Neovossia indica* following the food poison technique given in (Chart 1) showed that all the fungicides were found efficiency in reducing the mycelial growth of *Neovossia indica* out of seven, only two fungicides viz; Tilt 250EL and Folicur to be the most effective as they have inhibited the fungal growth completely. The remaining chemicals proved inhibitory to *Neovossia indica* to varying degree and were placed in partially effective. These fungicides in the descending order of merit were Bavistin, Thiram, Vitavax, Benlate and Dithane M-75. However, Bavistin and Thiram were at par.

The efficiency of seven fungicides of different group of tested against the pathogen *in-vitro* and it was observed that two of them viz.; Tilt 250EL and folicur inhibited the growth of the fungus completely. These fungicides considered to be the most effective ones. The remaining fungicides were partially effective. These fungicides in the descending order of merit were Bavistin, Thriam, Vitavax, Benlate and Dithane M-75 more or less similar results were obtained in bioassay test against *Nevossia indica.* The finding is based on the earlier report of Javed Bahar *et al.*, (2012) [2].

Screening of fungicides for controlling the disease (*in vivo*):

The fungicides found effective against the pathogen *in-vitro*, were further tested for controlling the disease under field conditions by foliar application. The results obtained are summarized in (Chart 2)

Tilt 250EL and Folicur was most effective fungicides. The other fungicides in descending order to efficiency were Bavistin, Thiram, Vitavax, Benlate and dithane M-75. These results are more or less similar to the report of Arshad *et al.*, 1995 [1].

Control of the disease by spray fungicides

The efficacy of seven fungicides found effective to varying extents in bioassay test was evaluated in pot experiment for the control of Karnal bunt disease of wheat. The first spray of fungicides was given after 24 hours of inoculation and repeated at 15-day-interval upto three month.

It is seen from the results in (Chart 2) that all the fungicides tested were significantly superior to control except for Dithane M-75 in checking the disease intensity. Three applications of Tilt 250EL (0.2%) at an interval of 15 days were found to be most effective in controlling the disease, followed by Folicur and Bavistin although, these were at par. The other chemicals in the descending order of efficacy during the year were Thiram, Vitavax, Benlate and Dithane M-75 and did not differ significantly. Thus, it may be conculaded that 3-4 foliar spray at an interval of 15 days by any of the fungicides, Tilt 250 EL, Folicur or Bavistin is sufficient to control the disease under field condition.

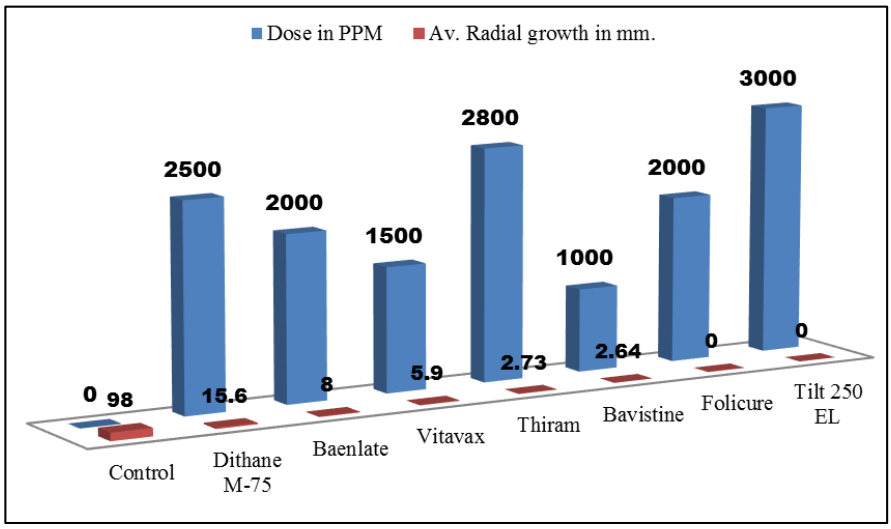

Chart 1: Effect of seven fungicides on the growth of *Neovossia indica in-vitro*

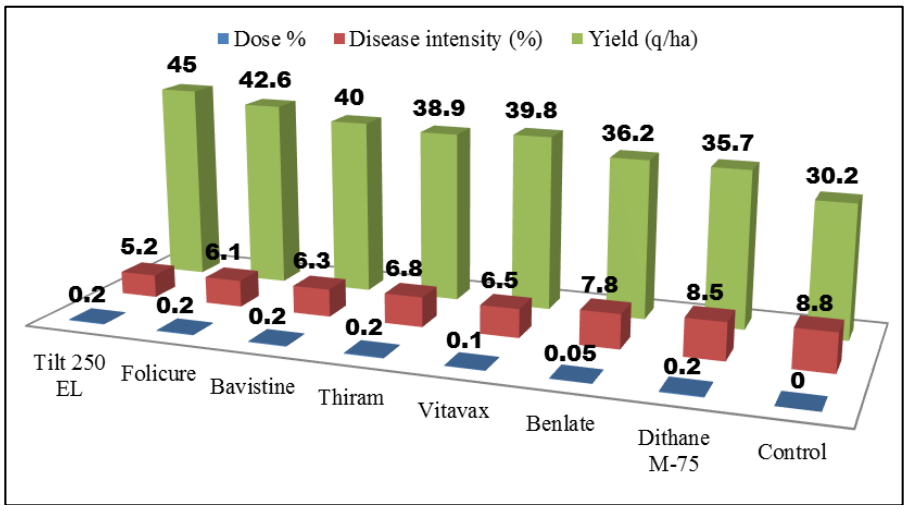

Chart 2: Screening of fungicides for controlling the disease *in vivo*

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