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RESEARCH ARTICLE

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Evaluation of selected fungicides against false smut disease of rice caused by *Ustilaginoidea virens*

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ABSTRACT : The present study was conducted to find out suitable management options against this disease, a field trial was carried out using six fungicides *viz.*, Coper hydrocide 77% WP @ (0.10%), Trifloxistrobin + Tebuconazole 75WG (0.04 %), Propaconazole 25 EC (0.10%), Kresoxim methyl 44.3 SC (0.04 %), Copper oxychloride (0.25 %) and Carbendazim 50 WP (0.10 %). There was significant difference among the treatments in false smut disease severity and yield. The best results was obtained in treatment of spraying rice field byTrifloxystrobin + Tebuconazole 75WG with maximum reduction in disease severity (68.6) and disease incidence (48.1), which gave least disease severity (1.6 %) and disease incidence (8.6), it was at par with the treatment propiconazole 25 EC (2.6 %), followed Kresoxim Methyl 44.3 SC (2.9). However Carbendazim 50 per cent WP treated plots showed highest (4.0%) disease severity and 15.8 per cent disease incidence. In terms of grain yield, the treatment with Trifloxystrobin + Tebuconazole 75WG gave maximum increase (23.6 %) in yield and 15.2 per cent increase in 1000 grain weight, it is followed by Propaconazole 25 EC with 21.6 per cent increase in grain yield and 10.6 per cent increase in 1000 grain weight. The least percentage increase of grains yield (11.13%) and 1000 grain weight (4.0%) was recorded in carbendazim sprayed plots.

KEY WORDS : False smut, Management, Fungicides, *Ustilaginoidea viren*

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INTRODUCTION

Rice (*Oryza sativa* L.) is a vital world commodity as it is the staple food of about half of the world population. It is the primary source of energy and protein for 4.5 billion peoples in the most populous nations of Asia. Rice is cultivated under diverse ecologies, ranging from irrigated to rain-fed and upland to lowland and deep water system (Kumar *et al.,* 2014 and 2017). Rice false smut caused by *Ustilaginoidea virens* (Cooke) (Takahashi) is a destructive grain disease in rice production throughout the world.The false smut pathogen is an ascomyceteous fungus, the perfect stage being *Villosiclava virens* (Nakata) E. Tanaka and C. Tanaka (Tanaka *et al.*,2008). The pathogen survives as dormant structures such as sporeballs, chlamydospores, sclerotia etc. in soil, stubbles

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of the crop and also in collateral hosts (Singh and Dube, 1976 and Yashoda and Anahosur, 2000). Rice false smut, also known as pseudo-smut, or green smut, has been recorded in all rice growing countriesin the world such as India, Australia, Pakistan, the United States, Mexico, the Philippines and Peru (Ou, 1985 and Webster and Gunnel, 1992). Earlier it was regarded as a minor disease, occurring sporadically in certain regions, but now epidemics of the disease are also being reported in different parts of the world including in India (Rush *et al.*,2000 and Anonymous, 2016). Recently in India, the disease has been observed in severe form since 2001 in major rice-growing states, *viz.*, Andhra Pradesh, Bihar, Gujarat, Haryana, Jammu and Kashmir, Jharkhand, Karnataka, Maharashtra, Pondicherry, Punjab, Tamil Nadu, Uttar Pradesh and Uttaranchal (Dodan and Singh 1996 and Mandhare *et al.*, 2008).

Its occurrence is related to soils with high fertilization, rainy periods with humidity higher than 90 per cent, especially during the crop flowering stage (Ahonsi *et al.*, 2000). The infection with *U. virens* is reported to be favoured by high relative humidity (>90%) (Yashoda *et al.*, 2000), high rainfall (Sugha *et al.*,1992), low sunshine hours (Nessa *et al.*,2015), temperatures in the range of 25 to 30°C (Chen *et al.*, 1994 and Yashoda *et al*., 2000), late sowing or maturing (Nessa *et al.*, 2015 and Sarker *et al.*, 2016) and high soil fertility (Ahonsi *et al.*,2000) as well as high amount of nitrogen (Li *et al.*,1986). In addition, large-scale expansion of high yielding rice varieties or hybrid rice (Biswas, 2001), over use of chemical fertilizers and more frequent irrigation (Lu *et al.*,2009) also have been recorded as factors for wide spreading of this disease.

The symptoms observed were similar with those described by (Ou, 1985 and Webster and Gunnel, 1992). The symptoms are visible only after flowering when the fungus transforms the individual grains of the panicle into globose structures or yellowed carbonaceous masses. These masses are dusty representing more than twice the diameter of normal grain and at early development are yellow and then acquire dark green or almost black color, and explode releasing the spores of the fungal causal agent. It transforms individual grains of the panicle into greenish, velvety spore balls of chlamydospores (Ou, 1972), which contain mycotoxins (ustiloxins) toxic to animals (Nakamura *et al.*, 1992).

Cultivation of resistant varieties is the best method of control but false smut resistant varieties are not available or if available but not suitable for western Uttar Pradesh. Copper fungicides are known for controlling false smut (Kannaiyan and Rao, 1976), but there are reports of copper showing phytotoxicity and reducing grain yields (Cartwright *et al.*, 2000). In this studysome new fungicides were evaluated, for the management of false smut disease.

EXPERIMENTAL METHODS

The field experiment was carried out during *Kharif*, 2014 and *Kharif* 2015 seasons at the Seed Production farm of the Krishi Vigyan Kendra, Aligarh. Aligarhis situated in the western part of Uttar Pradesh, occupies a small part of the Ganga-Yamuna doab. It lies between latitude 270 34'26" and 280 10'46" N and longitudes 770 289'17" and 780 36'02" E. Aligarh district experiences tropical monsoon climate characterized by two extreme conditions of severe cold in winter and oppressive heat in summer with a rainy season in between. July and August are the rainy months and having average rainfall varying from 157.05mm to 235mm, but in September there is a marked decrease in rainfall.

Nursery of Pusa Basmati-1 was seeded on 15th June during both years. Twenty-five days old seedlings were uprooted from the seedbed very carefully and then transplanted in the main field with row to row spacing of 20 cm and plant to plant spacing of 15 cm. In each plot a uniform plant stand was maintained and standard agronomic practices were followed for raising and maintenance of plants. The crop was irrigated as per need on regular basis and fertilizers were applied @ 120, 60 and 40 kg ha^{-1} N, P_2O_5 and K_2O, respectively. Nitrogen was applied on three occasions (1/3each at basal, maximum tillering and panicle initiation stage), while the P_2O_5 and K_2O were applied as a basal application.

Thirty days old seedlings of Pusa Basmati-1 were transplanted 10th July of both seasons *i.e.*, 2014 and 2015, respectively. The size of individual plots was 3×3 m. Agronomical practices such as irrigation, fertilizers, weeding were done following standard recommended rice production practices.

Plots were inoculated with chlamydospores of U. virens, collected from spore balls, from rice fields. Chlamydospores were suspended in water and applied to plots during the boot stage, by spraying, in the evening.

Six fungicides *viz.*, Coper hydrocide 77% WP (0.10%), Trifloxistrobin + Tebuconazole 75WG (0.04 %), Propaconazole 25 EC (0.10%), Kresoxim methyl 44.3 SC (0.10%), Copper oxychloride (0.25%) and Carbendazim 50 WP (0.10 %) were evaluated as two foliar sprays (the first spray applied at mid-late boot stage and the second 15 days later), after artificial infection in the field. Each plot was visited on regular basis for recording observations. The disease incidence was recorded at maturity stages of the plant. Data were recorded visually by observing the symptoms. Twenty plants were randomly selected from each unit plot and the following parameters were considered for data collection. Number of panicle/plants Number diseased panicle/plants Disease incidence was calculated by the following formula (Rajput and Bartaria, 1995):

Disease incidence = Number of diseased panicles / Total number of inspected panicles x 100 and grain yield (kg/plot) was recorded after harvesting. Data recorded during the both years was pooled and presented through Bar Diagram in this study.

EXPERIMENTAL RESULTS AND ANALYSIS

In the present study, in addition to the previously reported fungicides, we are reporting the efficacy of some new combination of fungicides such as Trifloxystrobin 25% + Tebuconazole 50 per cent (Nativo 75 WG) @ 0.4gm/lt at full panicle emergence stage, for the management of false smut disease under field condition. All the six fungicides evaluated other than Carbendazim significantly reduced false smut incidence when applied at both the stages *i.e.*, boot stage and milky stage, comparison with the control. The best results was obtainedin treatmentof spraying rice field by Trifloxystrobin + Tebuconazole 75WG with maximum reduction in disease severity (68.6) and disease incidence (48.1), whichgave least disease severity (1.6 %) and disease incidence (8.6), it was at par with the treatment propiconazole 25 EC which showed 2.6 per cent disease severity and 10.80 per cent disease incidence, respectively. It is followed Kresoxim methyl 44.3 SC with 2.9 per cent disease severity and 11.20 per cent disease incidence. However, Carbendazim 50 per cent WP treated plots showed highest (4.0%) disease severity and 15.8 per cent disease incidence (Fig.1). In terms of grain yield, the treatment with Trifloxystrobin+ Tebuconazole 75WG also gave maximum increase (23.6 %) in yield and 15.2 per cent increase in 1000 grain weight, it is followed by Propaconazole 25 EC with 21.6 per cent increase in grain yield and 10.6 per cent increase in 1000 grain weight. The least percentage increase of grains yield (11.13%) and 1000 grain weight (4.0%) was recorded in carbendazim sprayed plots (Fig. 2).

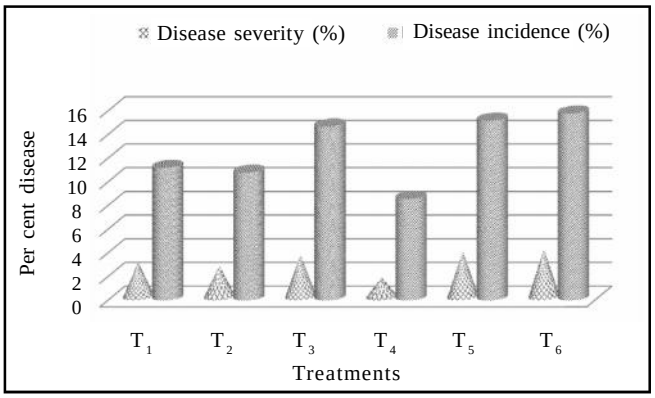

Fig. 1: Effect of different fungicides on false smut (Pooled data of 2014-2015)

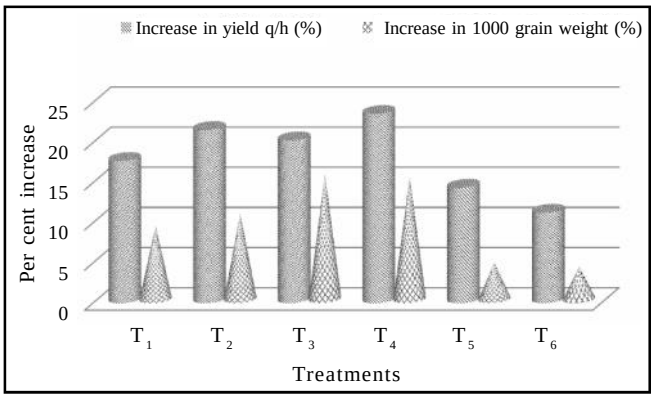

Fig. 2: Effect of different fungicides on false smut (Pooled data of 2014-2015)

T_1 = Kresoxim methyl 44.3 SC,
T_2 = Propaconazole 25 EC,
T_3 = Copper hydroxide 77 WP,
T_4 = Trifloxystrobin + Tebuconazole 75WG,
T_5 = Copper oxicloride 50 WP,
T_6 = Carbendazim 50% WP and
T_7 = Untreated check

Combination fungicides are better compare to the other solo fungicides due to their broad range of action, lower dose and also posses lower risk of fungicide resistance development in target fungal population.In rice, efficacy of such combi products in managing many fungal diseases has been reported (Bag and Saha, 2009;

Bhuvaneswari and Raju, 2012; Kumar and Veerabhadraswamy, 2014 and Pramesh *et al.,* 2016). According to Ladhalakshmi *et al.* (2014) applications of trifloxystrobin 25% + tebuconazole 50% (0.4g/l) or propiconazole 25 EC (1ml/l) either at 50 per cent or 100 per cent panicle emergence stage was effective and both the chemicals were on par in their performance in reducing the percentage of infected panicles/m^2 and infected spikelet's/panicles and increasing the yield.In case of rice, many researchers have reported the increased grain yield after application of fungicides due to reduction in biotic stress on plant during critical growth stages (Sood and Kapoor, 1997; Tirmali *et al.*,2001; Prabhu *et al.*,2003; Naik *et al.*,2012; Bhuvaneshwari and Raju, 2012; Bag *et al.*, 2016 and Pramesh *et al.*, 2016). For management of false smut disease, efficacy of many fungicides has been reported previously (Chen *et al.*, 2013; Kumar, 2015 and Raji *et al.*, 2016).

Conclusion:

The fungicide trifloxistrobin + tebuconazole 75 WG and propiconazole 25 EC were effective for the management of false smut of rice. The two spraying of trifloxistrobin + tebuconazole 75 WG and propiconazole 25 EC at milking, or even at 100 per cent panicle emergence reduced the percentage of spikelet infection as well as the percentage of infected panicles and increased grain yield. These two fungicides could be used for the management of false smut.

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