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**Original Research Article**

# Evaluation of Combination Fungicides on Leaf Blast Neck Blast Disease and Yield, Economics Analysis of Eastern U.P.

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**A B S T R A C T**

Experiments were conducted at Crop Research Station, Ghaghraghat, Bahraich to evaluate the compatibility of fungicidal evaluation against Neck blast and Leaf blast major disease of Eastern Uttar Pradesh of rice during ws 2017 and 2018. disease infestations are the primary constraints in rice (Oryza sativa.L) production. The Neck Blast and Leaf Blast causing major loss of production. The experiment consisted of nine treatments viz. T1- Flusilazole 12.5% + carbendazim 25% SC @ 1.0ml/l., T2- Azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC @ 1.0 ml/l., T3- Azoxystrobin 11% + tebuconazole 18.3% w/w SC @ 1.5 ml/letter, T4- Tricyclazole 18 % + Mancozeb 62 % WP @ 2.5g/l., T5- Zineb 68% + hexaconazole @ 4% WP 2.5g/l, T6- Trifloxystrobin 25% + tebuconazole 50% WG @ 0.4g/l., T7- Mancozeb 50% + carbendazim 25% WS @ 2.5g/l., T8- Fluxapyroxad 62.5g/l + epoxiconazole 62.5g/l EC @ 1.5ml/l. and T9- Untreated control (Spray of plain water), were applied the recommended dose of each product to diseased plants at the rate of two sprays with an intravel of 15 days.. Observations were recorded at 20 days after the second spray. Analysis of the data showed that among the treated with Trifloxystrobin 25% + tebuconazole 50% WG @ 0.4 g/l was found best in checking the disease severity leaf blast (10.4%,), neck blast (14.7%) and incidence was leaf blast and neck blast (12.0%), (17.9%) respectively and the better grain yield 6863 kg/ha was recorded. While severity and incidence of leaf blast and neck blast had gone to the extent of 54.5, 85.2, 46.3 and 55.7 % respectively in unsprayed plots. In check plots reduced grain yield was recorded (3863 kg/ha). In spite of increase in grain yield of treated with Trifloxystrobin 25% + tebuconazole 50% WG was 77.66 percent respectively. Treated with Trifloxystrobin 25% + tebuconazole 50% WG was gave higher gross return of Rs. 84219/ha with a benefit cost ratio of 1.72 and additional net return of Rs.84329/ha as compared to untreated check followed by Azoxystrobin 11% + tebuconazole 18.3% w/w SC @ 1.5ml/l. over check minimization of disease severity

**Keywords**

Rice Leaf blast, Neck blast, incidence, severity, fungicide

## Introduction

Rice, *Oryza sativa* L. is an important crop worldwide, serving as the staple food for half of humanity and additionally being used in industry and for animal feed. Rice is grown in various agro-ecological zones in tropical and subtropical areas, especially in Asia, the continent accounting for 90% of the world production (IRRI 2015 a). More than 90% of the world's rice is grown and consumed in Asia where 60% of the earth's people live (Kole, 2006). Rice is the staple food crops and responsible for the food security for 2/3 population of the world. The productivity of rice is affected by many biotic and abiotic factors. Among the different biotic constraints, diseases caused by fungal pathogens such as blast and sheath blight are more frequent and ferocious disease in

irrigated rice of both temperate and subtropical areas and which cause *damage* at all stages of crop growth [1]. Major Rice diseases include Rice Ragged stunt, sheath Blight and Tungro. Worldwide, rice blast caused by the filamentous fungus Magnaporthe grisea (Hebert) Barr. (*anamorph, Pyricularia grisea Sacc*.), which is one of the most economically devastating crop diseases (Valent and Chumley, 1994) in most rice growing and producing areas of the world (Ou, 1985), attacks at all stages of the crop and symptoms appear on leaves and nodes (Seebold *et al*., 2004). The extent of damage caused by the disease is by measuring incidence and severity which depend on factors like physiological race of the pathogen; rice varieties employed, cultural practices and the prevailing environmental factors (Ou, 1985 ; Singh and Bhatt, 1986).

Rice blast caused by *Pyricularia* oryzae Cavara [*synonym Pyricularia grisea Sacc*. the anamorph of *Magnaporthe grisea (Herbert) Yaegashi and Udagawa*], is one of the most destructive and wide spread disease of rice [2]. Blast epidemic causes the complete defeat of seedling [3] at the nursery and in field condition [4] and causes up to 80% of total yield reduction [5-6]. These germinate and develop an appressorium at the tip of the germ tube, which attaches to the surface of plant tissues; an infection-peg from the appresorium penetrates into plant tissues. The wall of conidiophores and appressorium are pigmented by melanin. Neck blast infection to the neck node produces triangular purplish lesions, followed by lesion elongation to both sides of the neck node – symptoms which are very serious for grain development. When young neck nodes are invaded, the panicles become white in colour – the so-called 'white head' that is sometimes misinterpreted as insect damage. Later infection causes incomplete grain filling, and poor grain quality. Panicle branches and glumes may also be infected. Spikelets attacked by the fungus change to white in colour from the top and produce many conidia, which become the inoculum source after heading. The fungus is able to infect and produce lesions on all organs of the rice plant except the root. Leaf blast when the fungus attacks a young leaf, purple spots can be observed after an incubation period, changing into a spindle shape which has a gray centre with a purple-to-brown bord e r, and then surrounded by a yellow zone as time passes.

Brown spots appear only on the older leaves or leaves of resistant cultivars. In young or susceptible leaves, lesions coalesce and cause withering of the leaves themselves, especially at the seedling and tillering stages. Lesion formation on the n-leaf (where n is the top developing leaf), causes shortening of the n + 1 leaf sheath and the n + 2 leaf blade, with consequent stunting of the whole plant. The discovery of several methods for the control of rice blast (Oryza sativa L.) caused by heterothallic Ascomycete, Magnaporthe grisea Barr (*anamorph, Pyricularia oryzae Cav. or Pyricularia grisea*) was the target for research in the World (Georgopoulos and Ziogas, 1992; Ntanos and Giamoustaris, 1991; Ntanos and Filippou, 1991; Thanassoulopoulos, Tzavella-Klonari and Katis, 1990), study was necessary for the evaluation of biological and chemical methods for the control of this disease in relation with the influence of environmental conditions. However, the evaluation of fungal antagonists was necessary as Trichoderma harzianum (Ágrios 1988; Beagle-Ristaino and Papavizaw 1984; Sy, Sarr, Albertini and Moletti, 1990), Chaetomium globosum (Ágrios 1988; Soytong and Quimio, 1989; Sy, Sarr, Albertini and Moletti, 1990) and fungicides as Ferimzone (Okuno, Furusawa, Matsura and Shishiyama, 1989). Fungicidal control is largely practiced for blast disease in temperate or subtropical rice cultivation, primarily in Japan, China, South Korea,

Taiwan and, increasingly, Vietnam [18]. For the management of blast, fungicides such as Isoprothiolane, Probenazole, Pyroquilon Tricyclazole [19] and most of the other fungicides like Benomyl, Carbendazim, Chloroneb, Captafol, Mancozeb, Zineb, Edifenphos, Iprobenphos, Thiophanate, Carboxin, Kitazin, Flutolanil, etc. are found to be effective for blast disease management under filed conditions [20-24].

## Materials and Methods

The field experiment was conducted during kharif season of 2017 and 2018 in Crop Research Station, Ghaghraghat, Bahraich of Latitude (North) 27°50'N, Longitude (East) 81°20'E and Elevation (m. from MSL) 112m. Experiment was transplanted in Randomized Block Design (RBD) with nine treatment ie; T1- Flusilazole 12.5% + carbendazim 25% SC @ 1.0ml/l., T2- Azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC @ 1.0 ml/l., T3- Azoxystrobin 11% + tebuconazole 18.3% w/w SC @ 1.5 ml/letter, T4- Tricyclazole 18 % + Mancozeb 62 % WP @ 2.5g/l., T5- Zineb 68% + hexaconazole @ 4% WP 2.5g/l, T6- Trifloxystrobin 25% + tebuconazole 50% WG @ 0.4g/l., T7- Mancozeb 50% + carbendazim 25% WS @ 2.5g/l., T8- Fluxapyroxad 62.5g/l + epoxiconazole 62.5g/l EC @ 1.5ml/l. and T9- Untreated control (Spray of plain water). The recommended dose of each product was applied to the diseased plants at the rate of two sprays with an intravel of 15 days. Control plot were sprayed with ordinary water.

Disease observations were recorded after 15 days last spray by fixing 5 sampling unit of one square metre in each plot. The disease severity and incidence were recorded in percent and increased in yield (kg/h). The soil is sandy loam low in organic carbon. It is rich in potassium, medium in phosphorus and possesses good water holding capacity and PH 7.50. The rice variety Jal Priya was sown in nursery 20-26 June in both years. The 28-30 days old seedling were used for transplanting keeping 2-3 seedling/hill in main field. Transplanting was done at 20x15 cm spacing with recommended dose of fertilizer 100:60:20 kg NPK/ha in all treatments. The data on grain yield of each plot were recorded separately by threshing the harvested Jal Priya on tarpaulin followed by proper sun drying and winnowing , grain yield measured in kilogram. The data so obtain were subjected to statistical analysis after necessary transformation for final statistical analysis (Gomez and Gomez, 1983). Observations on different growth and yield parameters were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and B: C ratio. Severity was scored and calculated by area of rice plant parts affected by total area of plant parts examined.

Disease Incidence (%) = No. of infected plant/total plant examined X100

**Disease Severity (%) =** No. of plant tissue affected /total area of plant parts affected X100

## Results and Discussion

There was significant difference among the treatments in leaf blast and neck blast disease severity and yield. The data on different disease parameters is summarised in table 1. Treated with Trifloxystrobin 25% + tebuconazole 50% WG @ 0.4 g/l was found best in checking the disease severity leaf blast (10.4%,), neck blast (14.7%) and incidence was leaf blast and neck blast (12.0%), (17.9%) respectively and the better grain yield 6863 kg/ha was recorded presented in Table-2.

**Table.1** Effect of different fungicides on severity and incidence of leaf blast and neck blast of rice

| Treatments | Dose/l or g | Leaf blast Incidence % | Leaf blast disease severity (%) | Neck blast Incidence % | Neck blast disease severity (%) |
|---|---|---|---|---|---|
| **T1- Flusilazole 12.5% + carbendazim 25% SC** | 1 ml | 22.3 (28.1) | 13.7 (21.7) | 22.4 (28.2) | 16.4 (23.9) |
| **T2- Azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC** | 1 ml | 31.0 (33.8) | 16.4 (23.8) | 27.6 (31.6) | 17.7 (24.9) |
| **T3- Azoxystrobin 11% + tebuconazole 18.3% w/w SC** | 1.5 ml | 20.1 (26.6) | 12.4 (20.6) | 20.0 (26.6) | 16.0 (23.5) |
| **T4- Tricyclazole 18 % + mancozeb 62 % WP** | 2.5 g | 27.2 (31.4) | 15.4 (23.1) | 25.8 (30.5) | 16.9 (24.9) |
| **T5- Zineb 68% + hexaconazole 4% WP** | 2.5 g | 31.4 (34.1) | 21.4 (27.6) | 45.5 (42.4) | 19.3 (26.0) |
| **T6- Trifloxystrobin 25% + tebuconazole 50% WG** | 0.4 g | 12.0 (20.3) | 10.4 (18.8) | 17.9 (25.0) | 14.7 (22.5) |
| **T7- Mancozeb 50% + carbendazim 25% WS** | 2.5 g | 32.0 (34.4) | 18.4 (25.4) | 28.3 (32.1) | 18.0 (25.1) |
| **T8- Fluxapyroxad 62.5g/l + epoxiconazole 62.5g/l EC** | 1.5 ml | 34.9 (36.2) | 19.2 (26.0) | 32.1 (34.5) | 18.6 (25.5) |
| **T9- Control** | - | 85.2 (67.8) | 54.5 (47.6) | 55.7 (48.2) | 46.3 (42.9) |
| **General Mean** | - | 32.9 | 20.2 | 30.6 | 20.4 |
| **LSD @ 5% (P= 0.05)** | - | 4.5 | 0.3 | 1.9 | 0.3 |
| **CV (%)** | - | 7.3 | 0.7 | 4.0 | 0.6 |
| **SE(m)** | - | 1.5 | 0.1 | 0.7 | 0.1 |
| **SE(d)** | - | 2.1 | 0.1 | 0.9 | 0.1 |

**Table.2** Effect of fungicides on grain yield

| Treatments | Dose/l or g | Grain Yield (kg/ha) | Increase (%) |
|---|---|---|---|
| **T1- Flusilazole 12.5% + carbendazim 25% SC** | 1 ml | 5788 | 49.83 |
| **T2- Azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC** | 1 ml | 4913 | 27.18 |
| **T3- Azoxystrobin 11% + tebuconazole 18.3% w/w SC** | 1.5 ml | 6313 | 63.42 |
| **T4- Tricyclazole 18 % + mancozeb 62 % WP** | 2.5 g | 5213 | 34.94 |
| **T5- Zineb 68% + hexaconazole 4% WP** | 2.5 g | 4325 | 11.95 |
| **T6- Trifloxystrobin 25% + tebuconazole 50% WG** | 0.4 g | 6863 | 77.66 |
| **T7- Mancozeb 50% + carbendazim 25% WS** | 2.5 g | 4775 | 23.6 |
| **T8- Fluxapyroxad 62.5g/l + epoxiconazole 62.5g/l EC** | 1.5 ml | 4563 | 18.12 |
| **T9- Control** | - | 3863 | - |
| **General Mean** | - | 5179 | - |
| **LSD @ 5% (P= 0.05)** | - | 213.8 | - |
| **CV (%)** | - | 2.8 | - |
| **SE(m)** | - | 72.8 | - |
| **SE(d)** | - | 103 | - |

**Table.3** Economic analysis of different treatments on rice WS 2017 & 2018

| Treatments | Grain Yield (q/ha) | Cost of cash input | Sale price of grain (MSP) (Rs./qt) | Total returns | Extra returns | Benefit: Cost ratio |
|---|---|---|---|---|---|---|
| **T1- Flusilazole 12.5% + carbendazim 25% SC** | 57.88 | 48900 | 1300 | 75205 | 26305 | 1.53 |
| **T2- Azoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC** | 49.13 | 48900 | 1300 | 63869 | 14969 | 1.30 |
| **T3- Azoxystrobin 11% + tebuconazole 18.3% w/w SC** | 63.13 | 48900 | 1300 | 82069 | 33169 | 1.67 |
| **T4- Tricyclazole 18 % + mancozeb 62 % WP** | 52.13 | 48900 | 1300 | 67769 | 18869 | 1.38 |
| **T5- Zineb 68% + hexaconazole 4% WP** | 43.25 | 48900 | 1300 | 56225 | 7325 | 1.14 |
| **T6- Trifloxystrobin 25% + tebuconazole 50% WG** | 68.63 | 48900 | 1300 | 89219 | 84329 | 1.72 |
| **T7- Mancozeb 50% + carbendazim 25% WS** | 47.75 | 48900 | 1300 | 62075 | 13175 | 1.26 |
| **T8- Fluxapyroxad 62.5g/l + epoxiconazole 62.5g/l EC** | 45.63 | 48900 | 1300 | 59319 | 10419 | 1.21 |
| **T9- Control** | 38.63 | 47000 | 1300 | 50219 | 3219 | 1.10 |

While severity and incidence of leaf blast and neck blast had gone to the extent of 54.5, 85.2, 46.3 and 55.7 % respectively in unsprayed plots. In check plots reduced grain yield was recorded (3863 kg/ha). In this treatment 77.66 increased grain yield over untreated check was observed. The plot treated with had also shown good response with T3- Azoxystrobin 11% + tebuconazole 18.3% w/w SC @ 1.5ml/l the leaf blast and neck blast disease severity (12.4, 16.0%,) and 20.1, 20.0 % disease incidence, along with good grain yield 6313 kg/ha was recorded. In treatment combinations T1- Flusilazole 12.5% + carbendazim 25% SC @ 1.0 ml/l, showed response of leaf blast and neck blast disease severity (13.7, 16.4%,) and 22.3, 22.4 % disease incidence, along with grain yield 5788 kg/ha was recorded. In the plot treated with T4- Tricyclazole 18 % + mancozeb 62 % WP @ 2.5 g/l. 15.4, 16.9% leaf blast and neck blast disease severity and 27.2, 25.8% disease incidence along with grain yield 5213 kg/ha. was recorded. The plot treated with T2- zoxystrobin 18.2 % w/w + difenoconazole 11.4 % w/w SC @ 1.0 ml/l. 16.4, 17.7% leaf blast and neck disease severity and 31.0, 27.6 % disease incidence with yield 4913 kg/ha was recorded. The plot treated with T7- Mancozeb 50% + carbendazim 25% WS @ 2.5g /l. 18.4, 18.0% leaf blast and neck blast disease severity and 32.0, 28.3%, disease incidence with yield 4775 kg/ha was recorded. The plot treated with T8- Fluxapyroxad 62.5g/l + epoxiconazole 62.5g/l EC @ 1.5ml /l., 18.2, 18.6% leaf blast and neck blast disease severity and 34.9, 32.1%, disease incidence with yield 4563 kg/ha was recorded.

In spite of increase in grain yield of treated with Trifloxystrobin 25% + tebuconazole 50% WG was 77.66 percent respectively. Treated with Trifloxystrobin 25% + tebuconazole 50% WG was gave higher gross return of Rs. 84219/ha with a benefit cost ratio of 1.72 and additional net return of Rs.84329/ha as compared to untreated check presented in Table-3.

All eight fungicidal treatments significantly reduced the disease severity and incidence at all test locations when compared to control. The combination product viz., trifloxystrobin 25% + tebuconazole 50% WG (0.4g/l) was significantly reduced the severity and increase the grain yield of rice (77.66%) over check, followed by Azoxystrobin 11% + tebuconazole 18.3% w/w SC @ 1.5ml/l. Minimization of disease severity may be one of the possible reasons for enhancement of grain yield by the spraying of these fungicides. Singh *et al.* (2016) also reported the compatibility of different fungicide with insecticide for the management of leaf blast and neck blast.

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