Field evaluation of certain treatments on rice blast disease

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ABSTRACT

Field experiments were conducted to evaluate the effect of five fungicides, one commercial biofungicide and one bioagent against rice blast disease under field conditions during the two summers of consecutive seasons (2020 and 2021). The tested fungicides were Beam (75% WP) tricyclazole, Fuji-one (40% EC) isoprothiolane, Score (25% EC) difenoconazole, Leader (45% EC) prochloraz and Nativo (75% WG) tebuconazole 50 + trifloxystrobin 25 each at two rates (75 and 100 gm, 300 and 400 cm^3, 150 and 200 cm^3, 300 and 400 cm^3 and 150 and 200 gm, 200 L^{-1}, respectively). The biofungicide Plant guard (30 million cell ml^{-1}) (*Trichoderma harzianum*) applied at two rates (375 and 500 ml, 200 L^{-1}) and the bioagent isolated from soil (*Trichoderma harzianum* 1×10^9 spores × ml^{-1}) applied at two rates (375 and 500 ml, 200 L^{-1}). Each chemical fungicide, biofungicide and isolated bioagent was applied as foliar spraying 2 times per $season^{-1}$. The results clearly indicated that chemical fungicides were significantly more effective than the biofungicides and isolated bioagent, and all the tested compounds particularly Nativo (75% WG) and Score (25% EC) significantly reduced incidence and severity of leaf and panicle blast disease in rice and subsequently increased a rice biological yield, grain yield and straw yield in comparison with the untreated control. Also, *T. harzianum* isolated was more effective than commercial product plant guard. The higher rate of application in all treatments gave higher reduction of the rice blast disease, and subsequently higher yield.

Keywords: Rice, Blast disease, Fungicides, Biofungicides, *Trichoderma harzianum*.

INTRODUCTION

Rice (*Oryza sativa* L.) is reported to be the most important major crop grown not only in Egypt but also in various countries all over the world (Ahmed, M. E. A. 2003 and Moktan *et al*., 2021). Rice is a major source of food consumed by 50 % of the world's population (Kumar *et al*., 2017). Also, it is a good food source, little in fat , 7% protein with amount of amino acids and high content in carbohydrates (75 – 80 % starch) (Moktan *et al*., 2021). Rice grains contain many minerals as potassium and vitamins as vitamin B and E (niacin, thiamin) (Qudsia *et al*., 2017). Different abiotic and biotic factors such as fungal diseases especially rice blast disease (RBD) are behind the lower reduction of the yield of rice. (Moletti *et al*., 1988; Shrestha, 1993; Chaudhary, 1999; Kumar *et al*., 2017; Wasimfiroz *et al*., 2018).The most common and destructive disease among all the cereal crops is rice blast which appeared at most in wet and low area of upland farming situations and reported in more than 80 countries wherever rice field. RBD caused by *Magnaporthe grisea* (*Pyricularia oryzae*)(Yaegashi and Udagawa, 1978; Jia *et al*., 2000; Gilbert *et al*., 2004 and Ghimire *et al*., 2017 and Nirmalkar *et al*., 2017). Rice blast disease (RBD) shows throughout the crop beginning from nursery stage to maturity stage and symptoms appear on most parts of the plant, where the leaves taking eye-shaped lesions with whitey to gray centers and red to brownish borders, whereas brown discoloration appears on panicle neck that breaks and panicles after fall over. the most destructive phase being nodal or panicle infection where nodes show brown lesions, dry up and break off and consequently the development of seeds is prevented which causes huge losses in quality and quantity of harvest (Ou, 1985; Georgopoulos and Ziogas, 1992; Correll *et al*., 2000; Seebold *et al*., 2004; Magar *et al*., 2015; Gohel and Chauhan, 2015; Nalley *et al*., 2016; Qudsia, *et al* (2017; Moktan *et al*., 2021). RBD would cause damage ranging from 30 to 100 % reduction of total yield production if suitable management standards are not applied in the cultivars. Only 30% losses in world rice production would be enough to feed more than 60 million people (Chaudhary, 1999; Koutroubas *et al*., 2009; Prabhu *et al*., 2009; Nalley *et al*., 2016; Balgude *et al*., 2019; Kongcharoen *et al*., 2020). Many management strategies can be used to control these diseases, (cultivation of resistant varieties, amended cultural practices, chemical and biological control) (Qudsia *et al*., 2017). Rice blast resistant varieties have not appeared stable resistance over the years, as this resistance overcome in three to five years after its releases, where that pathogens change themselves with environmental conditions changes overcoming the host resistance that make the host susceptible against the certain disease (Prabhu *et al.*, 2009; Qudsia *et al.*, 2017). The biological method of plant disease treatment appears to be a better substitution to chemical fungicides in control rice blast disease but its problem is that it isn't practicable for larger fields (Kumar *et al.*, 2017; Qudsia *et al.*, 2017). Depending on the above facts, chemicals fungicides is the most common tool for control of diseases (such as RBD) leading to higher yield and enhanced quality of the commodity (El-Kholy and El-Shazly, 2006; Nasruddin and Amin, 2013; Pak *et al.*, 2017; Qudsia *et al.*, 2017; Kongcharoen., 2020; Moktan *et al.*, 2021). So, this study was amid to compare between different fungicides and biofungicides for controling rice blast disease to improve the grain yield under field conditions.

MATERIALS AND METHODS

The field experiments were conducted to evaluate the efficacy of fungicides and biofungicides for the control of rice blast disease (RBD) in the field under natural conditions during two consecutive seasons (2020 and 2021) in a private farm at El-Mawaged Village, El-Manzala district, El-Dakhlia Governorate. it was also conducted to evaluate these treatments on yield and some agronomic traits. The soil samples were taken from the experimental sites randomly from the top of 0- 20 cm. Some physical and chemical characteristics of soil are listed in Table (1). The potassium and calcium fertilizer were added after five days from sowing as potassium sulphate (50%) and calcium super sulphate (15%) at the rate of 50 and 100 kg feddan^{-1}, respectively. The nitrogen fertilizer was added at the rate of 40 kg feddan^{-1} as ammonium sulphate (20.6%) in three equal doses, *i.e.* ⅓ incorporated in soil, ⅓ at 25 days after sowing (DAS) and finally ⅓ at 50 days according to Omar *et al.*, (1991) and El-Kholy and El-Shazly, (2006). Other agriculture practices for rice production were adopted during growing seasons in this study. The experiments were designed as a randomized complete block design (RCBD) with three replicates for each treatment. The size of each plot was 21 m^2 (3 × 7m.), with a 50 cm distance (El-Kholy and El-Shazly, 2006). Rice seeds (cv. Giza 178) were supplied by Rice Research and Training Center (RRTC), Sakha, Kafr El-Sheikh, Governorate. The seeds were directly seeded at the rate of 60 kg feddan^{-1} (300 gm seeds for each plot) in the soil field. Sowing occurred on the 5th ofJune2020 and on the 30 of May2021 in both seasons, respectively. The rice seeds were seeded by broadcast method. The preceding crop was wheat in both seasons. Eight treatments were used in this study: five chemical fungicides and two biofungicides (all at two rates) beside untreated control. Some information's on these treatments are listed in Table (2). The first spray was applied at v8 vegetative stage when began. The first symptoms of RBD in leaves (about 55 DAS), and the second spray (at 1% panicles emergence) (Ogoshi *et al.*, 2018). These treatments were sprayed by knapsack sprayer CP$_3$ at rate of 200 L. water feddan^{-1}. The leaf and panicle infection grades were recorded by (IRRI, 1996 and 2014) according to the following numerical scale:-

Rice leaf blast disease rating scale:-

Scale	Description
0.0	No lesion observed
1.0	Small brown specks of pin point size
2.0	Small roundish to slightly elongated, necrotic gray spots, about 1-2 mm in diameter with a distinct brown margin. Lesions are mostly found on the lower leaves
3.0	Lesion type same as in scale 2, but significant number of lesions are on the upper leaves
4.0	Typical susceptible blast lesions, 3 mm or longer infecting less than 4% of leaf area
5.0	Typical susceptible blast lesions of 3mm or longer infecting 4-10% of the leaf area
6.0	Typical susceptible blast lesions of 3 mm or longer infecting 11-25% of the leaf area
7.0	Typical susceptible blast lesions of 3 mm or longer infecting 26-50% of the leaf area
8.0	Typical susceptible blast lesions of 3 mm or longer infecting 51-75% of the leaf area many leaves are dead
9.0	Typical susceptible blast lesions of 3 mm or longer infecting more than 75% of leaf area affected

(IRRI System, 1996).

Rice panicle blast disease rating scale:-

SCALE	Description
0	No visible lesion or observed lesions on only a few pedicels
1	Lesions on several pedicels or secondary branches
3	Lesions on a few primary branches or the middle part of panicle axis
5	Lesion partially around the base (node) or the uppermost internode or the lower part of panicle axis near the base
7	Lesion completely around panicle base or uppermost internode or panicle axis near base with more than 30% of filled grains

9	Lesion completely near panicle base or uppermost internode or the panicle axis near the base with less than 30% of filled grain

(IRRI System, 2014).

Twenty five of leaves and /or panicles were counted from each treatment to calculate the infection percentage. Assessment of rice blast disease incidence on leaves was calculated at booting stage (70 DAS) according to (Korium, 1977) by using formula by Tuz-Zohura *et al*., (2019) as follow:-

$$\text{Leaf disease incidence } \% = \frac{\text{No.of infected leaves}}{\text{total No.of examied leaves}} \times 100$$

$$\text{PDI} = \frac{\text{Sum of individual rating}}{\text{No.of assessed leaves} \times \text{Max.disease grade value}} \times 100$$

By (wheeler, 1969).

The leaf infection grades were recorded by IRRI (1996).

The panicle blast incidence was recorded 20 days before harvest as follow:-

$$\text{Panicle disease incidence } \% = \frac{\text{No.of infected panicle}}{\text{total No.of examied panicle}} \times 100$$

By Wasimfiroz *et al*., (2018) with some modified.

The disease severity was calculated according to disease severity score (0-9) based on the relative lesion size and area covered by IRRI (1996 and 2014) mentioned above.

The following formula was recorded to show the disease severity by Tuz-Zohura *et al*., (2019) as follows: -

$$\text{DS (DI)} = \frac{\text{Sum of total rating}}{\text{No.of observation} \times \text{highest grade in the scale}} \times 100$$

At maturity, the rice plants were harvested by at full ripening stage (110 DAS) in the two tested season and the plant height (cm) were recorded (30 plant from each plot).

The rice plants were left to dry by sun under natural conditions for five days in the field, and the following parameters were recorded as follows: -

Biological yield (B.Y.) = weight of all plants in each plot (kg $plot^{-1}$).

Grain yield (G.Y.) = weight of all grains in each plot (kg $plot^{-1}$).

Harvest index (H.I.) = G.Y/ B.Y × 100 (as %).

Straw yield = weight of all straw in each plot (kg $plot^{-1}$).

TGW = weight of 1000 grains (gm) (three times from each plot).

Yield over control % (YOC %) = T - C/ T × 100

Where: - T= treatment, C= control.

All parameters in this study were analyzed with the analysis of variance (ANOVA) and means were separated with the least significant differences (LSD). Test at $p = 0.01$ and 0.05 according to the method described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Effect of treatments on leaf blast

The leaf blast data (Table 3 and 4) proved that the treatment differences due to fungicides were statistically significant. Various fungicides were evaluated to control leaf blast disease incidence and severity in rice plants during the summer of (2020 and 2021) seasons. Five chemical fungicides and the one biofungicide plant guard, one bioagent isolated from soil (*Trichoderma harzianum*) were investigated at two rates of applications for their effect on leaf blast disease. The results in tables (3 and 4) showed the effect of the tested treatments on number of infected leaves, % of infected leaves and on leaf severity of the tested cultivar (Giza 178 cv.) in the two tested seasons. Generally, all the tested treatments at the two rates of application significantly (*P=0.01* and *0.05*) reduced the number of infected leaves, % of infected leaves and leaf severity than the untreated control. Also, the chemical treatments were significantly better than the biological treatments. This is true in both seasons. In the case of number of infected leaves, among the tested fungicides, Nativo (75% WG) gave the best results (9.33 and 9.67 leaves) followed by Score (25% SC) where it was 10.00 and 10.33 leaves, while, *Trichoderma harzianum* and Plant guard were the least effective (16.67, 17.00 17.33 and 18.00 leaves), respectively at high rate compared to control (22.67 and 23.33 leaves) in two seasons. The treatment with Beam showed an intermediate effect. Also, the higher rate recorded the best results than the lowest rate in all tested treatments. Percentage of infected leaves was also reduced by all tested treatments. The remaining fungicides showed the same effect. For example, Leader (45% EC) and Fuji-one (40 % EC), at rate (300 ml $400L^{-1}$) during the 1st season reduced the percentage of infected leaves of rice plants to 70.68 % of infected leaves. The same trend of result was also found in the case of leaf severity, Nativo fungicide gave the best results ≥ Score > Leader ≥ Beam ≥ Fuji-one > Isolated fungi > Plant-Guard in the 1st season, while was Nativo ≥ Score > Leader ≥ Beam > Fuji-one > Isolated fungi > Plant-Guard in the 2st season. Also, the higher rate gave the best results than the lower rate. These results were true in the two tested seasons. The results of the present study on effect of the tested fungicides and biological treatments on disease incidence and disease severity of leaf blast disease in rice plants are consistent with those described by several authors. El-Kholy and El-Shazly, (2006**)** and Nirmalkar *et al*., (2017) reported that chemical fungicides were more effective as compared to Bio-agents**.** Debashis *et al*., (2012) found that Nativo (75% WG) performed better than Beem. This little performance returns to its repeated use for many years which may lead to the development of resistant causal organism population. Wasimfiroz *et al*., (2018) found that chemical fungicides were more effective than bio-agents in reducing the L.B and N.B disease. Where Nativo (75% WG) tebuconazole 50 % + trifloxystrobin 25 % was most effective than other treatments. Balgude *et al*. (2019) treated L.B. disease with different fungicides including tebuconazole 50 % + trifloxystrobin 25 % , tebuconazole 18.3% and azoxystrobin 11% w/w SC and carbendazim 25% + flusilazole 12.5% SC and recorded reduction of L.B. disease of (69.32 % , 62.27 and 58.13 % , respectively). Also, reported lowest incidence and severity (41.17 % and 17.35 %, respectively) when treated with trifloxystrobin 25 % + tebuconazole 50 % compared to untreated control which showed highest incidence of (85.51 %) and severity of (56.56 %) of the disease. Tuz-Zohura *et al*. (2019) observed that disease incidence at 55 DAT was (30.33%, 36%, 49.33 % and 62.33%, respectively) while disease severity was (27.66%, 30.66%, 34%, and 42.33%, respectively) when treated with (Karisma (28 % SC), Nativo (75 % WG), Trooper (75 % WP) and untreated control, respectively).

Effect of treatments on panicle blast

The data presented in Table (5 and 6) showed the effect of the tested treatments on number of infected panicle, % of infected panicle and on panicle severity of the tested cultivar (Giza 178 cv.) in the two tested seasons. The results indicated that all the tested compounds at the two rates of application significantly (*P= 0.05*) reduced number of infected panicle, % of infected panicle and blast severity of panicle in rice plants compared with the untreated control. Nativo fungicide gave the best results = Score > Leader > Fuji-one ≥ Beam > Isolated fungi = Plant-Guard in the 1st season, while was Nativo ≥ Score > Leader = Fuji-one ≥ Beam > Isolated fungi ≥ Plant-Guard in the 2st season, also the higher rate gave better results than the lower rate. These results were true in the two tested seasons. Percentage of infected leaves was also reduced by any tested treatments. The same trend of result was also found in the case of panicle severity, the chemical fungicides were more effective than biological treatments in both seasons. Among the tested fungicides, Nativo (75% WG) and Score (25% SC) were the most effective fungicides; while, *Trichoderma harzianum* and plant guard were the least effective. Effect of treatments varied between seasons and this may be due the environmental conditions.

Regarding the examined rates of fungicides or biological treatments and as expected, recommended rates significantly (*P = 0.05*) reduced the disease severity compared with three-quarters rate. For example, Beam 75% WP, at 75 gm and 100 gm $200L^{-1}$, respectively during the 2nd season reduced the disease severity of rice plants from 28.34 to 20.88 respectively. These results were true during the two tested seasons. Also, the results indicated that Beam (75% WP), Fuji-one (40% EC), Score (25% SC), Leader (45% EC), Nativo (75% WG), plant guard and Isolated fungi at the recommended rates (high rate) reduced the disease severity to 18.75, 19.79, 11.48, 15.61, 7.85, 37.87 and 37.69 % on rice panicle, respectively, in the first season and to 20.88, 20.88, 15.21, 16.17, 9.75, 41.78 and 39.85% on rice panicle, respectively, in the second season. The results of the present study on effect of the tested fungicides and biological managements on disease incidence and disease severity of panicle blast disease incidence in rice plants were consistent with those described by several authors. Tirmali *et al*. (2001) studied that the efficacy of fungicides such as WIN (30 % SC), Folicur (25 % EC), Swing (25 % EC) and Beam (75 % WP) in control of rice neck blast on susceptible rice cultivar (E. K. 70) at maximum tillering panicle emergence and at heading rice stage and observed that all fungicides resulted in significant reduction of neck blast. The influence of strobilurins fungicides such as azoxystrobin and trifloxystrobin, tricyclazole and mixture between tricyclazole + propiconazole was compared when applied at the starting of the stem elongation and at late booting stage and they deduced that azoxystrobin (250 gm ha^{-1}) and trifloxystrobin (125 gm ha^{-1}) were more effective than tricyclazole (225 gm ha^{-1}) against leaf blast and neck blast and reduced incidence and disease severity by 90-100% and by 70 - 90 %, respectively. Also, there was no significant improvement in efficacy of tricyclazole (225 gm ha^{-1}) in combination with propiconazole (125 gm ha^{-1}) when compared to tricyclazole alone (Cortesi and Giuditta, 2003). Kumbhar, (2005) found that the highest efficacy against neck rice blast appeared with epoxiconazole (12.5 % SC) (2 ml l^{-1}) followed by prochloraz (50 % WP) (1 gm l^{-1}), propineb (70 % WP) (5 gm l^{-1}), chlorothalonil (40 % EC) (2 ml $^{-1}$) and chlorothalonil (75 % WP) (1 g l^{-1}). Tricyclazole (75 % WP) (0.6%) suppressed the neck blast incidence to 37.88 per cent over the control and the efficacy of all the fungicides was next only to it. Tricyclazole (75 % WP) appeared a maximum increase of 60.99 % in grain yield followed by epoxiconazole (12.5 % SC) which recorded an increase of 34.85 % over the control. Also, El-Kholy and El-Shazly, (2006) reported experiments with five treatments for control RBD under natural conditions. The treatments were Beam fungicide at two rates of application 75 gm and 100 gm $feddan^{-1}$, Fuji-one 300 cm^3 and 400 cm^3 $feddan^{-1}$, Hinosan 100 cm^3 and 200 cm^3 $feddan^{-1}$, Neemix and plant-guard. The results indicated that all the tested fungicides reduced infection and severity on leaves and panicles in two tested cultivars (Sakha 101cv. and Giza 171cv.) comparing with the untreated control. (IIRR), Hyderabad (Anonymous, 2017) observed that the fungicide mixing tebuconazole 50 % + trifloxystrobin 25% reduced the leaf, node, neck blast and sheath rot diseases and increased the paddy yield to the greater extent. Wasimfiroz *et al*., (2018) studied effects of nine treatments on the neck blast and observed that the highest disease reduction per cent was found in Nativo (75 % WG) at 1 gm l^{-1} with neck blast (59.00%) compared with control. Balgude, *et al*., (2019) In addition, treating neck blast disease with trifloxystrobin 50+ tebuconazole 25 (0.04 %) which showed least incidence of 46.50 and 35.22 % and thus recorded highest disease control 48.90 % of this disease, respectively.

Effect of treatments on some agronomic traits of rice.

The data in Tables (7 and 8) showed the effect of chemical and biological treatments on biological yield, grain yield, harvest index % and straw yield during the two tested seasons (2020 and 2021). These results showed that all treatments, at any rate of applications, significantly (*P= 0.05*) increased biological yield, grain yield, harvest index % and straw yield in comparison with the untreated control during both seasons. As stated previously with other evaluation parameters, Score (25% SC), Leader (45% EC) and Nativo (75% WG) were the most effective fungicides in this respect whereas plant guard was the lowest effective one. For example, the application of Score (25% SC), Leader (45% EC), Nativo (75% WG) at recommended rate (200 cm^3, 400 cm^3 and 200 gm $200L^{-1}$, respectively) resulted in biological yield values 50.25, 43.90 and 54.43 kg $plot^{-1}$ in the first season and 49.95, 43.56 and 53.81 kg $plot^{-1}$ in the second season, respectively, whereas the corresponding biological yield values of plant guard were 37.27 and 35.84 kg $plot^{-1}$. The same trend of result was also found in the case of grain yield values, Nativo fungicide gave the best results > Score > Leader > Fuji-one > Beam > Isolated fungi ≥ Plant-Guard in the 1st season, while was Nativo ≥ Score > Leader ≥ Fuji-one > Beam > Isolated fungi ≥ Plant-Guard in the 2st season, Also the higher rate gave the best results than the lower rate.

Regarding the examined rates of fungicides, and as expected, recommended rate significantly (*P = 0.05*) increment biological yield, grain yield and straw yield were compared with three-quarters rate. For example, Beam (75% WP) at 75 and 100 gm $200L^{-1}$ significantly increased biological yield values from 34.25 to 40.67 kg $plot^{-1}$ in the first season and from 33.28 to 39.66 kg $plot^{-1}$ in the second season, respectively, while grain yield values were 12.38 and 16.23 kg $plot^{-1}$ in the first season and 12.27 and 15.76 kg $plot^{-1}$ in the second season, respectively. In addition, the same fungicide at the same rates of application significantly increased straw yield values from 21.87 to 24.43 kg $plot^{-1}$ in the first season and from 21.01 to 23.90 kg $plot^{-1}$ in the second season, respectively. Generally, chemical fungicides gave biological yield, grain yield, harvest index % and straw yield better than the bio-agents and this may be resulted from the efficacy of these compounds in controlling panicle blast rice diseases than bioagent compounds. Also, these results suggested that most fungicides were more effective than bio-agents. These results are in agreement with those obtained by several authors. El-Kholy and El-Shazly, (2006) conducted field experiments with five treatments for control RBD under natural conditions. The results indicated that all the tested fungicides increased biological yield, grain and straw yield of rice crop. The best results were obtained by Beam treatments, Fuji-one, Hinosan, respectively. The plant-guard treatment was the least effective, while Neemix recorded an intermediate effect. The higher rate produced the best results than the lower rate. Sakha 101cv. gave the best results than Giza 171cv. Also, Qudsia, *et al* (2017) found that yield increased to (4.68 t ha^{-1}, 4.33 t ha^{-1} and 3.83 t ha^{-1} ,respectively) as compared to control (1.83 t ha^{-1}) condition when treating rice with fungicides Amistar Top (32.5 % SC) azoxytrobin + difenconazonle, Nativo (75 % WG) Tebuconazole + trifloxystrobin and Dora (10 % WG) difenconazole, respectively) to control paddy blast disease. Also, Tirmali and Patil (2000) sprayed 5 new fungicide formulations (Antaco 170, Carpromid (30 % SC), Fliqiconazate (25 % WP), Opus (15.5 % SC) and Ocatve (50 % WP)) on rice cultivar Ek-70 (blast susceptible) at tillering, booting and heading stages of crop and conducted that Opus (15.5 % SC) was highly effective in controlling neck blast by 29.23 % and increasing grain yield. Wasimfiroz *et al*., (2018) studied effects of nine treatments on the neck blast and found that the Nativo (75 % WG) at 1 gm l^{-1} gave the higher yield (4204 kg ha^{-1}). Balgude, *et al* (2019) noticed that treatment with tebuconazole 50+ trifloxystrobin 25 (0.04%) resulted in highest grain yield (28. 26 q ha^{-1}) and straw yield (31.42 q ha^{-1}) with 84.22 and 80.78 % increase, while the untreated control plot yielded just 15.34 q ha^{-1} grain yield and 17.38 q ha^{-1} straw yield .

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Table 1: Some physical and chemical properties of the investigated soil (from El-Mawaged Village, El-Manzala Center, El-Dakhlia Governorate) in the two tested seasons.

Season	pH	Organic matter	T.S.S.* %	Total $CaCo_3$ %	E.C.** m.mohs/ cm	Chemical analysis								Physical analysis			
						Soluble cations meq./L.				Soluble anions meq./L.				Particle size distribution			
						Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Co_3^{-}	HCo_3^{-}	Cl^{-}	So_4^{-}	Total clay%	Total sand%	Total silt%	Textural class
2020	7.88	0.86	1.11	1.86	1.78	4.90	2.34	1.94	0.43	0.05	2.01	3.55	5.12	80.78	10.10	09.12	clay
2021	7.95	0.77	1.27	2.08	1.93	4.10	1.98	1.83	0.38	0.02	1.92	3.97	4.89	79.14	11.20	09.46	clay

*T.S.S. = Total soluble salts.
**E.C.= Electric conductivity.

Table 2: The tested compounds.

Treatment number	Trade names	Common names	Concentrations and formulations	Sources	Rates of application (gm or ml $200L^{-1}$ water fed^{-1})
1	Beam	Tricyclazole	75% WP	Dow Agro Sciences Company.	75 - 100 gm.
2	Fuji-one	Isoprothiolane	40% EC	Starchem Company	300 -400 cm^3
3	Score	Difenoconazole	25% SC	Starchem Company	150-200 cm^3
4	Leader	Prochloraz	45% EC	Starchem Company	300-400 cm^3
5	Nativo	Tebuconazole + Trifloxystobin	75% WG	Bayer Company	150-200 gm.
6	Plant Guard	*Trichoderma harzianum*	1×10^9 spores/ mL^{-1}	Biotech Company for Fertilizers and Biocides.	375 – 500 cm^3.
7	Isolated fungi	*Trichoderma harzianum*	1×10^9 spores/ mL^{-1}	Lab of fungicides.	375 – 500 cm^3.
8	Control				

*According to the Recommendations of Ministry of Agriculture and Land Reclamation (2018), Agriculture pesticide committee (APC).

Table 3: Effect of treatments on leaves blast disease on rice (cv. Giza 178) grown under field conditions during season (2020).

Treatments	Rates of application (gm or ml 200L^{-1} water fed^{-1})	Mean number of blast disease incidence	% of infected leaves	Disease severity*
Beam 75 % WP	75 gm	16.67	66.68	48.13
(Tricyclazole)	100 gm	12.67	50.68	34.14
Fuji-one 40 % EC	300 cm^3	17.67	70.68	50.92
Isoprothiolane)(	400 cm^3	13.33	53.32	36.00
Score 25 % EC	150 cm^3	15.33	61.32	42.56
Difenoconazole)(	200 cm^3	10.00	40	26.56
Leader 45 % EC	300 cm^3	17.33	69.32	47.52
(Prochloraz)	400 cm^3	11.67	46.68	32.67
Nativo 75 % WG	150 gm	15.00	60	41.94
Tebuconazole + Trifloxystobin)(	200 gm	9.33	37.32	25.14
Trichoderma harzianum	375 cm^3	21.67	86.68	63.90
Plant Guard 30million organism in each cm^3	500 cm^3	17.33	69.32	54.42
Isolated fungi	375 cm^3	21.33	85.32	64.29
Trichoderma harzianum 1×10^9 spores cm^3	500 cm^3	16.67	66.68	50.69
Untreated control	------	22.67	90.68	74.33

*No. of infected leaves (incidence) = these numbers resulted from 25 leaves collected randomly in each replicate. Assessed at booting stage (70 DAS).

% number of infected leaves was calculated according to Tuz-Zohura *et al*. (2019).

Leaf severity was calculated according to Wheeler, (1969) and IRRI (1996).

L.S.D at	1 %	5 %	1 %	5 %
Treatments (T.)	1.70	1.27	4.70	3.49
Rates (R.)	0.85	0.63	2.35	1.74
T.×R.	2.41	1.79	6.65	4.94

Table 4: Effect of treatments on the leaves blast on rice (cv. Giza 178) grown under field conditions during season (2021).

Treatments	Rates of application (gm or ml $200L^{-1}$ water fed^{-1})	Mean number of blast disease incidence	% of infected leaves	Disease severity*
Beam 75 % WP	75 gm	17.33	69.32	49.82
(Tricyclazole)	100 gm	13.00	52.00	35.18
Fuji-one 40 % EC	300 cm^3	17.67	70.68	52.84
Isoprothiolane)(	400 cm^3	13.67	54.68	37.83
Score 25 % EC	150 cm^3	15.67	62.68	43.93
Difenoconazole)(	200 cm^3	10.33	41.32	28.43
Leader 45 % EC	300 cm^3	17.67	70.68	48.50
(Prochloraz)	400 cm^3	12.00	48.00	34.13
Nativo 75 % WG	150 gm	15.67	62.68	43.02
Tebuconazole + Trifloxystobin)(	200 gm	9.67	38.68	27.41
Trichoderma harzianum	375 cm^3	21.33	85.32	64.69
Plant Guard 30million organism in each cm^3	500 cm^3	18.00	72.00	54.62
Isolated fungi	375 cm^3	22.00	88.00	62.44
Trichoderma harzianum 1×10^9 spores cm^3	500 cm^3	17.00	68.00	51.79
Untreated control	------	23.33	93.32	77.20

*No. of infected leaves (incidence) = these numbers resulted from 25 leaves collected randomly in each replicate. Assessed at booting stage (70 DAS).

% number of infected leaves was calculated according to Tuz-Zohura *et al*. (2019).

Leaf severity was calculated according to Wheeler, (1969) and IRRI (1996).

L.S.D at	1 %	5 %	1 %	5 %
Treatments (T.)	2.00	1.48	3.29	2.44
Rates (R.)	1.00	0.74	1.64	1.22
T.×R.	2.83	2.10	4.65	3.46

Table 5: Effect of treatments on panicle blast disease on rice (cv. Giza 178) grown under field conditions during season (2020).

Treatments	Rates of application (gm or ml 200L^{-1} water fed^{-1})	Mean number of blast disease incidence	% of infected panicle	Disease severity*
Beam 75 % WP	75 gm	16.00	64.00	28.85
(Tricyclazole)	100 gm	12.00	48.00	18.75
Fuji-one 40 % EC	300 cm^3	15.00	60.00	29.09
Isoprothiolane)(	400 cm^3	11.00	44.00	19.79
Score 25 % EC	150 cm^3	13.67	54.68	20.00
Difenoconazole)(	200 cm^3	8.33	33.32	11.48
Leader 45 % EC	300 cm^3	15.00	60.00	25.14
(Prochloraz)	400 cm^3	10.67	42.68	15.61
Nativo 75 % WG	150 gm	13.00	52.00	18.70
Tebuconazole + Trifloxystobin)(	200 gm	8.33	33.32	7.85
Trichoderma harzianum	375 cm^3	21.00	84.00	40.84
Plant Guard 30million organism in each cm^3	500 cm^3	16.67	66.68	37.87
Isolated fungi	375 cm^3	20.00	80.00	40.67
Trichoderma harzianum 1×10^9 spores cm^3	500 cm^3	16.67	66.68	37.69
Untreated control	------	22.67	90.68	50.50

*No. of infected panicle (incidence) = these numbers resulted from 25 panicle collected randomly in each replicate. Assessed at 30 days after heading.

% number of infected leaves was calculated according to Wasinfiroz *et al*. (2019) with some modified.

Disease severity on panicle was calculated according to IRRI (1996) and Tuz-Zohura *et al*. (2019).

L.S.D at	1 %	5 %	1 %	5 %
Treatments (T.)	1.88	1.40	2.93	2.18
Rates (R.)	0.94	0.70	1.47	1.09
T.×R.	2.66	1.98	4.15	3.09

Table 6: Effect of treatments on panicle blast disease on rice (cv. Giza 178) grown under field conditions during season (2021).

Treatments	Rates of application (gm or ml 200L^{-1} water fed^{-1})	Mean number of blast disease incidence	% of infected panicle	Disease severity*
Beam 75 % WP	75 gm	16.67	66.68	28.34
(Tricyclazole)	100 gm	12.33	49.32	20.88
Fuji-one 40 % EC	300 cm^3	15.67	62.68	29.06
Isoprothiolane)(	400 cm^3	11.67	46.68	20.88
Score 25 % EC	150 cm^3	13.33	53.32	20.31
Difenoconazole)(	200 cm^3	8.67	34.68	15.21
Leader 45 % EC	300 cm^3	15.33	61.32	24.43
(Prochloraz)	400 cm^3	11.67	46.68	16.17
Nativo 75 % WG	150 gm	13.00	52.00	19.01
Tebuconazole + Trifloxystobin)(	200 gm	7.67	30.68	9.57
Trichoderma harzianum	375 cm^3	20.67	82.68	45.16
Plant Guard 30million organism in each cm^3	500 cm^3	17.33	69.32	41.78
Isolated fungi	375 cm^3	20.67	82.68	42.32
Trichoderma harzianum 1×10^9 spores cm^3	500 cm^3	17.00	68.00	39.85
Untreated control	------	23.00	92.00	53.58

*No. of infected panicle (incidence) = these numbers resulted from 25 panicle collected randomly in each replicate. Assessed at 30 days after heading.

% number of infected leaves was calculated according to Wasinfiroz *et al*. (2019) with some modified.

Disease severity on panicle was calculated according to IRRI (1996) and Tuz-Zohura *et al*. (2019).

L.S.D at	1 %	5 %	1 %	5 %
Treatments (T.)	2.05	1.53	3.29	2.45
Rates (R.)	1.03	0.76	1.65	1.23
T.×R.	2.90	2.16	4.66	3.47

Table 7: Effect of treatments on biological, grain and straw yield of rice (cv. Giza 178) under field conditions during season (2020).

Treatments	Rates of application (gm or ml 200L^{-1} water fed^{-1})	Biological yield (kg plot^{-1})		Grain yield (kg plot^{-1})		Harvest index % ** (kg plot^{-1})		Straw yield (kg plot^{-1})	
		Mean	YOC %*	Mean	YOC %*	Mean	YOC %*	Mean	YOC %*
Beem 75 % WP	75 gm	34.25	17.46	12.38	23.10	36.15	06.82	21.87	14.27
(Tricylazole)	100 gm	40.66	30.47	16.23	41.34	39.92	15.62	24.43	23.25
Fujj-one 40 % EC	300 cm^3	34.24	17.44	12.17	21.77	35.54	05.24	22.07	15.04
(Isoprothiolane)	400 cm^3	41.23	31.43	17.20	44.65	41.72	19.27	24.03	21.97
Score 25 % EC	150 cm^3	37.51	24.63	13.16	27.66	35.08	04.00	24.35	23.00
(Difenoconazole)	200 cm^3	50.26	43.75	19.84	52.02	39.47	14.68	30.42	38.36
Leader 45 % EC	300 cm^3	35.84	21.12	12.29	22.54	34.29	01.78	23.55	20.38
(Prochloraze)	400 cm^3	43.90	35.60	17.70	46.21	40.32	16.47	26.20	28.44
Nativo 75 % WG	150 gm	39.59	28.59	13.65	30.26	34.48	2.32	25.94	27.72
(Tebuconazole + rifloxystobin)	200 gm	54.44	48.07	20.33	53.17	37.34	9.81	34.11	45.03
Trichoderma harzianum	375 cm^3	32.56	13.18	11.59	17.86	35.60	05.38	20.97	10.59
Plant Guard 30million organism in each cm3	500 cm^3	37.27	24.15	13.64	30.21	36.60	07.97	23.63	20.65
Isolated fungi	375 cm^3	33.37	15.28	11.73	18.84	35.15	04.19	21.64	13.35
Trichoderma harzianum 1×10^9 spores cm3	500 cm^3	37.36	24.33	13.66	30.31	36.56	07.89	23.70	20.89
Untreated control	------	28.27		09.52		33.68		18.75	

Biological yield (B.Y.) = weight of all plants in each plot (kg polt^{-1}) (21 m^2). Grain yield (G.Y.) = weight of seeds in each plot (kg polt^{-1}) (21 m^2). Straw yield (S.Y.) = weight of straw in each plot (kg polt^{-1}) (21 m^2). *YOC % = yield over control (treatment – control / treatment ×100).
**H.I. = Harvest index % = (G.Y/ B.Y ×100).

		B.Y.		G.Y.		S.Y.	
L.S.D. at	=	1%	5%	1%	5%	1%	5%
Treatments (T.)	=	0.66	0.49	0.31	0.23	0.39	0.29
Rates (R.)	=	0.33	0.25	0.16	0.12	0.20	0.15
T. × R.	=	0.93	0.69	0.44	0.33	0.55	0.41

Table 8: Effect of treatments on biological, grain and straw yield of rice (cv. Giza 178) under field conditions during season (2021).

Treatments	Rates of application (gm or ml 200L^{-1} water fed^{-1})	Biological yield (kg plot^{-1})		Grain yield (kg plot^{-1})		Harvest index %** (kg plot^{-1})		Straw yield (kg plot^{-1})	
		Mean	YOC %*	Mean	YOC %*	Mean	YOC %*	Mean	YOC %*
Beem 75 % WP	75 gm	33.28	16.32	12.27	31.87	36.87	18.58	21.01	07.23
(Tricylazole)	100 gm	39.66	29.78	15.76	46.95	39.74	24.45	23.90	18.45
Fujj-one 40 % EC	300 cm^3	33.94	17.94	11.48	27.18	33.82	11.25	22.46	13.22
(Isoprothiolane)	400 cm^3	40.42	31.10	17.14	51.23	42.40	29.21	23.28	16.28
Score 25 % EC	150 cm^3	37.67	26.07	12.76	34.48	33.87	11.38	24.91	21.76
(Difenoconazole)	200 cm^3	49.96	44.26	19.58	57.30	39.19	23.40	30.38	35.85
Leader 45 % EC	300 cm^3	36.39	23.47	12.13	31.08	33.33	09.94	24.26	19.66
(Prochloraze)	400 cm^3	43.56	36.07	17.48	52.17	40.13	25.19	26.08	25.27
Nativo 75 % WG	150 gm	39.50	29.49	13.51	38.12	34.20	12.23	25.99	25.01
(Tebuconazole + rifloxystobin)	200 gm	53.81	48.24	19.92	58.03	37.02	18.91	33.89	42.49
Trichoderma harzianum	375 cm^3	32.26	13.67	11.51	27.37	35.68	15.86	20.75	06.07
Plant Guard 30million organism in each cm3	500 cm^3	35.84	22.29	13.17	36.52	36.75	18.31	22.67	14.03
Isolated fungi	375 cm^3	32.80	15.09	11.66	28.30	35.55	15.55	21.14	07.81
Trichoderma harzianum 1×10^9 spores cm3	500 cm^3	36.19	23.05	13.32	37.24	36.81	18.44	22.87	14.78
Untreated control	------	27.85		08.36		30.02		19.49	

Biological yield (B.Y.) = weight of all plants in each plot (kg polt^{-1}) (21 m^2). Grain yield (G.Y.) = weight of seeds in each plot (kg polt^{-1}) (21 m^2). Straw yield (S.Y.) = weight of straw in each plot (kg polt^{-1}) (21 m^2). *YOC % = yield over control (treatment – control / treatment ×100)
**H.I. = Harvest index % = (G.Y/ B.Y ×100)

		B.Y.		G.Y.		S.Y.	
L.S.D. at	=	1%	5%	1%	5%	1%	5%
Treatments (T.)	=	2.76	2.05	1.08	0.81	2.94	2.18
Rates (R.)	=	1.38	1.03	0.54	0.40	1.47	1.09
T. × R.	=	3.90	2.90	1.53	1.14	4.15	3.09

التقييم الحقلى لبعض المعاملات على مرض اللفحة فى الأرز

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الملخص العربي

تم إجراء التجارب الحقلية في قرية المواجد مركز المنزلة محافظة الدقهلية بهدف تقييم فاعلية خمس من مبيدات الفطريات الكيماوية وواحد من المواد الحيوية وعزلة فطر تريكوديرما من تربة الأرز ضد مرض لفحة السنابل فى الأرز تحت الظروف الحقلية خلال موسمي (2020 و 2021) وكانت مبيدات الفطريات هي بيم (75 % WP) ترايسيكلازول , فوجى وان (40% EC) ايزوبروثيولان , و سكور(25 % SC) دايفينوكونازول، وليدر(40%EC) بروكلوراز ، ناتيفو (75 % WG) تيبوكونازول 50 + تراى فلوكسى استروبين25 علي معدلات 75 جم و 100 جم ، 300سم^3 و 400سم^3 ، 150سم^3 و 200سم^3 ، 300سم^3 و 400سم^3 ، 150 جم و 200جم لكل 200 لتر ماء علي التوالي, والمركب الحيوى هو بلانت جارد 30 مليون جرثومة/ مل (تريكوديرما هارزيانم) و العامل الحيوى المعزول (تريكوديرما هارزيانم) 1×10^9 جرثومة/ مل هو علي معدلات 375 سم^3 و 500 سم^3, لكل 200 لتر ماء علي التوالي, و طبقت المبيدات المختبرة بطريقة الرش مرتين في الموسم. أوضحت النتائج أن المبيدات الكيماوية كانت فعالة أكثر من المبيدات الحيوية وجميع المبيدات المستخدمة وبصفة خاصة ناتيفو وسكور كانت معنوية من حيث تأثيرها على وجود وشدة مرض لفحة الأوراق والسنابل في الأرز. وقد أدي ذلك إلي زيادة المحصول الكلى والحبوب والقش عند المقارنة بالكنترول، وكان الفطر تريكوديرما المعزول أكثر فاعلية من مبيد البلانت جارد. عموماً، بينت النتائج أن رش مبيدات الفطريات لمكافحة مرض اللفحة فى الأرز أمر أساسي لمكافحة المرض ويؤدي ذلك إلي زيادة المحصول.

الكلمات الاسترشادية: الأرز، مرض اللفحة، مبيدات الفطريات، المركبات الحيوية، فطر تريكوديرما.