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Field Evaluation of BAU-Biofungicide and Plant Extracts in Controlling Leaf Blight of Wheat Caused by *Bipolaris sorokiniana*

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ABSTRACT

Field evaluation of BAU-Biofungicide and plant extracts was performed to manage leaf blight of wheat caused by *Biopolaris sorokiniana* from November, 2015 to April, 2018. Two susceptible varieties of wheat viz.,Kanchan and Prodip were used in the experiment. Aqueous extracts of Neem leaf and garlic clove, *Trichoderma* based preparation BAU-Biofungicide, an inducer Bion were evaluated in the field as seed-treatment or seed-treatment along with foliar application. In addition, a chemical fungicide (Tilt) was used as positive control and an untreated negative control were included in the experiment. Based on the three years of experiment in three cropping seasons during 2015-16, 2016-17 and 2017-18; seed treatment with BAU-Biofungicide reduced leaf blight severity in both cultivars. The lowest disease severity was observed in plots where Tilt was used as spray followed by seed treatment with BAU-Biofungicide plus BAU-Biofungicide spray. BAU-Biofungicide showed better performance in controlling leaf blight of wheat. Based on the findings of the present study, BAU-Biofungicide potentially reduce the severity of Bipolaris leaf blight of wheat therefore, it could be an effective option for the growers for eco-friendly management of leaf blight disease of wheat and obtaining higher yield.

Introduction

Wheat (*Triticum aestivum* L.) is one of the most produced valuable cereal crops in all over the world. Due to high nutritive value, wheat grains are eaten in various forms across cultures and continents (Acharya *et al.,* 2011). There are many constraints responsible for lower yield of wheat in Bangladesh, among which use of unhealthy or diseased seeds are one of the major constraints (Monjil and Hossain, 2003, Panna *et al*., 2009). Bipolaris leaf blight caused by *Bipolaris sorokiniana* is a major biotic constrain affecting wheat production in Bangladesh (Ahmed and Meisner, 1996, Monjil *et al.*, 2005). In farmer's field, the average yield loss of wheat due to leaf blight disease was estimated upto 10-21% and it could reach to 100% in case of severe infection (Malaker *et al.,* 2004). Therefore, this disease should be controlled and managed in an effective way. The use of chemicals, has been found very effective in controlling fungal diseases of plant, but some major problems threaten to limit the continuous use of fungicides. Existing practice of chemical control is hazardous to environment and too costly, particularly for poor farmers in the country.

Biopesticides may be defined as the fungicides which contained living microorganisms as active ingredients (Doulas, 2008). They are consisted of mostly antagonistic bacteria or fungi and are effective to control certain plant disease. These are generally effective against soil-borne plant pathogens like species of *Pythium, Phytophthora, Rhizoctonia*, *Fusarium*, etc. (Vann, 2011). Several stains of *Trichoderma* have been found to be effective as biocontrol agent of various soil and foilar fungi such as *Fusarium* sp., *Sclerotium* sp., *Rhizoctonia*sp., *Bipolaris* sp, *Pyriclaria* sp. etc. (Dey and Monjil, 2016). *Trichderma* produces bio-chemical called trichodermin which is responsible for its antagonistic properties (Adekunle *et al*., 2006). Thus, *Trichoderma* spp. may eco-friendly be used as a biocontrol agent and the nature will relatively be undisturbed and many beneficial micro-organisms in the soil will be saved. In several field experiments, it has been observed that the biocontrol agent has great influence on yield and yield attributes of crops (Kucuk *et al*., 2007, Hasan and Alam,

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2007, Dey and Monjil, 2016, Hossen *et al*., 2017, Sohag *et al*., 2017). Treating of seeds with BAU-Biofungicide resulting strong barrier on the seed surface to protect the seed from seed borne pathogens as well as it protects the seed from soil borne pathogens when treated seeds are sown in the field or in the bed (Hossain, 2011). BAU-Biofungicide is a naturally occurring fungus, *Trichoderma* by growing on organic substrate to protect crops from different diseases (Hossain, 2011). Sultana *et al.* (2009) reported that seed treatment with BAU-Biofungicide significantly increases seed germination, decreases post emergence death and leaf blight severity of wheat. Several researchers have tried to find out safe and economical control of plant diseases by using extracts of different plant parts (Hossain *et al*., 2016; Miah *et al*., 2017; Sifat and Monjil, 2017). Ashraf (2015) evaluated the performance of different plant extracts on leaf spot disease severity and yield and yield contributing characters of wheat and concluded that the highest grain yield was obtained from seed treatment with garlic extracts followed by neem extract. In several studies it has been found that plant extract increased seed germination and improved seedling development (Hasan *et al*., 2005; Ahmed *et al*., 2013; Razu and Hossain, 2015, Islam and Monjil, 2016). When a physical, chemical or biological agent induces production/ accumulation of defense components in the host or activates defence mechanism, it may be regarded as induced or acquired resistance (Purkayastha, 1998, Monjil *et al*., 2015). Resistance can be induced by naturally occurring metabolites or by chemical substances. The protection is based on the stimulation of defense mechanisms by metabolic changes enabling the plants to defend themselves more efficiently. From this point of view induced resistance is considered to be a procedure for biological plant protection in which the plant, not the pathogen, is the target.

Raum (1997) reported Bion (Benzothiadiazole or BTH) as a plant activator that can improve the natural resistance of plants to diseases. Bion is a salicylic acid functional analogue that inactivates catalases and ascorbate peroxidases, the two major H_2O_2 scavenger enzymes, increasing the H_2O_2 pool in treated tissues (Wendehenne *et al*., 1998). Consequently, it enhances acid peroxidase activity involved in cell wall strengthening (Stadnik and Buchenauer, 2000). Bion deserves particular attention for its low or no toxicity to plants, animals and the environment and its high efficiency in protecting numerous plant species against a wide variety of pathogens (Tomlin, 2001). Jorgenson *et al*. (1997) reported that Bion gave approximately 75% control of mildews (*Erysiphe graminis*) of barley which lasted 30-40 days. Biological control has now become one of the most exciting and rapidly developing areas in plant pathology, because it has great potential to solve many agricultural and environmental problems. Biological control has been proposed as a replacement for chemical control of plant diseases. Concerning to the health, safety and environmental effects of agricultural chemicals in our water, soil and food, the use of biological control need to be emphasized strongly. Considering the above-mentioned facts, the present research work was undertaken to evaluate the efficacy of aqueous extracts of Garlic and Neem, BAU-Biofungicide, resistance inducer Bion and chemical fungicide, Tilt for the management of the leaf blight of wheat caused by *B. sorokiniana*.

Materials and Methods

An experiment was conducted during the period of November, 2015- April, 2018 in the farmers' fields of village Dhanna, Rampal Block, Tangail Sadar, Tangail, Bangladesh. The experiment was laid out in Randomized Complete Block Design (RCBD) with plot size of 10 m^2 (5 m × 2 m), where 10 treatment combinations were used with three replications for each treatment. The distances between block to block, plot to plot and line to line were 1.5 m, 1m and 20 cm, respectively. The seeds from two cultivars (Kanchan and Prodip) were known for their susceptibility to leaf blight by *B. sorokiniana*; the variety-Kanchan was collected from Bangladesh Wheat and Maize Research Institute (BMWRI), Noshipur, Dinajpur and and Prodip is popular and widely cultivated variety in the country which was collected from Bangladesh Agriculture Research Institute, Joydebpur, Gazipur.

Preparation of seed samples

Required amount of seeds for each treatment were suspended in water for overnight by dipping method and then separated the seeds by air dried 1% suspension of plant extracts. Plant extracts and BAU-Biofungicide were prepared according to the method of Hossain (2011) and Muna *et al.* (2020).

Preparation of treatments (plant extracts, BAU Bio-fungicide and fungicidal solutions) and treatment combinations

The plant extracts (Neem, *Azadirachta indica* and Garlic, *Allium sativum*) were prepared by crushing the plant parts (fresh leaves for neem extracts and clove for garlic extracts) in a blender with distilled water in 1:1 ratio (e.g. 1:1= 100 g plant material crushed in 100 ml water) following the method described by Sifat and Monjil. (2017). BAU-Biofungicide (30 g) was prepared in a 1000 ml beaker containing tube well water and stirred. The filtrate was made to volume as 1L by adding tube well water and used as 3% BAU-Biofungicide (Hossen et al., 2017). Fungicide and Bion solution were prepared by from formulated product following their label.

Ten treatment combinations were selected as follows: T_1 = Seed treatment with Neem extract (1%), T_2 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_3 = Seed treatment with Garlic extract (1%), T_4 = Seed treatment with Garlic extract (1%) +Garlic extract spray (1%), T_5 = Seed treatment with BAU-Biofungicide (3%), T_6= Seed treatment with BAU-Biofungicide (3%) +BAU-Biofungicide spray (3%), T_7 = Seed treatment with Bion (Benzothiadiazole) @ 50 ppm, T_8 = Bion as spray @ 50 ppm, T_9 = Tilt (Propiconazole) as spray @ 0.1% and T_{10} = Untreated control. All ten treatment combinations were used during the period of 2015-17; however, only 5 treatments (T_1 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_2= Seed treatment with BAU-Biofungicide (3%), T_3 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_4 = Tilt as spray @ 0.1% and T_5= Untreated control) were used in 3rd cropping season during 1st and 2nd cropping seasons of 2015-16 and 2016-17. The treatments of the year 2017-18 were: T_1 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_2= Seed treatment with BAU-Biofungicide (3%), T_3 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_4 = Tilt as spray @ 0.1% and T_5= Untreated control.

Seed treatment

Seeds for each treatment were suspended in water for overnight by dipping method and then separated the seeds by air dried 1% suspension of plant extracts. Seeds were sown at the rate of 120 Kg/ha. Plant extracts and BAU-Biofungicide were prepared according to the method of Hossain (2011) and Muna *et al*. (2020).

Application of foliar spray

Selected plant extracts (Garlic and Neem), BAU-Biofungicide, Bion and Tilt were applied for controlling Bipolaris leaf blight of wheat cv. Kanchan and Prodip. Bion (50 ppm) spray solution was sprayed in the plots as per treatment at seedling stage for one time. The spray schedule was started just after appearance of leaf spot symptom and three sprays were maintained in case of Kanchan and two sprays were maintained in case of cv. Prodip at 15 days interval (in variety Prodip, disease symptoms appeared 20 days later than variety Kanchan).

Assessment of leaf blight disease severity

Disease severity of leaf blight in cv. Kanchan and Prodip were assessed following the double-digit scale (00-99 scale) prescribed by CIMMYT after Sarri and Prescott (1975). Briefly, the first digit (D_1) indicates the disease progresses in height of the plant, which is shown as follows:1= Very resistant: A few isolated lesions on only the lowest leaves; 2= Resistant: Scattered lesions on second sets of leaves with first leave infected at light intensity; 3= Moderately resistant: Light infection on lower third of plant, lower most leaves infected at moderate to severe levels; 4= Low intermediate: Moderate to severe infection on lower leaves with scattered to light infection extending to the leaf immediately below the mid-point of plant; 5= Intermediate: Severe infection on lower leaves. Moderate to light infections extending to the mid-point of the plant with upper leaf free. Infection do not extend beyond midpoint of the plant; 6= High intermediate: Severe infection on lower third of the plant, moderate degree on middle leaves and scattered lesions beyond the mid-point of the plant; 7= Moderately susceptible: Lesions severe on lower and middle leaves with infection extending to the leaf below the flag leaf, or with trace infection on the flag leaf; 8= Susceptible: Lesions severe on lower and middle leaves. Moderate to severe infection on the upper third on the plant. Flag leaf infected in amounts more than a trace; 9= Very susceptible: Severe infection on all leaves and spike infected to some degree. The second digit (D_2) represents the percentage area covered by the blight pathogen on the flag leaf and one below it, which is as follows:< 10 % coverage = 0; 10 % coverage = 1; 20 % coverage = 2; 30 % coverage = 3; 40% coverage = 4; 50 % coverage = 5; 60% coverage = 6; 70 % coverage = 7; 80 % coverage = 8; 90 % coverage = 9.

Results and Discussion

Effect of aqueous plant extracts (Neem leaf, Garlic clove), BAU-Biofungicide, Bion and Tilt on leaf blight disease severity of wheat cv. Kanchan and Prodip was presented in Table 1 to 6. In three successive years, maximum disease severity was recorded in the control treatments at all counts. During 2015-16, at 1stand 2nd counts minimum disease severity was recorded in plots of seed treatment with BAU-Biofungicide plus BAU-Biofungicide spray. Whereas, minimum disease severity in var. Kanchan was recorded in plot treated with Tilt as foliar spray in 3rd (43) and 4th count (66) followed by BAU-Biofungicide seed treatment + BAU-Biofungicides pray [disease severity score in 3rd (54) and 4th (76) counts] (Table 1). In case of var. Prodip, at 1stcount minimum disease severity was observed in plots of seed treatment with BAU-Biofungicide plus BAU-Biofungicide spray. At 3rd and 4th counts minimum disease severity were recorded in Tilt sprayed plot followed by BAU-Biofungicide seed treatment plus BAU-Biofungicide spray (Table 2).

During 2016-17, in case of var. Kanchan, maximum leaf blight disease severity was observed in control treatments at all counts (Table 3). At 1st and at 2nd counts minimum disease severity was recorded in plots of seed treatment with BAU-Biofungicide plus BAU-Biofungicide spray. In case of 3rd and 4th counts minimum disease severity was recorded in Tilt sprayed plot (43 and 64)

followed by BAU-Biofungicide seed treatment (44 and 75) plus BAU-Biofungicide spray (Table 3). In case of var. Prodip, maximum disease severity was recorded in control treatments at all counts (Table 4). At 1st counts minimum disease severity was recorded in plots of seed treatment with BAU-Biofungicide plus BAU-Biofungicide spray. At 2nd and 3rd counts minimum disease severity was recorded in Tilt sprayed plots (32 and 54) followed by BAU-Biofungicide seed treatment (33 and 64) plus BAU-Biofungicide spray (Table 4).

Table 1. Effect of plant extracts, BAU-Biofungicide, Tilt and Bion on leaf blight severity of wheat cv. Kanchan during the period of 2015-16

Treatments	Diseases severity (00-99)			
	1st count (45 DAS)	2nd count (60 DAS)	3rd count (75 DAS)	4th count (90 DAS)
T_1	22	44	76	97
T_2	22	42	64	86
T_3	21	43	75	96
T_4	21	42	63	86
T_5	11	33	63	86
T_6	00	32	54	76
T_7	22	44	67	97
T_8	21	43	66	97
T_9	22	32	43	66
T_{10}	22	45	77	98

1st digit indicates the disease progresses in height of the plant and 2nd digit represents the percentage area covered by the blight disease. DAS = Days After Sowing. T_1 = Seed treatment with Neem extract (1%), T_2 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_3 = Seed treatment with Garlic extract (1%), T_4 = Seed treatment with Garlic extract (1%) + Garlic extract spray (1%), T_5 = Seed treatment with BAU-Biofungicide (3%), T_6 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_7 = Seed treatment with Bion @ 50 ppm, T_8 = Bion as spray @ 50 ppm, T_9 = Tilt as spray @ 0.1% and T_{10} = Untreated control

Table 2. Effect of plant extracts, BAU-Biofungicide, Tilt and Bion on leaf blight severity of wheat cv. Prodip during the period of 2015-16

Treatments	Diseases severity (00-99)		
	1st count (75 DAS)	2nd count (90 DAS)	3rd count (105 DAS)
T_1	22	45	78
T_2	22	44	77
T_3	22	44	78
T_4	22	43	76
T_5	11	43	75
T_6	11	33	65
T_7	22	55	86
T_8	22	55	86
T_9	22	32	64
T_{10}	22	56	87

1st digit indicates the disease progresses in height of the plant and 2nd digit represents the percentage area covered by the blight disease. DAS = Days After Sowing. T_1 = Seed treatment with Neem extract (1%), T_2 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_3 = Seed treatment with Garlic extract (1%), T_4 = Seed treatment with Garlic extract (1%) + Garlic extract spray (1%), T_5 = Seed treatment with BAU-Biofungicide (3%), T_6 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_7 = Seed treatment with Bion @ 50 ppm, T_8 = Bion as spray @ 50 ppm, T_9 = Tilt as spray @ 0.1% and T_{10} = Untreated control

During the cropping year 2017-18, maximum leaf blight disease severity was observed in control treatments at all counts (Table 5). At 1st and at 2nd counts minimum disease severity was recorded in plots of seed treatment with BAU-Biofungicide+BAU-Biofungicide spray. In case of 3rd and 4th counts minimum disease severity was recorded in Tilt sprayed plots (43 and 55) followed by BAU-Biofungicide seed treatment (53 and 64) plus BAU-Biofungicidespray var. Kanchan (Table 5). In case of var. Prodip, maximum disease severity was recorded in control treatments at all counts. At 1st counts minimum disease severity was recorded in plots of seed treatment with BAU-Biofungicide plus BAU-Biofungicide spray. At 2nd and 3rd counts minimum disease severity was recorded in Tilt sprayed plots (32 and 44) followed by BAU-Biofungicide seed treatment (32 and 54) plus BAU-Biofungicide spray (Table 6).

Similar results were observed by Hossain *et al*. (2016) and Sultana *et al*. (2009). According to them, the lowest severity of leaf blight of wheat at field was observed in plots where Tilt used as spray followed by BAU-Biofungicide used as seed treatment plus spray at field. In compare to control, Neem and Garlic extracts were reducing leaf spot severity. Hossain *et al*. (2016) conducted an experiment on the efficacy of selected plant extracts and BAU-Biofungicide in controlling leaf blight of wheat and observed that seed treatment with foliar spray of BAU-Biofungicide was most effective in reducing the leaf blight severity of wheat. It also supported by Najnine *et al.* (2016) who evaluated the effect of seed treatment and foliar spray with BAU-Biofungicide on disease severity of wheat and stated that minimum disease severity was observed inseed treatment and foliar spray with BAU-Biofungicide. Sultana *et al*. (2009) reported that the seed treatment plus foliar spray of BAU-Biofungicide reduced the remarkable disease severity and significantly increased the grain yield of wheat. Hossain (2009) evaluated the efficacy of Amistar and foliar spray of BAU-Biofungicide in controlling leaf blight of wheat and reported foliar spray of BAU-Biofungicide was most effective in reducing leaf blight of wheat. Hossain (2011) tested the BAU-Biofungicide and stated that the sprays of BAU-Biofungicide were effective to control the leaf spot of jack fruit, anthracnose, red rust and powdery mildew of mango. According to Biswas *et al*. (2008) seed treatment and seed treatment plus spray with *T. harzianum* reduced brown leaf spot of rice by 25.28% and 24.78%, respectively. *Trichoderma spp*. has been found to be effective in reducing the foliar disease severity on wheat compared with untreated plants (Muthomi *et al*., 2007; Hasan and Alam, 2007).

Table 3. Effect of plant extracts, BAU-Biofungicide, Tilt and Bion on leaf blight severity of wheat cv. Kanchan during the period of 2016-17

Treatments	Diseases severity (00-99)			
	1st count (45 DAS)	2nd count (60 DAS)	3rd count (75 DAS)	4th count (90 DAS)
T_1	21	33	64	86
T_2	21	32	53	84
T_3	11	33	64	85
T_4	11	32	53	84
T_5	00	23	45	78
T_6	00	22	44	75
T_7	22	33	66	88
T_8	21	32	64	87
T_9	22	32	43	64
T_{10}	22	43	74	88

1st digit indicates the disease progresses in height of the plant and 2nd digit represents the percentage area covered by the blight disease. DAS = Days After Sowing. T_1 = Seed treatment with Neem extract (1%), T_2 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_3 = Seed treatment with Garlic extract (1%), T_4 = Seed treatment with Garlic extract (1%) + Garlic extract spray (1%), T_5 = Seed treatment with BAU-Biofungicide (3%), T_6 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_7 = Seed treatment with Bion @ 50 ppm, T_8 = Bion as spray @ 50 ppm, T_9 = Tilt as spray @ 0.1% and T_{10} = Untreated control

Table 4. Effect of plant extracts, BAU-Biofungicide, Tilt and Bion on leaf blight severity of wheat cv. Prodip during the period of 2016-17

Treatments	Diseases severity (00-99)		
	1st count (75 DAS)	2nd count (90 DAS)	3rd count (105 DAS)
T_1	22	44	76
T_2	22	43	75
T_3	22	43	76
T_4	21	42	75
T_5	00	33	74
T_6	00	33	64
T_7	22	54	78
T_8	21	44	76
T_9	22	32	54
T_{10}	22	55	78

1st digit indicates the disease progresses in height of the plant and 2nd digit represents the percentage area covered by the blight disease. DAS = Days After Sowing. T_1 = Seed treatment with Neem extract (1%), T_2 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_3 = Seed treatment with Garlic extract (1%), T_4 = Seed treatment with Garlic extract (1%) + Garlic extract spray (1%), T_5 = Seed treatment with BAU-Biofungicide (3%), T_6 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_7 = Seed treatment with Bion @ 50 ppm, T_8 = Bion as spray @ 50 ppm, T_9 = Tilt as spray @ 0.1% and T_{10} = Untreated control

Table 5. Effect of Neem and BAU-Biofungicide on leaf blight severity of wheat cv. Kanchan during the period of 2017-18

Treatments	Diseases severity (00-99)			
	1st count (45 DAS)	2nd count (60 DAS)	3rd count (75 DAS)	4th count (90 DAS)
T_1	21	42	63	77
T_2	11	33	55	76
T_3	00	32	53	64
T_4	22	32	43	55
T_5	22	44	66	87

1st digit indicates the disease progresses in height of the plant and 2nd digit represents the percentage area covered by the blight disease. DAS = Days After Sowing. T_1 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_2 = Seed treatment with BAU-Biofungicide (3%), T_3 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_4 = Tilt as spray @ 0.1% and T_5 = Untreated control

Table 6. Effect of Neem and BAU-biofungicide on leaf blight severity of wheat cv. Prodip during the period of 2017-18

Treatments	Diseases severity (00-99)		
	1st count (75 DAS)	2nd count (90 DAS)	3rd count (105 DAS)
T_1	22	33	65
T_2	11	33	64
T_3	11	32	54
T_4	22	32	44
T_5	22	44	78

1st digit indicates the disease progresses in height of the plant and 2nd digit represents the percentage area covered by the blight disease. DAS = Days After Sowing. T_1 = Seed treatment with Neem extract (1%) + Neem extract spray (1%), T_2 = Seed treatment with BAU-Biofungicide (3%), T_3 = Seed treatment with BAU-Biofungicide (3%) + BAU-Biofungicide spray (3%), T_4 = Tilt as spray @ 0.1% and T_5 = Untreated control

Hossain *et al.* (1993) evaluated the extracts of four plants (*Lawsonia alba, Ipomoea fistulosa, Allium sativum and Leucas aspera*) against *Bipolaris sorokiniana* causing leaf blight of wheat and stated that *Allium sativum* completely inhibited the mycelial growth. Extract of *Allium sativum* was effective in controlling the seed borne *Bipolaris sorokiniana*. Sarker (2008) conducted an experiment using two seed treating chemicals and three botanicals to determine their efficacy in controlling seed borne mycoflora of maize seeds. Among the botanicals garlic tablet @ 1:3 w/v was the best in controlling seed borne infection of maize seeds. Meena *et al.,* (2008) stated that foliar spray of 1% garlic clove at 45 and 75 days after sowing against *Alternaria* blight in *Brassica juncea* resulted in the lowest blight severity on leaf and pod which were 3%-10% and 15%-25%, respectively. Bidliya and Alkali (2010) found that the plant parts namely neem seed, garlic clove, onion bulb and rhizome of zinger led to about 3-10% more reduction in the disease incidence of leaf spot of peanut and 10-15% more reduction in disease severity than the control.

Although, fungicide (Tilt) and Bion reduced the severity of leaf blight of wheat however, non-chemical approaches such as plant extracts (Neem and Garlic) were effective against this disease; moreover, BAU-Biofungicide was found to be the most effective in controlling leaf blight of wheat in comparison to chemical treatments.

Conclusion

Based on the findings of the present study, it is possible to conclude the effectiveness of BAU-Biofungicide (3%) in controlling Bipolaris leaf blight of wheat. This non-chemical method could be adopted by the wheat farmers for ensuring sustainability of the environment.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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