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**PJBS**

ISSN 1028-8880

**Pakistan  
Journal of Biological Sciences**

**ANSI***net*

Asian Network for Scientific Information  
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

## Efficacy of Fungicides and Botanicals in Controlling Leaf Blight of Wheat and its Cost Benefit Analysis

I. Hossain, M.H. Rahman, F.M. Aminuzzaman and F. Ahmed

Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

**Abstract:** The efficacy of three fungicides viz. Tilt 250 EC, Bavistin, Pencozeb and botanicals viz. *Allium sativum* (clove), *Nigella sativa* (seed), *Lawsonia alba* (leaf) and *Cymbopogon citratus* (oil) were evaluated for leaf blight (*Bipolaris sorokiniana*) and grain yield of wheat cv. Kanchan under field condition. All the fungicides showed significant affect in controlling leaf blight of wheat cv. Kanchan. The highest reduction of the disease was recorded in plots that received Tilt 250 EC (0.1%) followed by Pencozeb (0.2%). Maximum grain yield of 3.89 t/ha with the gross margin of US\$ 881.24/ha which 22.80% increase over the control was obtained by using Tilt which was followed by Pencozeb (10.01%). Among botanicals, leaf extract of *Lawsonia alba* resulted an increase of gross margin of US\$ 731.78/ha which is 1.98% increase over the untreated control. Tilt 250 EC, Bavistin, Pencozeb and *Lawsonia alba* showed 13.16, 3.71, 9.31 and 8.39 BCR, respectively, while others resulted negative response.

**Key words:** Fungicides, botanicals, wheat, leaf blight, control, cost-benefit analysis

### Introduction

Wheat is one of the main staple food crops in the world and considered as the second most important cereal in Bangladesh. Wheat plants at all growth stages are prone to attack of leaf blight which play a major role among the various factors responsible for lowering the yield of the crop (Rashid, 1996). Not a single wheat cultivar in the country is found to be free from this disease (Hossain and Azad, 1992). The yield loss in wheat due to leaf blight disease in the country has been reported to be 20% in var. Sonelika, whereas 14% and 8% in Akbar and Kanchan, respectively (Razzaque and Hossain, 1991). In farmers fields the yield loss was estimated to be 14.97% (Alam *et al.*, 1995).

The disease can be controlled by the application of fungicides. Researchers now a days are also interested to control disease by biological means. Foliar spray with Tilt 250 EC has been practiced in controlling the disease under field condition (Meyer, 1990; Bockus *et al.*, 1992; Anonymous, 1993; Malaker *et al.*, 1994). Existing practice of chemical control is too costly, particularly for poor farmers. In addition, their harmful effect is responsible for environmental pollution. Use of botanicals in controlling pathogens against certain fungal pathogens has been reported by Miah *et al.* (1990), Assadi and Behroozin (1987), Fakir and Khan (1992), Surattuzaman *et al.* (1994) and Hossain *et al.* (1997). Hossein and Schlosser (1993) have reported promising fungicidal effect of Neem (*Azadirachta indica*) extracts on *Bipolaris sorokiniana*. Considering the above facts, the present research programme has been designed to evaluate the efficacy of some fungicides and botanicals for controlling leaf blight (*Bipolaris sorokiniana*) with increasing grain yield of wheat and cost benefit analysis.

### Materials and Methods

The present study was conducted to evaluate the efficacy of three fungicides viz. Tilt 250 EC (1-(2-(2,4-dichlorophenyl)-4-propyl)-1,3-Dioxalene-2-yl-methyl)-1H, 1,2,4-triazolell, Bavistin (Methyl-1H-benzimidazol-2-ylcarbamate), Pencozeb (Manganese ethylene bisdithiocarbamate plus zinc) and four botanicals viz., *Allium sativum* (clove), *Nigella sativa* (seed), *Lawsonia alba* (leaf) and *Cymbopogon citratus* (oil) under natural epiphytic condition following RC8D. The fungicides and botanical were used as treatments, where Tilt (0.1%), Bavistin (0.1%), Pencozeb (0.2%), *Allium sativum* clove extract (1:4 wt/v), *Nigella sativa* seed extract (1:2 wt/v), *Lawsonia alba* leaf extract (1:4 wt/v), *Cymbopogon citratus* oil (1:80 ratio) and Control (water) having three replications. The sources of fertilizer used for N, P, K, S and Zn were urea, TSP,

MP, Gypsum and Zinc-oxide respectively at the rate of 100 kg, 40 kg, 60 kg, 20 kg and 3 kg ha<sup>-1</sup> (Anonymous, 1989). Except N, all other ingredients were applied to the soil as basal dose. N was applied in three equal splits; firstly during final land preparation and remaining two thirds of N were applied at growth stages after 3 and 7 weeks of sowing. Cowdung (10 t/ha) were mixed with soil two weeks before sowing during land preparation. Wheat seeds of variety kanchan were sown in lines at 120 kg/ha with spacing 20 cm between rows. Irrigation was performed twice, after 21 and 50 days after sowing.

Plant parts (leaf or seed) were grinded in required amount of sterilized water to make the solutions in different concentrations. The crushed materials were filtered through cheese cloth to get fine spray solution. Spraying of fungicides/botanicals were done twice, 76 days after sowing and 91 days after sowing. Leaf Area Diseased (LAD) of flag leaf and penultimate leaf (2nd from top) were measured following 0-5 rating scale as used by Hossain and Azad (1992) where 0 = Free from infection, 1 = Few minute lesions on leaves, 2 = Black lesions with no distinct chlorotic halos covering < 10% of the leaf area, 3 = Typical lesions surrounded by distinct chlorotic halos covering 10-50% of the leaf area, 4 = Severe lesions on leaves with ample necrotic zones, drying over a part of the leaf, covering > 50% of the leaf area and 5 = Severe infection, drying of the leaf, spike infected to some extent. The grading of black point seed infection was done using 0-5 rating scale of CIMMYT (Gilchrist, 1985). Yield and yield contributing parameters were also determined.

The cost-benefit analysis was done following the method of Mondal *et al.* (1994). In case of benefit-cost ratio (BCR), it was calculated by slight modification of the formula as used by DAE (Anonymous, 1997) as shown below:

$$BCA = \frac{\text{Yield of (Fungicide / botanical extract)} \times \text{price of the product} - \text{Yield of control plot}}{\text{Cost of fungicides / botanical extract}}$$

### Results and Discussion

Fungicides and botanical. showed significant role in controlling leaf blight of wheat (Table 1). The lowest mean disease severity of flag leaf and penultimate leaf after 90 days of sowing were found by spraying Tilt followed by pencozeb and the highest in Control, where the mean disease severity ranged from 0.43 to 0.99. Bavistin, *Allium sativum*, *Nigella sativa* *Lawsonia alba* and *Cymbopogon citratus* showed similar effect On disease severity as of control treatment. But after 105 days of sowing, the disease severity grade for flag leaf

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Table 1: Effect of fungicides and botanicals on leaf blight of wheat cv. Kanchan at 90 days and 105 days after sowing

Treatments	Disease severity (0-5 grade) <sup>a</sup>					
	90 days after sowing			105 days after sowing		
	Flag leaf	Penultimate leaf	Average	Flag leaf	Penultimate leaf	Average
Tilt	0.24	0.62	0.43	0.73	1.27	1.00
Bavistin	0.49	0.89	0.69	2.57	3.10	2.83
Pencozeb	0.28	0.71	0.49	1.50	3.00	2.25
<i>Allium sativum</i>	0.91	0.98	0.95	3.03	3.75	3.39
<i>Nigella sativa</i>	0.75	0.95	0.85	2.87	3.84	3.25
<i>Lawsonia elba</i>	0.80	0.93	0.87	3.08	3.89	3.49
<i>Cymbopogon citratus</i>	0.89	0.98	0.83	3.16	3.90	3.54
Control (untreated)	0.91	1.07	0.99	3.95	4.08	4.02
LSD (p < 0.01)	0.442	0.231	0.307	1.140	0.888	0.842

<sup>a</sup>0-5 grading scale of Hossein and Azad (1992)

Table 2: Effect of fungicides and botanicals on yield of wheat cv. Kanchan

Treatments	Ear length (Cm)	No. of grains/ear	No. of healthy grains/ear	No. of diseased grains/ear	Grain wt./ear (g)	1000-grain wt. (g)	Yield	Yield increase over control (%)
Tilt	11.67	68.64	47.38	19.04	3.40	52.46	3.89	24.68
Bavistin	11.32	85.77	38.24	29.51	3.19	48.53	3.30	5.77
Pencozeb	11.60	63.73	42.57	21.15	3.25	52.27	3.47	11.22
<i>Allium sativum</i>	11.32	67.14	49.38	17.10	3.30	48.30	3.37	8.01
<i>Nivea sativa</i>	10.98	65.40	45.00	20.40	3.03	47.59	3.25	4.17
<i>Lawsonia alba</i>	11.09	83.93	47.37	16.55	3.15	50.48	3.19	2.24
<i>Cymbopogon citratus</i>	11.13	81.97	48.24	12.38	2.98	47.78	3.15	0.98
Control (untreated)	10.88	61.01	34.84	28.38	2.97	47.28	3.12	
LSD (p < 0.01)	0.433	4.288	7.150	8.024	0.277	2.321	0.268	

Table 3: Effect of fungicides and botanicals on formation of different grades of black pointed grains (0-5 grade)

Treatments	Percent grains under different grades					
	0	1	2	3	4	5
Tilt	90.97	7.47	1.37	0.20	0.00	0.00
Bavistin	85.53	14.70	1.33	0.33	0.27	1.83
Pencozeb	89.43	8.83	0.43	0.13	0.00	1.17
<i>Allium sativum</i>	90.20	7.43	0.50	0.17	0.00	1.70
<i>Nigella sativa</i>	99.03	4.80	0.30	0.13	0.00	1.73
<i>Lawsonia a/be</i>	92.83	6.40	0.17	0.00	0.03	0.67
<i>Cymbopogon citratus</i>	85.83	12.13	0.37	0.00	0.00	1.60
Control (untreated)	84.23	12.40	1.17	0.33	0.13	1.73
LSO (p < 0.05)	5.828	4.472	NS	NS	0.185	NS

<sup>a</sup>0-5 grade of CIMMYT (Gilchrist, 1985) NS = Not significant

Table 4: Cost benefit analysis of different fungicides and botanicals in controlling leaf blight of wheat cv. Kanchan

Treatments	Grain yield (t/ha)	Gross return (US\$/ha)	Cost of fungicides/botanicals (US\$/ha)	Gross margin (US\$/ha)	Gross margin increase or decrease over control (%)
Tilt	3.89	894.70	13.48	881.24	22.80
Bavistin	3.30	759.00	11.15	747.85	4.22
Pencozeb	3.47	798.10	8.65	789.45	10.01
<i>Allium sativum</i>	3.37	775.10	72.50	702.60	-2.09
<i>Nigella sativa</i>	3.25	747.50	240.00	507.50	-29.27
<i>Lawsonia alba</i>	3.19	733.70	1.92	731.78	1.98
<i>Cymbopogon citratus</i>	3.15	724.50	154.00	570.50	-20.49
Control (untreated)	3.12	717.60	-	717.80	

Price: Wheat = US\$ 0.23/kg, Tilt t. US\$ 28.92/L, Bavistin ii US\$ 22.31/kg, Pencozeb = US\$ 8.85/kg, *Allium sativum* - US\$ 0.58/kg, *Mona sativa* = US\$ 0.98/kg, *Cymbopogon citratus* oil = US\$ 0.77/oz

Table 5: Benefit cost ratio (BCR) of different fungicides and botanicals in controlling leaf blight of wheat cv. Kanchan

Treatments	Grain yield (t/ha)	Gross return (US\$/ha)	Gross margin over control (US\$/ha)	Cost of fungicides/botanicals (US\$/ha)	RCA
Tilt	3.89	894.70	177.10	13.46	13.16
Bavistin	3.30	759.00	41.40	11.15	7.31
Pencozeb	3.47	798.10	80.50	8.65	9.31
<i>Allium sativum</i>	3.37	775.10	57.50	72.50	0.79
<i>Nigella sativa</i>	3.25	747.50	29.90	240.00	0.12
<i>Lawsonia alba</i>	3.19	733.70	16.10	1.92	8.39
<i>Cymbopogon citratus</i>	3.15	724.50	8.90	154.00	0.04
Control (untreated)	3.12	717.60	-	-	-

Price : Wheat - US\$ 0.23/kg, Tilt t. US\$ 26.92/L, Bavistin ii US\$ 22.31/kg, Pencozeb ii US\$ 8.65/kg, *Allium sativum* = US\$ 0.58/kg, *Aligalla sativa* = US\$ 0.98/kg, *Cymbopogon citratus* oil = US\$ 0.77/oz

and penultimate leaf ranged from 0.73 to 3.95 and 1.27 to 4.08, plots that sprayed with Tilt followed by Pencozeb.

Bavistin and respectively. The lowest disease severity was observed in all botanicals significantly controlled the leaf blight

disease over untreated control.

The treatments differed significantly in respect of ear length, number of grains/ear, number of healthy as well as diseased grains/ear, grain weight/ear, 1000-grain weight and grain yield (t/ha) (Table 2). The ear length under different treatments ranged from 10.88 to 11.67 cm, while the highest ear length was observed in plots that received Tilt followed by Pencozeb and *Allium sativum* and lowest was in control plot. *Nigella sativa*, *Lawsonia alba* and *Cymbopogon citratus* showed similar effect with regard to the ear length. Number of grains/ear among the treatment ranged from 61.01 to 68.64. Tilt also resulted the highest number of grains/ear and the lowest in control plot. The highest number of healthy grains/ear was obtained in plots that sprayed with *Allium sativum* but statistically no significant differences were found with Tilt, Pencozeb, *Nigella sativa*, *Lawsonia alba* and *Cymbopogon citratus*. On the other hand, the lowest number of diseased grains/ear has been observed in plots of *Cymbopogon citratus*. The highest number of diseased grains/ear was recorded in Bavistin sprayed plot followed by Pencozeb, *Mgt. satya* and Control. Significantly highest weight of grains/ear (3.4 g) was recorded in Tilt sprayed plot and the lowest (2.97 g) was recorded in control plot. 1000-grain weight of all the treatments ranged from 47.28 to 52.46 g. while the highest and lowest were found in Tilt and control plots respectively. Yield of wheat profoundly varied from one treatment to another, ranging from 3.12 to 3.89 t/ha. Highest yield (3.89 t/ha) was recorded in plots of Tilt, which was 24.68% higher over the control treatment. Seeds were graded into 0-5 rating scale (Table 3). Highest percent of healthy seeds 99.03% were found in plants of plots that received *Nigella sativa*.

Cost benefit analysis of fungicides and botanicals revealed that the highest gross margin of US\$ 881.24/ha was obtained by Tilt application which is 22.80% higher over control followed by Pencozeb of US\$ 789.45/ha that increased gross margin of 10.01% over the control (Table 4). Among botanicals, *Lawsonia alba* increased gross margin of 1.98% over the control. The highest BCR (13.16) was determined by using Tilt which was followed by Pencozeb (Table 5). Among botanicals, *Lawsonia alba* resulted highest BCR (8.39).

In the present study Tilt resulted the best performance which is in accordance with Peltonen and Karjalainen (1992), Mondel *et al.* (1994), Goswami *et al.* (1998) and Kabir (1997). Efficacy of extracts of *Allium sativum*, *Nigella sativa*, *Lawsonia alba* and oil of *Cymbopogon citratus* as foliar spray were found less effective in controlling the leaf blight than the chemical fungicides used. Hossain *et al.* (1997) reported that the extracts of *Allium sativum* and *Lawsonia alba* showed remarkable effect in controlling the mycelial growth of *Bipolaris sorokiniana* and its pathogenicity to wheat leaves. They also found positive antifungal activity of *Nigella sativa* in reducing the pathogenicity of *Bipolaris sorokiniana* OR wheat leaves.

Tilt increased 24.68% grain yield over untreated control. Singh *et al.* (1995) observed that Tilt was as good as four sprays in respect of yield and grain weight. Mondal *et al.* (1994) evaluated that Tilt was the most effective and producing the highest grain yield with maximum gross margin. Goswami *et al.* (1998) recorded 55.16 and 56.99% increased grain yield over control in 1987-'88 and 1988-'89 respectively, by the application of Tilt 250 EC.

Cost-benefit analysis on the fungicidal use showed that the highest gross margin of US\$ 881.24/ha was obtained by Tilt 250 EC followed by US\$ 789.45/ha for Pencozeb. In case of botanicals, the negative gross margin was found except *Lawsonia alba* that resulted an increase of gross margin of 1.98% over the control. Regarding the benefit-cost ratio (BCR)

it has been found that Tilt showed maximum BCR (13.16) followed by Pencozeb (9.31) and Bavistin (3.71), while *Lawsonia alba* extract showed also 8.39 BCR. From the findings of the study it is clearly well exposed that among the fungicides and botanicals, Tilt and the extract of *Lawsonia alba* may successfully be advised to the farmers for controlling leaf blight of wheat.

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