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Neeraj Kumar Rajvanshi

Department of Plant Pathology,
Acharya Narendra Deva
University of Agriculture and
Technology Kumarganj,
Ayodhya, Uttar Pradesh, India

HK Singh

Department of Plant Pathology,
Acharya Narendra Deva
University of Agriculture and
Technology Kumarganj,
Ayodhya, Uttar Pradesh, India

Manish Kumar Maurya

Department of Plant Pathology,
Acharya Narendra Deva
University of Agriculture and
Technology Kumarganj,
Ayodhya, Uttar Pradesh, India

Management of Alternaria blight of Indian mustard through combo of seed treatment and foliar sprays of bioagent and fungicides

Neeraj Kumar Rajvanshi, HK Singh and Manish Kumar Maurya

Abstract

Alternaria blight caused by *Alternaria brassicae* (Berk) Sacc. and *A. brassicicola* (Schw) Wiltshire is one of the most devastating disease on rapeseed-mustard causing major economic losses. The field experiments were conducted during 2017-18 and 2018-19 to evaluate combo of seed treatment and foliar sprays of bio-agents and fungicides. Treatment T₈ i.e. ST with Thiram 2.5 g/kg seed + 3 spray of Nativo @ 0.05% was found most effective with minimum mean disease severity 13.27% and AUDPC 397.4 followed by T₂- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Nativo @ 0.05% with severity 17.66% and AUDPC 527.85, T₁₂- ST with Thiram 2.5 g/kg seed + 3 spray of Folicur @ 0.2% (21.40%, 647.55), T₆- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Folicur @ 0.2% (24.05%, 725.25), T₉- ST with Thiram 2.5 g/kg seed + 3 spray of Propiconazole @ 0.1% (25.93%, 775.15). Maximum yield (Kg/ha) and increase in yield was found in T₈ 1672.22 kg/ha and 70.05% respectively followed by T₂ (1627.77; 65.63%), T₁₂ (1594.44; 62.14%), T₆ (1561.11; 58.75%), T₉ (1544.44; 57.06%). The highest yield loss was avoided by T₈ (41.19%) followed by T₂ (39.55%), T₁₂ (38.32%), T₆ (37.01%), T₉ (36.33%). The maximum cost benefit ratio was found in T₉ (1:3.60) followed by T₃ (1:3.38), T₈ (1:2.48), T₂ (1:2.32), T₁₁ (1:2.03).

Keywords: Alternaria; mustard; Treatment; severity; bioagents

Introduction

India is one of the largest rapeseed-mustard growing countries in the world, occupying the third position in area and production after China and Canada sharing 12 per cent of world's total production. At global level, rapeseed-mustard is cultivated on 5.96 million hectares with production of 8.32 million tonnes and productivity of 1397 kg/ha (Anonymous, 2018). Rapeseed-mustard is the second most important oilseed crop after groundnut and accounts for nearly 30.7 per cent of the total oilseed production in the country. In spite of higher yield potential, diseases are major constraints, of which Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc. and *A. brassicicola* (Schw) Wiltshire is one of the most severe and yield destabilizing factor reduction from 35 to 70 per cent (Kolte, 1985, Saharan, 1992, Singh and Singh, 2005, Kumar *et al.*, 2014) [5, 11, 16, 6]. The disease also adversely affects quality by reducing seed size, impairing seed colour and oil content (Kaushik *et al.* 1984 and Singh *et al.* 2019). In oilseed Brassicas, the symptoms of disease caused by *A. brassicae* appear primarily in the seedling stage on cotyledons and hypocotyls in the form of small light brown lesions which at adult stage affect leaves, leaf petiole, stem, inflorescence, siliquae and seeds (Jung *et al.*, 2002, Prasad and Lallu, 2006) [3, 8]. Information on incidence of Alternaria blight on various cultivars and management of disease through different chemicals is lacking (Prasad *et al.*, 2003) [9]. Therefore, the present investigation was undertaken to manage the disease through bio-agent combination with newer molecules of fungicides.

Materials and Methods

Field experiments were conducted at Genetics and Plant Breeding Research Farm of A.N.D. University of Agriculture and Technology, Kumarganj (26° 47'N, 82° 12'E, 113 msl), Ayodhya (UP) during *Rabi* session 2017-18 and 2018-19.

Trials were conducted using a Randomized Block Design with 13 treatments in 3 replications. The susceptible variety 'Varuna' were sown as treatment. The variety Varuna was sown with plot size 5 m x 3 m with row to row spacing 30 cm and plant to plant 10 cm. recommended doses of N P K fertilizers were applied. Sowing of the crop was done on 14 November, 2017 and 20 November, 2018. Treatments were evaluated under field condition against Alternaria blight. The treatments are T₁-Seed treatment with *P.fluorescence* @ 6.0 g/kg seed+3 spray of Quintal @ 0.2%; T₂-ST with *P.fluorescence* @ 6.0 g/kg seed + 3 spray of Nativo @ 0.05%;

Corresponding Author:**Neeraj Kumar Rajvanshi**

Department of Plant Pathology,
Acharya Narendra Deva
University of Agriculture and
Technology Kumarganj,
Ayodhya, Uttar Pradesh, India

T₃- ST with *P.fluorescence* @ 6.0 g/kg seed+3 spray of Propiconazole @ 0.1%; T₄- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Difenoconazole @ 0.1%; T₅- ST with *P.fluorescence* @ 6.0 g/kg seed + 3 spray of Propineb @ 0.2% ; T₆- ST with *P.fluorescence* @ 6.0 g/kg seed + 3 spray of Folicur @ 0.2%; T₇- ST with Thiram 2.5 g/kg seed + 3 spray of Quintal @ 0.2%; T₈- ST with Thiram 2.5 g/kg seed + 3 spray of Nativo @ 0.05%; T₉- ST with Thiram 2.5 g/kg seed + 3 spray of Propiconazole @ 0.1%; T₁₀- ST with Thiram 2.5 g/kg seed + 3 spray of Difenoconazole @ 0.1%; T₁₁- ST with Thiram 2.5 g/kg seed + 3 spray of Propineb @ 0.2%; T₁₂- ST with Thiram 2.5 g/kg seed + 3 spray of Folicur @ 0.2% and T₁₃- Untreated (Check). Solution of required amount of fungicides prepared with water and volume made up to the desired level. This prepared solution was sprayed by using high volume knapsack sprayer of 14 litre capacity.

The first spray was given on the initiation of disease which was followed by two subsequent spraying at 15 days intervals. Observations were recorded on leaf blight severity (0-9 disease rating scale based on blighted area) after final spray, on ten randomly selected plants from each plot and per cent disease intensity (PDI) was calculated:

$$PDI = \frac{\text{Sum of all the numerical ratings}}{\text{Total Number of leaves observed}} \times \frac{100}{\text{Highest grade}}$$

The disease severity was recorded following scale as per recommendation of All India Coordinated Research Project on Rapeseed- Mustard, which is as under [0=No lesion [Immune (I)]; 1= Non sporulating pinpoint size or small brown necrotic spots, less than 5% leaf area covered by the lesions [Highly resistant (HR)]; 3= small roundish slightly sporulating larger brown necrotic spot, about 1-2 mm in diameter with a distinct margin or yellow halo, 5-10% leaf area covered by lesions [Resistant (R)]; 5 = moderate sporulation, non-coalescing larger brown spots, about 2-4mm in diameter with a distinct margin or yellow halo, 11-25% leaf area covered by the lesions [Moderately resistant (MR)]; 7 = moderately sporulating, coalescing, larger brown spots about 4-5 mm in diameter, 26-50% leaf area covered by the lesions [Susceptible (S)]; 9 = profusely sporulating, rapidly coalescing, brown to black spots measuring more than 6mm in diameter without margins covering more than 50% leaf area [Highly susceptible (HS)] and genotypes were classified based on the highest of the two years disease score.

The avoidable yield loss (AYL) was also calculated by using the formula

$$AYL = \frac{Y_p - Y_{up}}{Y_p} \times 100$$

Where,

Y_p – yield under protected condition

Y_{up} – yield under unprotected condition

Area under disease progress curve (AUDPC) was calculated on the basis of per cent disease severity for each treatment by using the formula as given below on the basis of average pooled data recorded during both the years of experimentations.

$$AUDPC = \sum_{i=1}^n [(Y_{i+1} + Y_i) \times 0.5 (T_{i+1} + T_i)]$$

Where,

Y_i= Alternaria blight severity (%) at the i observation, T_i= Time (days) of the i observation, n= Total number of observations.

Result and Discussion

Effect of treatments on disease severity

All the treatments significantly reduced the severity of the disease on leaves in comparison to the untreated control. The minimum mean disease severity (13.27%) and AUDPC (394.4) was found under T₈-ST with Thiram 2.5 g/kg seed + 3 spray of Nativo @ 0.05% followed by T₂- ST with *P.fluorescence* @ 6.0 g/kg seed + 3 spray of Nativo @ 0.05% with severity 17.66% and AUDPC 527.85, T₁₂- ST with Thiram 2.5 g/kg seed + 3 spray of Folicur @ 0.2% (21.40%, 647.55), T₆- ST with *P.fluorescence* @ 6.0 g/kg seed + 3 spray of Folicur @ 0.2% (24.05%, 725.25), T₉- ST with Thiram 2.5 g/kg seed + 3 spray of Propiconazole @ 0.1% (25.93%, 775.15), T₃- ST with *P.fluorescence* @ 6.0 g/kg seed+3 spray of Propiconazole @ 0.1% (28.12%, 841.43), T₁₀- ST with Thiram 2.5 g/kg seed + 3 spray of Difenoconazole @ 0.1% (30.86%, 921.8), T₄- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Difenoconazole @ 0.1% (34.99%, 1049.7), T₇- ST with Thiram 2.5 g/kg seed + 3 spray of Quintal @ 0.2% (37.66%, 1143.8), T₁-Seed treatment with *P.fluorescence* @ 6.0 g/kg seed+3 spray of Quintal @ 0.2% (40.28%, 1193.7), T₁₁- ST with Thiram 2.5 g/kg seed + 3 spray of Propineb @ 0.2% (41.66%, 1287.8), T₅- ST with *P.fluorescence* @ 6.0 g/kg seed + 3 spray of Propineb @ 0.2% (44.11%, 1339.7). The maximum disease severity was found in untreated plot (check) (68.17%). (Table-1)

A lot of findings were done by several scientist to manage the Alternaria blight disease of mustard with the help of bioagents and fungicides time to time (Kumar *et al.* 2009; Singh *et al.* 2013; Singh *et al.* 2015; Singh *et al.* 2018 and Priyanka *et al.* 2020) [7, 16, 14, 17, 11].

Maximum yield (Kg/ha) and increase in yield was found in T₈ 1672.22 kg/ha and 70.05% respectively followed by T₂ (1627.77; 65.63%), T₁₂ (1594.44; 62.14%), T₆ (1561.11; 58.75%), T₉ (1544.44; 57.06%), T₃ (1511.11; 53.67%). (Table-1) Priyanka *et al.* (2020) [11] also reported maximum yield loss (41.16%) was avoided with three sprays of Nativo75 EC @ 0.08%

All the treatments significantly avoid the yield losses due to this disease. Range of yield loss was avoided from 23.37% to 41.19%. The highest yield loss was avoided by T₈ (41.19%) followed by T₂ (39.55%), T₁₂ (38.32%), T₆ (37.01%), T₉ (36.33%). Priyanka *et al.* (2020) [11] also reported maximum seed yield (2455.96 kg/ha) was recorded with three sprays of Nativo75 EC @ 0.08%.

The maximum cost benefit ratio was found in T₉ (1:3.60) followed by T₃ (1:3.38), T₈ (1:2.48), T₂ (1:2.32), T₁₁ (1:2.03). Singh *et al.* (2013) [16] reported maximum cost benefit ratio of 1:6.79 was obtained with Propiconazole @25% EC.

Table 1: Management of Alternaria blight of mustard by bioagent and fungicides during 2017-18 and 2018-19

Treatments	Disease intensity		Mean	disease control (%)	AUDPC		Mean	Yield (Kg/ha)		Mean (Kg/ha)	Increase in yield (%)	Avoidable yield loss
	2017-18	2018-19			2017-18	2018-19		2017-18	2018-19			
	T ₁	38.68 (38.47)			41.88 (40.32)	40.28		40.91	1146.7			
T ₂	16.46 (23.92)	18.86 (25.37)	17.66	74.09	504.9	550.8	527.85	1644.44	1611.11	1627.77	65.53	39.55
T ₃	26.66 (31.08)	29.57 (32.94)	28.12	58.75	795.8	887.1	841.45	1533.33	1488.88	1511.11	53.67	34.92
T ₄	33.57 (35.41)	36.41 (37.11)	34.99	48.67	1007.1	1092.3	1049.7	1455.55	1411.11	1433.33	45.76	31.39
T ₅	42.65 (40.77)	45.56 (42.45)	44.11	35.29	1295.5	1383.9	1339.7	1300.00	1266.66	1283.33	30.50	23.37
T ₆	22.72 (28.45)	25.38 (30.25)	24.05	64.72	698.6	751.9	725.25	1577.77	1544.44	1561.11	58.75	37.01
T ₇	36.14 (36.95)	39.17 (38.74)	37.66	44.75	1097.8	1189.8	1143.8	1400.00	1366.66	1383.33	40.67	28.91
T ₈	11.36 (19.69)	15.18 (22.93)	13.27	80.53	345.1	449.7	397.4	1688.88	1655.55	1672.22	70.05	41.19
T ₉	24.42 (29.72)	27.44 (31.59)	25.93	61.96	727.1	823.2	775.15	1566.66	1522.22	1544.44	57.06	36.33
T ₁₀	29.35 (32.78)	32.36 (34.67)	30.86	54.73	884.9	958.7	921.8	1477.77	1444.44	1461.11	48.58	32.69
T ₁₁	40.18 (39.33)	43.14 (41.06)	41.66	38.89	1205.4	1287.8	1246.6	1344.44	1311.11	1327.77	35.02	25.94
T ₁₂	20.56 (26.96)	22.23 (28.20)	21.40	68.61	616.8	678.3	647.55	1611.11	1577.77	1594.44	62.14	38.32
T ₁₃	66.34 (54.58)	70.00 (56.81)	68.17		1940.6	2073.8	2007.2	1000.00	966.66	983.33	-	-
SEm±	0.82	0.68						44.88	50.87			
CD (p=0.05)	2.40	1.98						131.02	148.48			
CV	4.23	3.31						5.32	6.18			

T₁-Seed treatment with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Quintal @ 0.2%; T₂-ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Nativo @ 0.05%; T₃- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Propiconazole @ 0.1%; T₄- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Difenconazole @ 0.1%; T₅- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Propineb @ 0.2% ; T₆- ST with *P. fluorescence* @ 6.0 g/kg seed + 3 spray of Follicur @ 0.2%; T₇- ST with Thiram 2.5 g/kg seed + 3 spray of Quintal @ 0.2%; T₈- ST with Thiram 2.5 g/kg seed + 3 spray of Nativo @ 0.05%; T₉- ST with Thiram 2.5 g/kg seed + 3 spray of Propiconazole @ 0.1%; T₁₀- ST with Thiram 2.5 g/kg seed + 3 spray of Difenconazole @ 0.1%; T₁₁- ST with Thiram 2.5 g/kg seed + 3 spray of Propineb @ 0.2%; T₁₂- ST with Thiram 2.5 g/kg seed + 3 spray of Follicur @ 0.2% and T₁₃- Untreated (Check)

Table 2: Economics of bioagent and fungicides for the management of Alternaria blight of mustard during 2017-18 and 2018-19

Treatments	Additional yield over control (Kg/ha)		Additional income (Rs./ha)		Cost of protection (Rs./ha)		Net income (Rs./ha)		Cost Benefit Ratio (Rs./ha)		Mean Cost Benefit Ratio
	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	
T ₁	388.88	377.78	16332.96	15866.76	9548.40	9548.40	6784.56	6318.36	1: 0.71	1: 0.66	1:1.68
T ₂	644.44	644.45	27066.48	27066.90	11618.40	11618.40	15448.08	15448.5	1: 1.32	1: 1.32	1:2.32
T ₃	533.33	522.22	22399.86	21933.24	6548.40	6548.40	15851.46	15384.84	1: 2.42	1: 2.34	1:3.38
T ₄	455.55	444.45	19133.10	18666.90	12518.40	12518.40	6614.07	6148.5	1: 0.52	1: 0.49	1:1.50
T ₅	300.00	300.00	12600.00	12600.00	7118.40	7118.40	5481.06	5481.6	1: 0.77	1: 0.77	1:1.77
T ₆	577.77	577.78	24266.34	24266.76	14318.40	14318.40	9947.94	9948.36	1: 0.69	1: 0.69	1:1.69
T ₇	400.00	400.00	16800.00	16800.00	9538.61	9538.61	7261.39	7261.39	1: 0.76	1: 0.76	1:1.76
T ₈	688.88	688.89	28932.96	28933.38	11608.61	11608.61	17324.35	17324.77	1: 1.49	1: 1.49	1:2.48
T ₉	566.66	555.56	23799.72	23333.52	6538.61	6538.61	17261.11	16794.91	1: 2.63	1: 2.56	1:3.60
T ₁₀	477.77	477.78	20066.34	20066.76	12508.61	12508.61	7557.73	7558.15	1: 0.60	1: 0.60	1:1.60
T ₁₁	344.44	344.45	14466.48	14466.90	7108.61	7108.61	7357.87	7358.29	1: 1.03	1: 1.03	1:2.03
T ₁₂	611.11	611.11	25666.62	25666.62	14308.61	14308.61	11358.01	11358.01	1: 0.79	1: 0.79	1:1.79
T ₁₃		-	-	-	-	-	-	-	-	-	-

Note- Mustard price – Rs 4200/q, Labour charge – Rs 174/day, Sprayer charge – Rs 20/day, Nativo – Rs 7000/Kg, Antracol-top – Rs 1000/Kg, Tilt – Rs 1810/lit, Follicur – Rs 2200/lit, Score – Rs 3800/lit, Quintal – Rs 1405/Kg, Thiram – Rs 450/Kg and *P. fluorescence* – Rs 480/kg.

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