Management of Alternaria Blight through Genotypes, Fungicides, Bio-Agents and Botanical in Rapeseed-Mustard

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ABSTRACT

Alternaria blight caused by Alternaria brassicae (Berk) Sacc. and A. brassicicola (Schw) Wiltshire is one of the most common and destructive disease of rapeseed-mustard. The experiments were conducted under field condition to develop effective management strategies for this disease through evaluation of genotypes for resistance and application of fungicide, bio-agents and botanical. Out of 200 promising genotypes evaluated for resistance, none of the entry was found resistant, twenty two genotypes namely DLSC-1, DRMR-261, DRMR-270, GSC-101, GSL-1, NPC-20 and PHR-2, CNH-11-13, CNH-11-7, EC-552608, HNS-1001, PAB 04-10, PAB 05-16, PAB 05-19, PAB 09-05, PAB-2004-4, PAB-2005-16, PPBJ 5, PPBJ-2, PPBJ-3, PPBN 3 and PPBN-2 were moderately resistant and 63 genotypes moderately susceptible. Seed treatment with Apron @ 6g/Kg seed and spray of all fungicides, bio-agents and botanical extract, significantly reduced the blight severity in comparison to the untreated control (water spray). Of the fungicides, Nativo @ 0.05% was found most effective followed by Difenconazole @ 0.05%, Iprodione @ 0.2, Folcure @ 0.2, Difolatan@ 0.2, Mancozeb @ 0.2, Antracol @ 0.25, Pseudomonas fluorescens @ 1.0, Trichoderma harzianum @ 1.0 and Garlic bulb extract @ 1.0 which showed 8.70%, 14.62%, 16.27%, 16.41%, 18.54%, 20.51%, 21.42%, 24.27%, 25.42%, and 26.83% severity, respectively after third spray of each chemical, bio-agents and botanical extract. The disease severity of water spray control was 69.10%. Same tread was also recorded with per cent disease control. Maximum seed yield (kg/ha) and yield increase (%) of 1740.22, 37.90 was recorded with the treatment Nativo @ 0.05% followed by Difenconazole @ 0.05% (1629.61, 29.16), Iprodione @ 0.2 (1587.50, 25.85), Trichoderma harzianum @ 1.0 (1525.68, 20.93), Difolatan @ 0.2 (1516.98, 2024), Pseudomonas fluorescens @ 1.0 (1512.37, 19.87), Antracol @ 0.25 (1511.45,19.80), Mancozeb @ 0.2 (1507.99, 19.52), respectively. The maximum benefit cost ratio 1:12.60 was obtained with Garlic bulb extract @1.0 followed by Trichoderma harzianum @ 1.0 (1:6.0), Nativo @ 0.05% (1:4.01), Pseudomonas fluorescens @ 1.0 (1:3.79).

Keywords
Rapeseed and mustard, Alternaria blight, Management

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Introduction

Rapeseed and mustard are the major oilseed crops grown in northern and eastern part of India. Alternaria blight caused by *Alternaria brassicae* (Berk.) Sacc and *A. brassicicola* (Schewein) Wiltshire, is one of the most severe disease and yield distablishing factors reduction from 35 to 70 per cent (Kolte, 1985, Saharan, 1992, Singh and Singh, 2005, Kumar et al., 2014). In addition to direct losses, the disease also affects the quality of the seed by reducing seed size; seed colour and oil content (Kaushik et al., 1984). Information on incidence of Alternaria blight on various cultivars and management of disease through different chemicals is lacking (Prasad et al., 2003). Therefore, the present investigation was undertaken to identify genotypes for resistance to Alternaria blight, chemicals, bio-agents and botanical which would reduce the disease intensity.

Materials and Methods

The investigations were carried out at Genetics and Plant Breeding Research Farm and in the laboratory of the Department of Plant Pathology, N.D. University of Agriculture and Technology, Kumarganj, Faizabad (26°47 N latitude and 82.12°E longitudes at an altitude of 113 m from the mean sea level). The investigations consisted of two separate components *i.e.* varietal screening for host resistance and management in Indian mustard [*Brassica juncea* (L.) Czern & Coss.] through fungicide, bio-agents and botanical.

For resistance evaluation, two hundred twenty rapeseed-mustard genotypes of diverse background were sown in single rows of 3 meter length having 30 x 10 cm row to row and plant to plant, respectively and replicated twice in plot supplemented with diseased plant debris carrying *Alternaria brassicae* inoculum from the preceding years. A susceptible variety ‘Jagrati’ was planted in single row after every five test lines and flanked the trial around with triple rows to serve as infector. The crop was inoculated twice by the spore suspension $10^{-6}$ of *Alternaria brassicae* (Berk.) Sacc. artificially to create epiphytotic condition. The trial was given three irrigations to maintain a humid micro-climate.

The disease severity was recorded following scale as per recommendation of All India Coordinated Research Project on Rapeseed-Mustard, 2017 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, 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.

For the management, a field experiment with twelve treatments including control was laid out with three replications and test variety ‘Varuna’. The trial was sown in randomized block design (RBD) during 2012-13 and 2013-14 in first week of November having plant spacing of 30 x 10 cm in plots size of 5x3 m which has been identified as a hot spot for this disease. Twelve treatments having eight
fungicides i.e. Apron, Mancozeb, Difolatan, Iprodiane, Difenconazoles, Antracol, Nativo, Folicure; two bio-agents i.e. Trichoderma harzianum and Pseudomonas fluorescens; one garlic bulb extract and one check plot by water spray (control) (Table 1). 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:

$$\text{PDI} = \frac{\text{Sum of total numerical ratings}}{\text{Total number of leaves observed} \times \text{Highest grade}} \times 100$$

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

$$\text{AYL} = \frac{\text{Yp} - \text{Yup}}{\text{Yp}} \times 100$$

Where,

Yp = yield under protected conditions
Yup = yield under unprotected conditions

Results and Discussion

Out of two hundred twenty genotypes, none of the entry was found resistant, twenty two genotypes namely DLSC-1, DRMR-261, DRMR-270, GSC-101, GSL-1, NPC-20 and PHR-2, CNH-11-13, CNH-11-7, EC-552608, HNS-1001, PAB 04-10, PAB 05-16, PAB 05-19, PAB 09-05, PAB-2004-4, PAB-2005-16, PPBJ 5, PPBJ-2, PPBJ-3, PPBN 3 and PPBN-2 were moderately resistant and 63 genotypes moderately susceptible. Rest of the genotypes was either susceptible or highly susceptible (Table 1). Dang et al., (2002), Singh and Singh (2005) and Singh et al. (2006), Singh et al., (2013), Kumar et al., (2016), Singh et al., (2016) also found variable level of resistance in rapeseed-mustard and did not report any immunity.

Seed treatment with Apron @ 6g/Kg seed and spray of all fungicides, bio-agents and botanical extract, significantly reduced the blight severity in comparison to the untreated control (water spray). Of the fungicides, Nativo @ 0.05% was found most effective followed by Difenconazole @ 0.05%, Iprodione @ 0.2, Folicure @ 0.2, Difolatan@ 0.2, Mancozeb @ 0.2, Antracol @ 0.25, Pseudomonas fluorescens @ 1.0, Trichoderma harzianum @ 1.0, Garlic bulb extract @1.0 and Seed treatment with Apron @ 6g/Kg seed which showed 8.70%, 14.62%, 16.27%, 16.14%, 18.54%, 20.51%, 21.42%, 24.27%, 25.42%, 26.83%, and 52.40% severity, respectively after third spray of each chemical, bio-agents and botanical extract. The disease severity of water spray control was 69.10%. Same tread was also recorded with per cent disease control (Table 2).

Maximum seed yield (kg/ha) and yield increase (%) of 1740.22, 37.90 was recorded with the treatment Nativo @ 0.05% followed by Difenconazole @ 0.05% (1629.61, 29.16), Iprodione @ 0.2 (1617.11, 28.17), Folicure @ 0.2 (1587.50, 25.85), Trichoderma harzianum @ 1.0 (1525.68, 20.93), Difolatan @ 0.2 (1516.98, 21.98), Pseudomonas fluorescens @ 1.0, Trichoderma harzianum @ 1.0, Garlic bulb extract @1.0, respectively. All the treatments could avoided test weight loss of 8.52% to 27.49% and maximum with Nativo @ 0.05% followed by Difenconazole @ 0.05% (22.52), Iprodione @ 0.2 (21.98), Folicure @ 0.2 (20.54), Trichoderma harzianum @ 1.0 (17.30), Difolatan @ 0.2 (16.83), Garlic bulb extract @1.0 (16.70), respectively (Table 2).
Table 1 Management of Alternaria blight of mustard by chemicals, bio-agents and botanical

| Treatment /Doses                      | Disease Intensity (%) | Mean Per cent disease control | Yield (kg/ha)    | Mean (Kg/ha) | Yield Increased (%) | Avoidable yield loss | Cost benefit ratio |
|--------------------------------------|-----------------------|-------------------------------|------------------|--------------|---------------------|----------------------|-------------------|
|                                      | 2012-2013 | 2013-2014 |                   | 2012-2013 | 2013-2014 |                   |                   |                   |
| Seed Treatment with Apron @ 6g/Kg seed | 53.07 (47.12) | 51.74 (46.38) | 52.40 | 24.16 | 1315.53 | 1443.02 | 1379.27 | 9.32 | 8.52 | 1:8.34 |
| Difenconazole @ 0.05%                | 15.98 (23.50) | 13.26 (22.46) | 14.62 | 78.84 | 1577.77 | 1681.45 | 1629.61 | 29.16 | 22.57 | 1:1.40 |
| Antracol @ 0.25%                     | 22.35 (28.18) | 20.49 (27.56) | 21.42 | 69.00 | 1465.77 | 1557.41 | 1511.45 | 19.80 | 16.52 | 1:0.94 |
| Difolatan@ 0.2%                      | 19.90 (26.49) | 17.19 (25.48) | 18.54 | 73.16 | 1465.57 | 1568.39 | 1516.98 | 20.24 | 16.83 | 1:2.22 |
| Ipodione @ 0.2%                      | 17.18 (24.43) | 15.36 (23.73) | 16.27 | 76.45 | 1565.62 | 1668.60 | 1617.11 | 28.17 | 21.98 | 1:2.35 |
| Mancozeb @ 0.2%                      | 22.52 (28.32) | 18.50 (26.92) | 20.51 | 70.31 | 1445.33 | 1570.65 | 1507.99 | 19.52 | 16.33 | 1:1.42 |
| Nativo @ 0.05%                       | 7.90 (16.32)  | 9.50 (17.16)  | 8.70 | 87.41 | 1700.11 | 1780.33 | 1740.22 | 37.90 | 27.49 | 1:4.01 |
| Folicure @ 0.2%                      | 15.33 (23.03) | 17.50 (23.89) | 16.41 | 76.25 | 1600.00 | 1575.00 | 1587.50 | 25.85 | 20.54 | 1:1.20 |
| Trichoderma harzianum @ 1.0%         | 25.96 (30.59) | 24.88 (30.26) | 25.42 | 63.21 | 1455.41 | 1595.95 | 1525.68 | 20.93 | 17.30 | 1:6.00 |
| Pseudomonas fluorescens @ 1.0%      | 25.11 (30.07) | 23.43 (29.47) | 24.27 | 64.87 | 1455.08 | 1569.62 | 1512.35 | 19.87 | 16.57 | 1:3.79 |
| Garlic bulb extract @1.0%            | 27.92 (31.88) | 25.74 (31.18) | 26.83 | 61.17 | 1459.44 | 1569.94 | 1514.69 | 20.05 | 16.70 | 1:12.6 |
| Control (Water spray)                | 71.14 (57.48) | 67.05 (56.73) | 69.10 | -     | 1256.67 | 1266.67 | 1261.67 | 0.00  | 1:8.34 |
| SEM ±                                | 1.20 | 1.1. | 20.25 | 14.83 |
| CD at 5%                             | 2.75 | 2.50 | 49.84 | 41.53 |
Table 2: Reaction of rapeseed and mustard genotypes against Alternaria blight on the basis of maximum grade

| Maximum Grade (0-9) | Reactions | No. of Genotypes | Name of genotypes |
|---------------------|-----------|------------------|-------------------|
| 0                   | F         | None             | -                 |
| 1                   | HR        | None             | -                 |
| 3                   | R         | None             | -                 |
| 5                   | MR        | 22               | DLSC-1, DRMR-261, DRMR-270, GSC-101, GSL-1, NPC-20 and PHR-2, CNH-11-13, CNH-11-7, EC-552608, HNS-1001, PAB 04-10, PAB 05-16, PAB 05-19, PAB 09-05, PAB-2004-4, PAB-2005-16, PPBJ 5, PPBJ-2, PPBJ-3, PPBN 3 and PPBN-2 |
| 7                   | MS        | 63               | 44S31, AHS-55, C-3001-1-1-1, DRMR-100, DRMR-11-08, DRMR-11-10, DRMR-11-11, DRMR-1187-60, DRMR-13, DRMR-302, DRMR-92, DRMRJ-04, DRMRJ-11-04, DRMRJ-11-286, DRMRJ-27, DRMRMJ-35, DRMRMJ-38, EC-399299, EC-414324, Hyb-7-2011, IC-255498, IC-399678, JMT-08-13, KMR(L)-12-1, KMR(L)-12-2, LADLI, LES-45, MCP-807, NPJ 156, NPJ-164, NPJ-167, NPJ-168, NPJ-169, NPJ-171, NUDH-YJ-6, OMK-4, PMH-12-2, PMH-12-3, PPBJ 4, PR-2006-14, PR-2008-1, PR-2009-12, PRB-2004-3-4, PRB-2008-5, PRL-2010-10, PRO-5111, RAUDT-10-33, RB-59, RB-64, RGN-306, RGN-315, RGN-323, RH-0831, RH0901, RH0948, RH-0952, RMM-9-12, RMWR-09-4, RMWR-09-5, RMWR-09-6, RRN-813, SKM-1013 and SKM-B-817 |
| 9                   | S         | 115              | 2IJ 0009, 4S42, AH-53, Albeli-1, ASH 42, CJ-37-61, CS 13000-3-3-2-2-1, CS-1100-1-2-2-3, CS-204-2-2-1, Divya-33, DRMR-10-40, DRMR-15, DRMR-1679-100, DRMR-312, DRMR-316, DRMR-64, DRMR-81, DRMRHJ-2409, DRMRJ-11-287, DRMRJ-1-275, DRMRJ-21-1, DRMRJ-31, DRMRMJ-27, EC 399301, EC-414322, Hyb-9-2011, IC-399824, JC-210-541, JMM-08-1, JMW-08-3, KMR-12-1, KMR-12-2, LES-46, LES-47, MCP-802, NDRE-7, NDRS 2017, NPJ 153, NPJ 154, NPJ 154, NPJ 121, NPJ-127, NPJ-140, NPJ-165, NPJ-170, NPJ-172, NPJ-173, NPJ-174, NPJ-175, NUDH-YJ-10, PAB 09-07, PBR-384, PBR-422, PMH-12-1, PPBR-2, PRB-2008-5, PRE-2007-6, PRE-2010-15, PRE-2010-19, PRL-2009-3, PT-2006-4, PT-2008-2, PT-2010-10, PT-303, PTE-2008-02, PYS-2007-10, PYS-2008-5, RAUDT-10-18, RAUDYS-10-07, RAUDYS-10-12, RAURD 09-25, RAURD-9-78, RAURD-09-212, RAURD-09-32, RAURDL-02-01, RB-57, RGN-307, RGN-308, RGN-321, RH 0749, RH-0555A, RH-0834, RH0902, RH-0904, RH-903, RHH-1101, RMM-10-1, RMM-10-12, RMM-9-4, RMT-08-2, RMT-10-10, RMT-10-7, Rohini, RRN-783, RRN-788, RRN-789, RTM-10-10, RTM-1351, RTM-1359, SKM-1040, SKM-815, TK-17-14, TKM-102, TL-21, TM-106, TM-117, Varuna, YSB-9, YSKM-12-1, YSKM-12-2, YSWB-2010/8, YSWB-2011-10-1, YSWB-2012/9, YSWB-2014/3-12 and YSWB-20229/2-12 |

F=Free, HR= Highly Resistant, R= Resistant, MR= Moderately Resistant, MR= Moderately Susceptible, S= Susceptible
The maximum benefit cost ratio 1:12.60 was obtained with Garlic bulb extract @1.0 followed by Trichoderma harzianum @ 1.0 (1:6.0), Nativo @ 0.05% (1:4.01), Pseudomonas fluorescens @ 1.0 (1:3.79). Singh et al., (2016) have reported Garlic bulb extract @ 1.0 and Trichoderma harzianum @ 1.0 as most economic as compared to others which supports the present findings. The maximum cost benefit cost ratio (1:21.83) was also reported (Mahapatra and Das, 2016) only single application of Garlic bulb extract which is highly acceptable for eco-friendly management of Alternaria blight of mustard. Nativo 0.05% was found most effective for reduction of disease and enhance the yield but ranked 3rd in benefit cost ratio (Table 2). It is due to its high cost value and may be due to higher doses.

It is evident from the results that all the fungicides and chemicals were found effective however; maximum control was obtained by the application of 0.05% Nativo followed by Difenconazole @ 0.05%. Among the bio pesticide, best control was obtained by application of garlic bulb extracts @ 1% followed by Trichoderma harzianum @ 1.0%. The variable results of fungicides and botanicals in reduction of disease severity of Alternaria blight may be attributed to the toxic principles present in the fungicides and botanicals. The efficacies of botanicals, bio-control agent (Garlic bulb extract, Neem, Eucalyptus, Madar Dhatura and Trichoderma harzianum) and with fungicides in management of Altenaria blight of rapeseed-mustard was also reported by other workers (Meena et al., 2008; Yadav, 2009; Patni et al., 2005, Singh et al., 2013; Singh et al., 2016; Kumar et al., 2016).

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