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Effect of plant defense inducers in the management of Alternaria blight of linseed

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Abstract

Alternaria blight is an important disease of Linseed that limits both the productivity and oil content. In the present investigation, three plant defense inducers, viz., salicylic acid, Monopotassium phosphate and sodium propionate were evaluated against the disease in different concentrations and combinations. Field experiment was conducted in Randomised Block Design with ten treatments in three replications during the year 2019-20 and 2020-21. Seed treatment and foliar application at 30 and 45 days after sowing with salicylic acid @100 ppm was found most effective in controlling the Alternaria blight with a significant reduction in disease severity (84.21%) and increased yield up to 107.23 percent over control. This was followed by seed treatment with salicylic acid @ 100 ppm and foliar application of Monopotassium phosphate @ 1% at 30 and 45 days after sowing with 77.37 and 92.05 percent disease reduction and increase in yield, respectively.

Keywords: Alternaria blight, linseed, Monopotassium phosphate, plant defense inducers, salicylic acid, sodium propionate

1. Introduction

Alternaria blight caused by *Alternaria lini* is one of the important factors limiting the productivity and oil content of Linseed (*Linum usitatissimum*). The disease is responsible for causing losses to an extent of 23-60 percent (Holi and Meena, 2015) [3]. Initially, the symptoms appears as black point on the lower leaves and gradually increase in size, becoming circular to oval or irregular in shape. Later, the large area of the leaves is covered by several spots. Ultimately the affected leaves get dried up and curled. The pathogen also attacks the other plant parts. On stem, symptoms start as a light brown linear spot with a darker margin, which eventually becomes more linear and darker in colour.

The pathogen is air borne, hence the use of suitable fungicides is the most appropriate method for controlling the disease. The disease can also be managed using non-chemical method such as Neem based fungicides. However, many strategies have been formulated to manage the disease using synthetic chemicals, the indiscriminate use of chemical method only adds up the residual toxicity to the environment. Again, there is not much information on the varietal reaction of promising linseed germplasm lines against this disease. The use of plant defense inducers as an alternative management strategy and increasing productivity can be a solution. In the present investigation, three plant defense inducers namely, salicylic acid, monopotassium phosphate and sodium propionate were evaluated for their efficacy in controlling the Alternaria blight of linseed in field condition.

2. Materials and Methods

Field trails comprising of ten treatments including control were conducted with one susceptible variety 'T 397' during *rabi*, 2019-20 and 2020-21 at AAU-Zonal Research Station, Shillongani (26°36'N latitude and 92°64'E longitude and an elevation of 50.2 m above mean sea level), Assam in natural condition (sick plot). Seed sowing and other agronomic practices were performed following the standard agronomic practices (Anonymous 2015) [1]. Plot size of 4m × 3m with spacing 25cm × 5cm was maintained.

The disease severity (DS) on leaves was recorded at 90 days after sowing (DAS) using 0-5 scale given by Conn *et al.* (1990) [2] (Table 1) and DS (%) was calculated as follows.

$$DS (\%) = \frac{\text{Sum of numerical rating}}{\text{Total no. of observations} \times \text{maximum disease score}} \times 100$$

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Further, yield from all the treatments were recorded at the time harvest of the crop.

Table 1: Disease rating scale for disease severity of Alternaria blight in linseed

Rating	Leaf area infection (%)
0	0
1	0.1-10
2	10.1-25
3	25.1-50
4	50.1-75
5	75.1-100

3. Results and Discussion

The results (Table 2) showed that all the treatments significantly reduced the disease severity (DS) as compared to control for both the years (*i.e.* 2019-20 and 2020-21). Among different treatments, T₄ comprising of seed treatment (ST) with salicylic acid (SA) @100 ppm + foliar spray of SA @100 ppm at 30 and 45 DAS was found to be highly effective in managing the Alternaria blight with least DS (10.00%). This was followed by T₆ (ST with SA @100 ppm + foliar spray of Monopotassium phosphate @1% at 30 and 45 DAS and T₈ (ST with SA @100 ppm + foliar spray of sodium propionate @1% at 30 and 45 DAS with disease severity of 14.33 and 19.33 percent, respectively. However, T₄ was statistically at par with T₆, which was also at par with T₈. Similarly, seed yield was also differed significantly in different treatments during both the years of study. The maximum yield (860 kg/ha) was recorded in T₄ followed by T₆ (797.50 kg/ha) and T₈ (750 kg/ha). The maximum disease severity (63.33%) and minimum yield (415 kg/ha) were

recorded in control plot (T₁₀).

The combined application of ST + foliar application of SA @100 ppm at 30 and 45 DAS (T₄) showed maximum reduction of DS (84.21%) over control followed by T₄ (77.37%) and T₈ (69.48%). Application of the same treatment (T₄) resulted in maximum increase in yield (107.23%) over control. This was followed by T₆ (92.05%) and T₈ (80.72%). Among all the treatment, ST with SA @50 ppm (T₁) was found to be least effective and caused 36.84 percent disease reduction and 19.28 percent in increase in yield over control (Fig. 1).

Singh *et al.* (2020) [5] assessed the effectiveness of various resistance inducing chemicals, including naphthelic acetic acid, benzoic acid, salicylic acid, phosphoric acid and isonicotinic acid at 0.05 and 0.10% along with fungicide mancozeb at 0.25% against the Alternaria blight. The minimum DS (28.40%) and maximum yield (724.16 kg/ha) were achieved with spraying salicylic acid at 0.10% followed by benzoic acid at 0.10%.

The management of Alternaria blight in linseed was reported by Singh and Singh (2007) [7] using plant growth activator, including salicylic acid, BION (CGA 245704) and phosphoric acid, and mancozeb fungicide. They found that the use of salicylic acid as prophylactic sprays (30 and 45 DAS) were superior over spray after disease onset. The effectiveness of salicylic acid against Alternaria blight of mustard caused by *Alternaria brassicae* has also been demonstrated by Singh and Singh (2004) [6]. Sharma and Sohal (2017) [4] reported that the combined application of salicylic acid and benzothiadiazole significantly increased peroxidase activity and phenolic content in the mustard plant, resulting in a induced defense mechanism against the *A. brassicae*.

Table 2: Effect of different treatments of plant defense inducers on blight severity and yield of linseed

Tim	Disease severity (%)			Yield (kg/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T ₁ : Seed treatment (ST) with salicylic acid (SA) at 50 ppm	35.00* (36.22) ^{b**}	45.00 (42.10) ^b	40.00 (39.21) ^b	510.00 ⁱ	480.00 ^g	495.00 ^h
T ₂ : ST with salicylic acid (SA) at 100 ppm	33.33 (35.20) ^{bc}	41.67 (40.15) ^{bc}	37.50 (37.70) ^b	550.00 ^h	540.00 ^f	545.00 ^g
T ₃ : T ₁ + foliar spray of salicylic acid (SA) at 50 ppm at 30 and 45 DAS	26.67 (31.06) ^{bcd}	29.00 (32.54) ^{ef}	27.83 (31.80) ^{cd}	660.00 ^e	650.00 ^d	655.00 ^e
T ₄ : T ₂ + foliar spray of salicylic acid (SA) at 100 ppm at 30 and 45 DAS	10.00 (18.04) ^f	10.00 (18.37) ⁱ	10.00 (18.36) ^f	880.00 ^a	840.00 ^a	860.00 ^a
T ₅ : T ₁ + foliar spray of monopotassium phosphate (1%) at 30 and 45 DAS	28.33 (32.13) ^{bcd}	31.67 (34.22) ^{de}	30.00 (33.18) ^{cd}	630.00 ^f	630.00 ^{de}	630.00 ^e
T ₆ : T ₂ + foliar spray of monopotassium phosphate (1%) at 30 and 45 DAS	15.00 (22.58) ^{ef}	13.67 (21.67) ^h	14.33 (22.17) ^{ef}	805.00 ^b	790.00 ^b	797.50 ^b
T ₇ : T ₁ + foliar spray of sodium propionate (1%) at 30 and 45 DAS	30.00 (33.14) ^{bc}	36.67 (37.24) ^{cd}	33.33 (35.24) ^{bc}	60.00 ^g	590.00 ^e	595.00 ^f
T ₈ : T ₂ + foliar spray of sodium propionate (1%) at 30 and 45 DAS	20.00 (26.44) ^{de}	18.67 (25.56) ^g	19.33 (26.04) ^e	760.00 ^c	740.00 ^c	750.00 ^c
T ₉ : Foliar spray with hexaconazole (0.1%), first spray at initiation of disease and second spray at 10 days interval	25.00 (29.91) ^{cd}	26.67 (31.03) ^f	25.83 (30.47) ^d	710.00 ^d	700.00 ^c	705.00 ^d
T ₁₀ : Control	58.33 (49.81) ^a	68.33 (55.83) ^a	63.33 (52.77) ^a	440.00 ^j	390.00 ^h	415.00 ⁱ
S.Ed(±)	3.002	1.458	1.944	14.096	13.700	14.027
CD (0.05)	6.307	3.063	4.084	29.615	49.793	29.471

*Data are mean of three replications, **Data in parentheses are arc sine transformed values

The values with different superscript letters in a column are significantly different at P=0.05 by DMRT technique

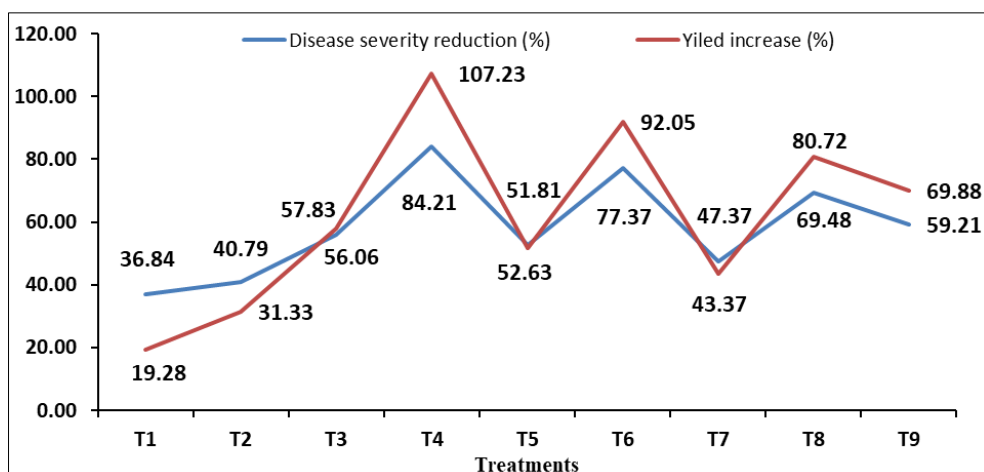


Fig 1: Effect of different treatments of plant defense inducers on disease severity reduction of *Alternaria* blight and yield increase over control of linseed

4. Conclusion

In both the year (2019-20 and 2020-21), the seed treatment with salicylic acid at 100 ppm combined with foliar application at 30 and 45 DAS resulted in the highest reduction in disease severity with increased yield. From the present investigation it can be concluded that the *Alternaria* blight of linseed can significantly be minimized by seed and foliar application of salicylic acid @100 ppm, along with increased yield.

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