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# Elicitors of Systemic Acquired Resistance in Mustard against Sclerotinia Rot

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**Abstract**

Sclerotinia rot or Stem rot or stem blight or white rot of Indian mustard caused by *Sclerotinia sclerotiorum (*Lib.) de Bary is a serious threat to oilseed rape production with substantial yield losses worldwide. The disease has been widely reported in the last few years in India causing considerable loss in yield of mustard production in India. Keeping this in view three abiotic elicitors (Bion®: benzothiadiazole, salicylic acid, oxalic acid) were evaluated to find out a suitable and cost effective control measure for this disease. It was observed that abiotic elicitors were found to be effective in reducing disease and inhibiting pathogen growth in the form of lesion on stem and sclerotia formation. The maximum disease control was observed in **s**eed-cum-foliar spray with the treatment of Bion® (75.97%) followed by salicylic acid (62.41%) and oxalic acid (47.60%).

**Keywords:** Salicylic Acid, Oxalic Acid, Indian Mustard, *Sclerotinia sclerotiorum,* SAR.

**Introduction**

Indian mustard or rape seed mustard [*Brassica juncea* (L.) Czern & Coss.] belonging to *Brassicaceae* (Syn. *Cruciferae*) or the mustard is one of the major oilseed crops cultivated in India and around the world. In India although it is being cultivated across the country and 7 states (Rajasthan, MP, UP, Haryana, WB, Assam and Gujarat) contribute significantly to its production (> 90%) and acreage (>80%). Rapeseed-mustard is cultivated during rabi season. Cool and moist climate of winter months is most favourable for growth and productivity of Indian mustard.

**Review of Literature**

Mustard is used as sources of oil, vegetable, condiments and fodder. The oil content of the seeds ranges from 38-46%. The oil cakes obtained after extraction of oil are used as cattle feed and are rich in protein and minerals. Indian mustard suffers from various destructive diseases caused by fungi, bacteria, viruses and phytoplasma. Among them, Sclerotinia stem rot is the most serious fungal disease that causes maximum damage and yield loss. The pathogen affects many crops in India, particularly rapeseed and mustard and has become very wide spread and most destructive in mustard growing areas (Ghasolia *et. al.,* 2004). *S. sclerotiorum* has a large distribution in many countries and wide host range. In Bangladesh, it is reported on hyacinth bean, marigold, jackfruit and okra (Prova et al., 2017)

The Mycelium of pathogen, *Sclerotinia sclerotiorum* (Lib.) de Bary is thin, 9-18µm in diameter with lateral branches. The vegetative hyphae are multi nucleate and haploid (n=8). The sclerotia are black, round or semi spherical in shape measuring 3-10 µm. The sclerotial germination is mycelogenic or carpogenic (formation of fruiting body, apothecia). Ascospores are sexual spores formed in apothecia. Ascospores are discharged from the apothecia at the base of the infected plants in soil and constitute important primary sources of infection.

**Aim of the Study**

As the pathogen is a soil dewelling fungus and has been causing complete death of the seedling and mature plants. It is particularly a different task to control this serious menace, especially within the framework of integrated disease management system, which is needed to hold disease below economic threshold without damaging the agro-ecosystem.The existing control measures are not so effective framework of integrated disease management system therefore, the induction of

systemic resistance could be the one of the most important solution to combat this disease(Rothmann LA and McLaren NW.;2018, Abdel-Monaim *et al.;*2012, Dantre *et al.;*2003, El Bana;2007, El-Mougy *et al.;* 2004 and Shalaby *et al.;*2001). This paper attempts to present future outlook and strategy for inducing Systemic Acquired Resistance by abiotic elicitors against Sclerotinia rot of rapeseed mustard.

**Materials and Methods**

These experiment were conducted in a controlled environment for an intact host-pathogen interaction between *Brassica juncea* (L.) Czern & Coss and *S.sclerotiorum(*Lib.) de Bary. The three abiotic (Bion®: benzothiadiazole, salicylic acid, oxalic acid) compounds were used throughout the experiment.

**Isolation and Culture of the Pathogen**

The pathogen *S.sclerotiorum* was isolated from naturally infected plants of rapeseed using potato dextrose agar (PDA) medium. For mass production of the fungal inoculum, sorghum grains were boiled for one-hour and placed in Erlenmeyer flasks (250ml). The flasks were sterilized in an autoclave for 1h at 121 $^{o}$C and subsequently inoculated with mycelial plugs (5mm) of *S.sclerotiorum* and incubated at 20±2 $^{o}$C. The sclerotia produced were harvested after one weeks and used in experiment. For mixing in the soil, sorghum grains were crushed and directly used as inoculum and for plant inoculation mycelial plug or tooth prick method was used.

**Seed treatment with abiotic elicitors**

Seeds of rapeseed mustard with Bion®, salicylic acid, oxalic acid were imbibed for 24 h in a suspension of (100mg l $^{-1}$) made up in sterilized distilled water. Seed imbibition followed by drying seed was then air dried on filter paper at room temperature for 24 h/prior to sowing. The seeds treated with distilled water served as control for comparison.

**Calculation of Disease Intensity Disease Inhibition Percentage**

The percent disease intensity was calculated using the following formula (Wheeler,1969):

$$\% \text{ disease intensity} = \frac{\text{Sum of individual ratings}}{\text{No. of plants observed} \times \text{maximum disease rating}} \times 100$$

Percent disease inhibition by elicitors over control was calculated by the following formula (Bliss, 1934).

$$\% \text{ inhibition over control} = \frac{C - T}{C} \times 100$$

C = growth of pathogen in control
T = growth of pathogen in treatment

The length of lesion on infected stems of rapeseed was considered for recording the disease intensity. To determine the stem rot intensity the following modified disease rating (0-4) scale (Lesovoi *et al.*, 1987 and Sansford, 1995) was used.

| Grade | lesion length on stem |
|---|---|
| 0 | no visible lesion |
| 1 | 0.1-2.0 cm lesion length on stem |
| 2 | 2.1-4.0 cm lesion length on stem |
| 3 | 4.1-6.0 cm lesion length on stem |
| 4 | > 6 cm lesion length on stem |

**Results and Discussions**

**Efficacy of Bion®, Salicylic Acid, Oxalic Acid against Stalk Rot Disease**

Potting medium (soil: sand: farm yard manure at 1:1:1 w/w/w) was autoclaved for 1h on two consecutive days. The virulent strain of *S.sclerotiorum* mass multiplied in the sorghum grain-medium, was mixed with the sterilized potting medium at the ratio of 19:1 w/w. The soil was placed in 15 cm diameter and 30 cm height's pots. Varuna(T-59), the susceptible variety of Indian mustard was sown in these pots with four replications. Seeds of rapeseed mustard were thickly sown in the pots @ 25 seeds per pot. The SAR elicitors Benzothiodaizole (100 ppm), Salicylic acid (100 ppm), oxalic acid(100 ppm), were tested by applying as seed soaking (for 30 minutes), foliar spray and seed soaking-cum-foliar spray.

**Table: 1**

| Elicitors of SAR | Conc. (ppm) | Seed soaking | | Foliar spray | | Seed soaking-cum-foliar spray | |
|---|---|---|---|---|---|---|---|
| | | Disease intensity (%)* | Per cent disease control | Disease intensity (%)* | Per cent disease control | Disease intensity (%)* | Per cent disease control |
| Bion® | 100 | 18.67 | 65.80 | 20.64 | 63.66 | 12.63 | 75.97 |
| Salicylic Acid | 100 | 24.51 | 55.10 | 26.76 | 52.90 | 19.75 | 62.41 |
| Oxalic Acid | 100 | 35.47 | 35.04 | 38.23 | 32.69 | 27.54 | 47.60 |
| Control | | 54.60 | 00.00 | 56.80 | 00.00 | 52.55 | 00.00 |

*Average of four replications

**Efficacy of SAR Elicitors in Different Applications**

**Seed Soaking**

Data in Table 1 reveals minimum disease intensity with Bion® (18.67%) followed by salicylic acid (24.51%) and oxalic acid (35.47) as compared to control (54.60%). Maximum reduction in disease intensity over control was osberved with Bion® (65.80%) followed by salicylic acid (55.10%) and oxalic acid (35.04%) over control. The minimum reduction in disease intensity was observed by oxalic acid (35.04%).

**Foliar Spray**

Data in table 1 reveals nearely similar trend of results as That of seed soaking. The highest reduction in disease intensity over control was observed in Bion® (63.66%) followed by salicylic acid (52.90%) and oxalic acid (32.69%).It was observed that foliar spray was comparatively less effective over seed soaking.

**Seed-cum-Foliar Spray**

Data in table 1 reveals that maximum reduction in disease intensity over control was observed in Bion® (75.97%) followed by salicylic acid (62.41%) and oxalic acid (47.60%). It was observed that Seed-cum-foliar spray was comparatively more effective strategy in controlling the disease intensity.

**Conclusion**

Three different SAR elicitors used in the present investigation were applied through seed soaking, foliar and seed-cum-foliar spray. In these treatments, seed soaking-cum-foliar spray of SAR elicitors was found most effective to control disease by reducing disease intensity, followed by foliar spray and seed soaking. All three abiotic SAR elicitors tested were capable in reducing the disease intensity significantly over the control. Bion® was most effective in reducing the disease intensity followed by salicylic acid and oxalic acid.

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