Studies on management of *Sclerotium rolfsii* Sacc. affecting *Zea mays* L. crop

SUMMARY OF THESIS

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SUMMARY

Zea mays seeds are nutritive and edible cereal enriched with carbohydrates, protein, minerals and vitamins (A, B, C, K). It is used as food sources for people and animals. It is short day with large grain and C_4 plant. The diversity of *Zea mays* plants were recorded in temperate zone in sandy soil during 2017-18. Plant density and cultivar was affected on morphological trait of *Zea mays* such as stem diameter and leaf length of the plant but plant height and number of leaf per plant was not affected. Soil borne fungus (*Sclerotium rolfsii*) affected the growth and yield production in *Zea mays*. The root-rot disease is caused by *S. rolfsii* in root of *Zea mays*. Apart from root-rot disease, *S. rolfsii* causes different types of diseases viz. collar-rot, *Sclerotium* wilt, seedling blight, damping-off of seedlings, stem canker, crown blight, crown, bulb rot, tuber rot, fruit rot, crown rot, systemic wilt or blight of whole plant, stem-rot, charcoal rot, foot-rot and stem blight. It also affected to other plants including tomato, chilli, maize, groundnut, sunflower, cucumber, brinjal, soybean, bean, watermelon.

The soil samples were collected from rhizospheric and non-rhizospheric region of healthy *Zea mays* plant from Jaunpur, Barabanki and Lucknow. The soil texture, temperature, pH, organic carbon and organic matter were analyzed from the soil samples. The highest sand particle (33.33%) was found in sample no. 4 compared to sample no. 1, 2 and 3. The maximum silt particle (38.09%) was recorded in sample no. 3 followed by sample no. 1, 2 and 4. The highest clay particle (41.67%) was in sample no. 2&4 and minimum clay particle (33.33%) was recorded in sample no. 3. The soil pH (9.34) was recorded in sample no. 2 followed by sample no. 1, 3 and 4. The maximum soil temperature (27.15^0 C) was recorded in sample no. 2 and

minimum temperature (24.23^0 C) in sample no. 4. These factors are also responsible for growth and development of soil mycoflora. The organic carbon and organic matter is an important part of soil, the maximum organic carbon (2.00%) and organic matter (5.79%) was recorded in sample no. 1 compared to sample no. 2, 3, 4.

Twelve soil mycoflora have been isolated from collected soil samples using serial dilution technique [1/1000 (10^{-3}), 1/10000 (10^{-4}), 1/100000 (10^{-5}) dilution]. The isolated soil mycoflora are *Aspergillus flavus, A. fumigatus A. luchuensis, A. niger, A. sydowii, Alternaria solani, Fusarium solani, Penicillium citrinum, Penicillium italicum, Penicillium* species, *Trichoderma viride* and white sterile mycelium, isolated from four soil samples. The rich fungal diversity was recorded in soil sample no. 1. The percent frequency and percent occurrence of *Aspergillus flavus* and *Aspergillus luchuensis* were highest compared to other soil mycoflora. *Sclerotium rolfsii* was isolated on potato dextrose agar (PDA) Petriplates from infected root of *Zea mays*. The pathogen produced cottony white mycelia on PDA Petriplate after one day, on the 5^{th} day cottony white mycelia changed into light brown and after seven days light brown mycelia changed into dark brown and become hard mustard seed like "sclerotia" (2-4 mm diameter) are formed which is a characteristic feature of *S. rolfsii*.

The pathogen grows around the *Zea mays* and enters into the root of the *Zea mays*. After infection, the crop growth was inhibited resulting in drying of the plant. Histopathological study of the infected root of the plants with Scanning Electron Microscope (SEM) showed ruptured xylem vessels. The bioagents viz. *Aspergillus flavus, A. niger, Trichoderma viride, Penicillium citrinum, P. italicum* and *Penicillium* sp. had antagonistic activity against mycelial growth of *S. rolfsii* on 3^{rd} day under *in vitro* condition. Among the selected test fungi, *T. viride* and *Penicillium* sp. were most

effective ($p \leq 0.05$) bioagents against *S. rolfsii* and inhibits the growth of *S. rolfsii* at different levels.

Three chemical fungicides viz. Myclobutanil 10% WP, Carbendazim 50% WP and Conika 50% WP, procured from local market of Lucknow, were tested against *S. rolfsii* using poisoned food technique. The fungicides were significantly ($P \leq 0.05$) effective against mycelial growth of *S. rolfsii* under *in vitro* condition on 3rd day. Myclobutanil 10% WP inhibited the growth by 77.16% at 100 ppm concentration while Conika 50% WP inhibited 70.57% mycelial growth of *S. rolfsii* at 600 ppm concentration on 3rd day. Carbendazim 50% WP inhibited 84.19% mycelial growth of *S. rolfsii* at 6 ppm concentration on 3rd day. We observed that Carbendazim 50% WP was most effective fungicide compared to Myclobutanil 10% WP and Conika 50% WP against *S. rolfsii* at different concentration on 1st, 2nd and 3rd day under *in vitro* condition.

The plants viz. *Azadirachta indica* (leaf), *Ocimum tenuiflorum* (leaf), *Syzygium aromaticum* (oil), *Tinospora cordifolia* (stem), *Trachyspermum ammi* (seeds) contained antifungal activity against *S. rolfsii*. The leaves extract of *A. indica* inhibited 79.65% mycelial growth of *S. rolfsii* at 75% concentration on 3rd day. At 75% concentration, the leaves extract of *O. tenuiflorum* inhibited 100% mycelial expansion of *S. rolfsii* on 3rd day. *Syzygium aromaticum* oil inhibited 100% growth of *S. rolfsii* at 400 ppm concentration on 3rd day. The stem extract of *T. cordifolia* showed antifungal activity against *S. rolfsii* and inhibited the growth by 100% at 75% concentration on 3rd day. *Trachyspermum ammi* seeds powder inhibited 100% growth of test fungus at 50% concentration on 3rd day. Among all the tested extract of medicinal plants, *S. aromaticum* and *T. ammi* inhibited the growth (100%) at 400 ppm

and 50% concentration respectively while *T. cordifolia* inhibited 100% growth at 75% concentration on 3rd day after inoculation. The extract of *S. aromaticum*, *T. ammi* and *T. cordifolia* were most significantly effective compared to *A. indica* and *O. tenuiflorum* at different concentration on 1st, 2nd and 3rd day.

The metabolite of fungal species viz. *Aspergillus flavus, A. niger, Trichoderma viride, Penicillium citrinum, P. italicum* and *Penicillium* sp. were significantly effective against *S. rolfsii* on 3rd day under *in vitro* condition. Amongst all metabolites of test fungi, *A. flavus* inhibited the growth of test fungus by 70.04%, followed by *A. niger* (76.52%), *T. viride* (76.63%), *P. citrinum* (100%), *P. italicum* (100%) *Penicillium* sp (68.14%) at 75% concentration on 3rd day. The metabolite of *P. citrinum* and *P. italicum* were significantly effective to inhibit the growth compared to *A. flavus, A. niger, T. viride* and *Penicillium* sp. at 10%, 25%, 50%, 75% on 1st, 2nd and 3rd day.

The composite *O. tenuiflorum*+Myclobutanil 10%WP and *O. tenuiflorum*+*T. viride* inhibited 100% mycelial growth of *S. rolfsii* at 50%+50 ppm and 50%+50% concentration respectively on 3rd day. At 75 %+100 ppm and 75 %+100ppm+75 % concentration the composite *T. viride*+Myclobutanil 10%WP and *T.viride* +Mycobutanil 10%WP+*O. tenuiflorum* inhibited 100 % mycelial growth of *S. rolfsii* on 3rd day after inoculation under *in vitro* condition.

Sclerotium rolfsii was treated with bioagent, plant extract and chemical fungicide at different concentration against *S. rolfsii* in pot experiments. The bioagent and plant extract were most significantly and ecofriendly effective compared to chemical fungicide under *in vivo* condition. The treatment with myclobutanil 10% WP showed 100% healthy plant at 1000 ppm v/w on 30th day while on 50th day, 30%

plants were infected from disease and 70% plants were healthy with shoot length (46.33 cm), root length (17.67 cm), fresh weight (80 gm), dry weight (30 gm) at 1000 ppm concentration compared to 200 ppm, 600 ppm under *in vivo* condition. In treatment with leaf extract of *O. tenuiflorum* at 3% v/w concentration, 100% healthy plants were recorded on 30^{th} day while on the 50^{th} day, 20% plants were unhealthy and 80% plants were healthy under *in vivo* study. The healthy plants recorded shoot length (52.33 cm), root length (19.67 cm), fresh weight (93.67 gm), dry weight (34 gm) at 3% v/w concentration, while in case of *T. viride* at 4% w/w concentration, 100% healthy plants were recorded on both 30^{th} and 50^{th} day after inoculation and their shoot length (61.67 cm), root length (25.33 cm), fresh weight (98 gm), dry weight (33.33 gm) were more developed under *in vivo* condition.

The treatment with composite *T. viride*+Myclobutanil 10% WP, *O. tenuiflorum*+Myclobutanil 10% WP *T. viride+O. tenuiflorum* showed 100% healthy plants at 4%w/w+1000ppm v/w, 3%v/w+1000ppm v/w, 4%w/w+3%v/w concentration on 30^{th} and 50^{th} day respectively with healthy shoot length, root length, fresh weight, dry weight. At 4%w/w+3%v/w+ 1000ppm v/w concentration, composite *T. viride+O. tenuiflorum*+Myclobutanil 10% WP showed 100% healthy plants with shoot length (90cm), root length (52.33cm), fresh weight (147.33gm), dry weight (65.67gm) on 30^{th} and 50^{th} day under in pot experiment.

In histopathological study, the T. S. of root & stem of infected *Zea mays* plants images was taken with SEM and showed that the xylem vessels of root and stem were ruptured from *S. rolfsii*.