

## Evaluation of sugar beet (*Beta vulgaris* L.) genotypes for resistance against root rot caused by *Sclerotium rolfsii*.

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### Abstract

Eleven sugar beet genotypes were evaluated at National Agricultural Research Centre, Islamabad, Pakistan, during the year 2009 for their resistance against root rot caused by *Sclerotium rolfsii*. The fungus was isolated from infected beet root, purified and maintained on Potato Dextrose Agar at 4°C for further experimentations. Mass culturing of pathogen was prepared through sorghum seed inoculum technique. Inoculation of eleven genotypes with *S. rolfsii* exhibited resistant response only in SD-PAK-09/07 and moderately resistance in SD-PAK-07/071. The remaining nine genotypes showed susceptible to highly susceptible response to the pathogen.

**Key words:** Root rot, *sclerotium rolfsii*, sugar beet.

### Introduction

Sugarcane and sugar beet are two important crops for sugar production in Pakistan. Sugar beet, being a short duration and low delta crop, has potential to substitute sugarcane in areas where irrigation water is limiting factor for sugarcane cultivation. Therefore, the recent shortfall of sugar in the country has called the attention of policy makers to either grow sugar beet to supplement or replace sugarcane in the country (Majid and Shakoor, 2006). There are a number of soil borne fungal pathogens that are responsible for poor establishment and yield loss in sugar beet crop (Harveson and Rush, 1998; Kiewnick *et al.*, 2001; Weiland and Sundsbak, 2000) and reduction in yield (Harveson and Rush, 2002; Windels and Lamey, 1998).

*Sclerotium rolfsii* Sacc. (teleomorph: *Athelia rolfsii* (Curzi) Tu & Kimbrough) is one of those soil borne plant pathogenic fungi that are prevalent in warm temperate and subtropical regions of the world (Punja *et al.*, 1985). This pathogen has a host range of over 500 plant species mostly of dicotyledonous plants. A wide range of symptoms are produced by this pathogen on its hosts including crown and root rot, stem canker and damping-off and resulting diseases are southern wilt, blight or stem rot (Punja, 1988).

In Pakistan, Ahmed *et al.* (1984) reported for the first time *S. rolfsii* on maize (*Zea mays*). The fungus was subsequently reported from oat (*Avena sativa*) and mash bean (*Vigna mungo*) (Shahzad

and Ghaffar 1995), apple (*Malus sylvestris*) (Jahangir *et al.*, 1995), lentil (*Lens culinaris*) (Iqbal *et al.*, 1995) and seeds of sugar beet (*Beta vulgaris*) (Ruqia, 2001). Yaqub and Shahzad (2005), in a study on eight different plant species reported that sugar beet, sunflower, mungbean and tomato showed greater Root Colonization Index (RCI) for *S. rolfsii* as compared to lentil, sweet pumpkin, cabbage and cauliflower.

The present study was undertaken in 2009 to evaluate different sugar beet genotypes for their resistance against southern *sclerotium* rot (beet root rot) at Pathology Laboratory of Sugar Crops Research Program, National Agricultural Research Centre, Islamabad, Pakistan.

### Materials and Methods

Typical infected beet root were collected and placed in a moist chamber at 25°C. Besides this the collar portion of the infected plants were cut in 3-5 mm thick tissue sections and sterilized with 1% sodium hypochlorite solution for two minutes, rinsed thrice in sterilized distilled water (SDW) and dried on sterilized filter paper at room temperature. The tissue sections were then placed on potato dextrose agar (PDA) amended with 100 µg/ml streptomycin sulphate and incubated at 25°C for fifteen days. The pure culture of the pathogen was isolated and subsequently maintained on PDA.

The mass culture of the pathogen was prepared through sorghum seed inoculum technique. The sorghum seeds were steeped in water for 48 hrs, autoclaved for 45 min at 120°C. Disks (5 mm diameter) from actively growing edge of pure culture were used to inoculate 50 g of sorghum seeds. The inoculated seeds were incubated for 15 days at 27 °C. For testing the pathogenicity, plastic bags filled with sterile medium loam filed soil were kept in paper bags and autoclaved for two hours. Small plastic pots were filled with sterilized soil, inoculated with sorghum seeds. Seeds of sugar beet genotypes were sowed in those pots and a set of pots filled with sterilized soil was planted with all the eleven genotypes served as control. Five seeds per pot of each genotype were sown and treatments were replicated thrice. The pots were kept under controlled environmental conditions with relative humidity near 100% at 25°C. Pots were regularly monitored for disease development. The data was recorded on 15<sup>th</sup> day after germination and reaction of test genotypes was studied on the basis of following 0-7 scale, where;

- 0= Healthy: no visible lesions
- 1= Small: rot in center of crown
- 2= Moderate: Rot affecting no more than 5% of root tissue
- 3= Deep: rot affecting no more than 25% of root tissue
- 4= Extensive: rot affecting 26-50% of root tissue
- 5= From more than 50-75% of root rotted
- 6= Entire root rotted and most foliage dead
- 7= plant dead, 100% rotted

On the basis of rating according to above mentioned scale all test genotypes were placed in following four categories.

- R= Resistant with scores of 1-3
- MR= Moderately Resistance with scores 3-4
- S= Susceptible with scores 5-6
- HS= Highly Susceptible with score 7.

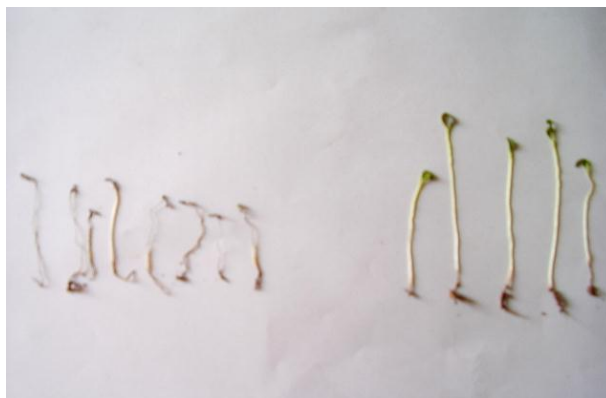
## Results and Discussion

Soil infested with *S. rolfisii* exhibited mycelial growth on soil surface and around some of the seedlings after 10<sup>th</sup> day of inoculation. In severely infected seedlings, soft watery rot symptoms and brown lesions advanced up to three cm above the soil level appeared at the collar region (Fig 1). On the lesions, white mycelial growth having white and brown sclerotia depending on the maturity was observed. The seedlings of highly susceptible genotypes were killed within 10-15 days.

Of the eleven test genotypes, only SD-PAK-09/07 showed resistance, one SD-PAK-07/07 found moderately resistant, two genotypes SD-PAK-12970 and SD-PAK-01/07 were found susceptible and remaining seven were highly susceptible to southern *sclerotium* rot (Table 1). It has been documented that secretion of oxalic acid and other degrading enzymes by *S. rolfisii* cause disintegration and killing of host tissue. Plant found resistant to hyphal invasion and infection to *S. rolfisii* may contain high level of calcium and oxalic acid oxidase that help to endure the action of oxalic acid and cell wall degrading enzymes by the action of fungus (Punja *et al.*, 1985). Lawlor and Doxtator (1950) determined distinction among genotypes in term of survival rate and recommended that breeding efforts could successfully produce southern *sclerotium* rot resistant cultivars.

**Table 1:** Reaction of sugar beet genotypes against *Sclerotium* root rot.

| S. No. | Name of Variety | Reaction with root rot |
|--------|-----------------|------------------------|
| 1.     | SD-PAK-04/06    | HS                     |
| 2.     | SD-PAK-12970    | S                      |
| 3.     | SD-PAK-09/07    | R                      |
| 4.     | SD-PAK-03/06    | HS                     |
| 5.     | SD-PAK-01/07    | S                      |
| 6.     | SD-PAK-07/07    | MR                     |
| 7.     | MIRABELLA       | HS                     |
| 8.     | CALIFORNIA      | HS                     |
| 9.     | MAGNOLIA        | HS                     |
| 10.    | ERNSTINIA       | HS                     |
| 11.    | SANDRINA        | HS                     |



**Fig 1:** Comparison between rotten/wilted (left) and healthy (right) seedlings of sugar beet.

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