Root Exudate Effect on Germination and Mycelial Growth of Sclerotia of *Sclerotium rolfsii* Sacc

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Abstract

The effect of some root exudates on the germination and mycelial growth of sclerotia of Sclerotium rolfsii Sacc. was studied. Root exudates of 5 – 10 days old seedlings from five plants viz: - tomato (Lycopersicum esculenta) maize (Zea mays), garden egg (Solanum melongena), pigeon pea (Cajanus cajan), and pepper (Capsicum annum) were employed for this study. The results showed that exudates from maize, tomato and pigeon pea root seedlings stimulated the germination of sclerotia of S. rolfsii while that of pepper and garden egg inhibited their germination. The age of seedlings of these plants studied had effect on the production and or potency of the root exudates in promoting or inhibiting the germination of sclerotia of S. rolfsii.

Keywords: Root exudates, Germination, Mycelial growth, Sclerotia, *Sclerotium rolfsii*

Introduction

The liberation of organic substances or chemicals by roots of growing plants is of considerable agricultural and biological interest. These librated organic substances by plant roots are termed root exudates and they play vital role in the selection and feeding, entry sites and in activating free-living stages of soil micro-flora (Rovira, 1965). Plants are in constant contact with a community of soil biota that contains saprophytic, parasitic and symbiotic fungi (Broeckling et al. 2008). The relationship between plant root exudates and increased microbial activity around roots had been recognized for years (Scroth, 1964). It is generally accepted that the main factor for the stimulation of micro-organisms in the rhizosphere is the secretion of organic substances by plant roots.

Some of the major substances exuded by plant roots include amino acids, simple sugars, glycosides, organic acids, vitamins, enzymes, alkaloids, nucleotides and other inorganic ions. This exudate which contains numerous compounds had great influence in the germination of spores and sclerotia or conidia of fungi (Rovira, 1965). Most soil borne plant pathogens are inactive in the soil but may be stimulated into activity or inhibited from growth by exudation from plant roots (Odunfa, 1981). Root exudates in cowpea and Sorghum and the effect on spore germination and growth of soil *Fusaria* has earlier been studied by Odunfa (2006), and he found out that exudates from the roots of both species enhanced the germination of conida of four *Fusarium* species previously isolated from the rhizosphere and rhizoplane. The germ tubes and some conida were lysed by cowpea exudates in 48 hours.

Sclerotium rolfsii is one of the fungi that cause several plant diseases. Among the important diseases caused by *S. rolfsii* are the basal stem rot, root rot diseases of several crops, damping off disease of seeding etc (Odunfa, 1981). The occurrence of *S. rolfsii* is ubiquitous in the soil and its ecological success can partly be attributed to its ability to parasitize a wide range of host plants or to grow extensively on dead organic matter and form masses of resistant sclerotia during unfavourable condition (Maduewesi, 1984). Any nutritional factor which has influence on this fungi or its ability to produce sclerotia would affect its growth and survival in the soil (Maduewesi, 1984).

It is the aim of this study to examine the effect of exudates from roots of some plant seedlings on the germination and mycelial growth of sclerotia of *Sclerotiom roflsii*.

Materials and Methods

Seedlings of five crop plants were employed for this study. The crops were common garden egg (*Solanum melongena* (L.)), pigeon pea (*Cajanus cajan* (L.) Mulls), pepper (*Capsicum annum* (L.) tomato (*Lycopersicum esculeuta* (L.) and maize – (*Zea mays* Linn.). Root exudates of 5 – 10 days old seedlings of the above mentioned plants were collected using standard method of collection of host root exudates (Vasu deva-Rao, 1985). This involves the dipping of thoroughly washed root of seedlings of the above plants in 25mls of double distilled water in the text tube rapped with black polyethylene paper or black cloth and using cotton wool to hold the seedlings in position. For maize, five seedlings per test-tube were immersed while for garden egg, tomato, pepper and pigeon pea with smaller seedling sizes, ten seedlings were immersed in each test-tube. The seedlings were left for two days before collecting the root exudates. The exudates so collected were sterilized using Morton's Sintered glass bacteriological filter.

The sterilized exudates were immediately used to avoid denaturation. 5 mls of the filtered exudates were introduced on water agar contained in Petri-dishes maintained at a temperature of 29 ± 2^0C and thoroughly mixed in the petri-dishes.

Twenty sclerotia of *S. rolfsii* per petri-dish were inoculated. The inoculation was carried out in Laminar Air flow chamber. Five petri-dishes per seedling root exudates were set up in each petri-dish making up 5 – replicates.

Table I: Effects of root exudates on percentage germination of sclerotia of *S. rolfsii*

Plant seedling	Time (hours) after inoculation							
	6	**12**	**18**	**24**	**30**	**36**	**42**	**48**
Tomato (*Lycopersicum esculenta*)	0±0.00	0±0.00	52±3.12	77±2.17	85±2.44	100±0.00	100± 0.00	100±0.00
Maize (*Zea mays*)	0±0.00	0±0.00	65±2.16	78±2.31	82±3.18	100±0.00	100± 0.00	100±0.00
Pigeon pea (*Cajanus cajan*)	0±0.00	0±0.00	60±2.24	74±1.15	80±2.68	100±0.00	100± 0.00	100±0.00
Garden egg (*Solanum melongena*)	0±0.00	0±0.00	4±0.16	10±1.12	14±2.25	18±2.13	22±1.0 5	25±1.12
Pepper (*Capsicum annum*)	0±0.00	0±0.00	2±0.12	6±0.50	8±1.10	10±1.58	12±1.62	12±1.43
Control	0±0.00	0±0.00	18±1.32	29±2.45	35±2.30	42±2.71	55±2.23	78±2.23

For the control, 5 mls of deionized distilled water was introduced on water agar and the same number of sclerotia per petri-dish was inoculated.

At twelve hourly intervals, the number of the germinated sclerotia wees determined by direct counting. A sclerotium was said to have germinated when the length of the germ tube was equal to or greater than the diameter of the sclerotium. The radial growth of the mycelia formed was also measured by taking the vertical and horizontal diameters and dividing the total by two (mean). The above investigation on the germination of the sclerotia of *S. rolfsii* was repeated using seedling of one, two, three, four, five and six weeks old plant respectively. All the results obtained from different parameters investigated were statistically analyzed using analysis of variance (ANOVA).

Results

The results of the study showed that exudates from the seedling roots of crop had marked effect on germination of sclerotia of *S. rolfsii*. The mean percentage germination of sclerotia of *S. rolfsii* was very high when root exudates from seedling roots of maize, tomato and pigeon pea were applied when compared with that of the control where ordinary distilled water was applied. Root exudates from pepper (*Capsicum annum*) and garden egg (*S. melongena*) however significantly (P = 0.05) inhibited the germination of sclerotia of *S. rolfsii* (Table 1). When compared with the control, the mean percentage germination of sclerolia of *S. rolfsii* was less when pepper and garden egg root exudates were applied. Among the sclerotia treated with tomato, pigeon pea and maize root exudates, the germination started after the 12th hour and before the 24th hour, more than 70% of the sclerotia have germinated. Percentage germination of sclerotia treated with pepper and garden egg root exudates was less than 15% after 24hrs compared with 29% germination recorded in the control.

This investigation again showed that crop root exudates affected the mycelial growth of *S. rolfsii*. The mycelial growth was highest in those treated with maize and closely followed by tomato and pigeon pea root exudates. There was little or no growth of the mycelia in the control and those treated with pepper and garden egg root exudates (Fig. 1).

The results of this investigation generally showed that the crops employed produced root exudates which proved very potent in promoting the germination of the sclerotia of *S. rolfsii* between the ages of 14 – 24 days (i.e. 2nd to 3rd week) (Fig. 2). Root exudates collected from all the plants investigated proved very poor in promoting the germination of the sclerotia after the 3rd week. However, the exudates collected between the 2nd and 3rd week in tomato proved most potent in promoting the germination of the sclerotia and this is closely followed by that of the maize and pigeon pea.

Discussion

Various studies have shown the effect of exudates from roots of plants on the germination of fungal prop gules (Rovira, 1965; Eze and Igbinosa, 1990; Odunfa, 1981; 2006). The result of this study showed that the germination of sclerotia of *S. rolfsii* can either be promoted or inhibited by exudates from seedling of plants. While exudates from roots of some plant seedling promoted the germination and mycelial growth of sclerotia of *S. rolfsii*, others inhibited both the germination and mycelial growth.

In this study, exudates from tomato, maize and pigeon pea gave a stimulatory or promoting effect on the germination and mycelial growth of sclerotia of *S. rolfsii* while exudates from pepper and garden egg gave inhibitory effect. It is possible that exudates from tomato, maize and pigeon pea root seedlings might possess some germination and growth stimulatory substances while exudates from roots of pepper and garden egg seedlings do possess inhibitory substances. Earlier, Rovira (1965) stated that root exudates possess commonly occurring substances like amino acids, inorganic acids and sugars which differ greatly among species of plants and these compounds can lead to stimulatory or inhibitory effect on the germination and growth of fungi. Odunfa (1981) observed that *S. rolfsii* requires specific substances for growth and are therefore host specific.

It is possible that the sclerotia of *S. rolfsii* and other soil borne plant pathogens require these organic and inorganic substances or compounds for their germination and growth.

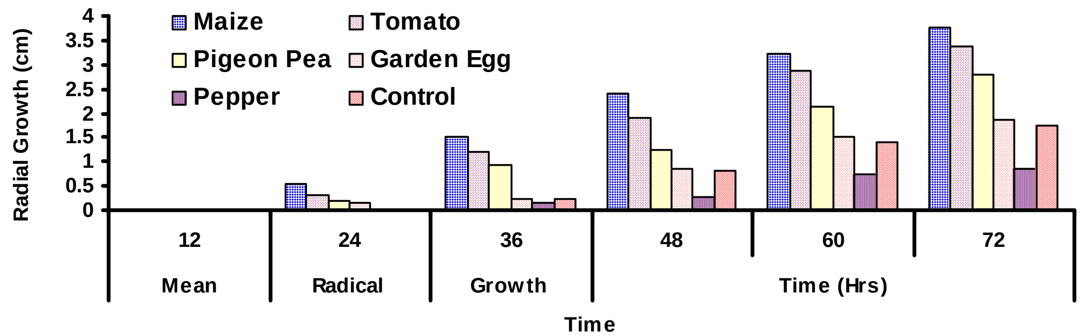

Fig. 1: Radial growth of mycelia of S. rolfsii with time

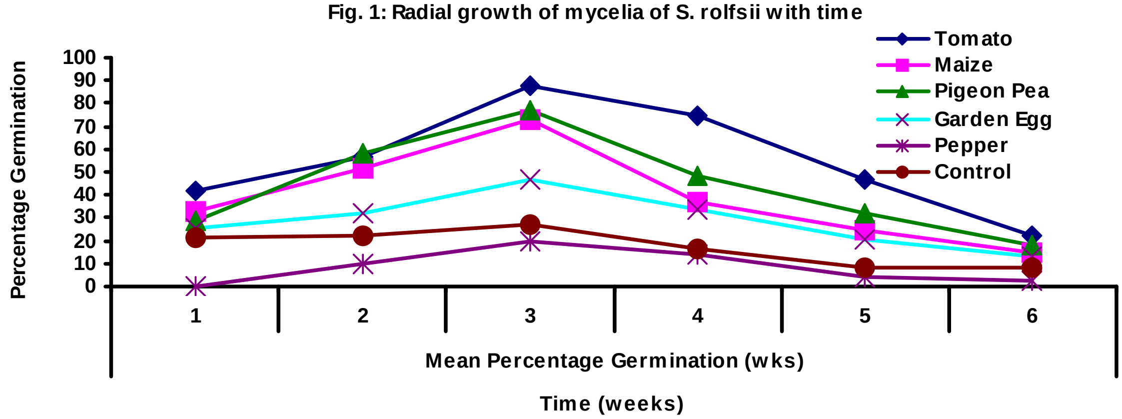

Fig. 2: Effect of seedling age on germination of Sclerotia of *S. rolfsii*

It is known that organisms require sugars as carbon source for their energy and amino acids for their cell division. The sclerotia must be utilizing the materials contained in the exudates which might be sugars and amino acids. These must have helped the physiological activities taking place in their cells causing rapid cell division and multiplication leading to stimulation of germination as all other factors necessary for germination were available and also their subsequent mycelial growth. It is possible that pepper and garden egg produce root exudates that contained some inhibitory substances or that the amount of sugars and amino acids contained in their exudates were very low in concentration.

The results of this study also showed that the age of plant have serious effect on the production of root exudates and possibly the potency of the exudates in promoting or inhibiting the germination and growth of the fungal propagules. Mehrola and Kakkar (1972) notice a reduction in the number of fungal growth after seedling stage of some vegetable crops. A number of workers also observed a progressive increase in the fungal population in the rhizosphere of plant roots up to the flowering stage and subsequent decrease thereafter.

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