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Minimization of Stem rot incidence of Groundnut with plant spacing and fungicides application

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A field experiment was conducted to minimize the Stem rot incidence caused by *Sclerotium rolfsii* in naturally infested field with integration of different plant spacing and fungicides. High incidence of stem rot was observed with increase in plant population due to rapid disease spread in closely spaced plots. The disease incidence increased from 4.5 to 24.1% with increasing plant stand ranging from 22.22 to 67.67 per square meter for both fungicides and non-treated plots. Plot having widest spacing of 15 cm x 30 cm had almost half disease incidence than closely spaced plot. Groundnut pod yield over plant stand was best fit to a polynomial curve for non-treated and treated plot (R^2 0.87). Highest pod yield (3.412 kg/plot) was recorded in plot having spacing of 15 cm x 20 cm and treated with pyraclostrobin as compared to 1.765 kg per plot in 10 cm x 15 cm spaced non-treated plot.

Key words: Fungicides, groundnut, plant spacing, *Sclerotium rolfsii*, stem rot

INTRODUCTION

Stem rot of groundnut caused by *Sclerotium rolfsii* Sacc., a necrotropic soil borne fungus, is one of the serious diseases of groundnut in India (Kumar *et al*. 2013). Disease is more severe particularly in kharif groundnut in the major groundnut producing states namely Gujarat, Maharashtra, Madhya Pradesh, Odissa and Tamil Nadu etc. The primary symptoms are browning and wilting of leaves and branches which are still attached with the plant. This fungus produces a fluffy white mycelium that is always seen at the crown of its host. Under favorable condition pathogen can infect any parts of susceptible host including stem, root, peg and pods. The pods, which are produced below the soil surface, come in contact with the fungi more easily causing pod rot symptoms. The pathogen is distributed throughout tropical and subtropical areas due to presence of warm and humid climatic condition. Sclerotia which act as resting structure play an important role in primary source of inoculum and germinate in the presence of volatile compounds from decaying organic matter at temperature of 27-30°C. In warm and high moisture condition, the occurrence of stem rot usually coincides with early stages of peg and pod development.

The manipulation of plant density to check the development of soil borne fungal diseases in groundnut has been reported. Research has also been conducted to study the effect of spacing, seed rate and as well as row pattern on stem rot development. Stem rot incidence increased and tomato spotted wilt virus incidence decreased at higher seeding rate in runner type variety sown in single row pattern. The management of stem rot of groundnut is particularly complex because of sclerotia that can survive in soil for long periods, frequently tolerating biological and chemical degradation due to the presence of melanin in the outer membrane . Methods employed to manage *S. rolfsii* are fungicides application, soil solarization, use of antagonistic microorganisms, deep ploughing, crop rotation, and incorporation of organic and inorganic residues, etc. Nevertheless, management of the disease in the field is still challenging due to the absence of profitable rotational crops, un-decomposed previous crop residues in the field act as substrate for the fungal growth, tolerance of the pathogen to the fungicide and non-availability of resistant varieties to the groundnut growers, etc (Thirumalaisamy *et al.* 2014). Fungicides with curative activity such as quinine outside inhibitor (QoI), like azoxystrobin,

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pyraclostrobin, etc sterol biosynthesis inhibitor (SBI) like tebuconazole and prothioconazole or benzamides i.e. flutolanil are effective against stem rot of groundnut (Augusto and Brenneman, 2011; Jash and Sarkar, 2017, Jash *et al*. 2018). The objective of this experiment is to minimize the stem rot incidence in naturally infested plot with integration of different plant spacing that restrict the plant stand and fungicides.

MATERIALS AND METHODS

The field experiment was conducted to evaluate development of stem rot of groundnut by adjusting plant spacing along with fungicides during the *kharif* wet season of 2018 at Regional Research Station (RRS), Bidhan Chandra Krishi Viswavidyalaya, Jhargram, West Bengal. The variety TAG 24, popular in this zone, was used as test crop. All plots were naturally infested with stem rot as they had a history of stem rot incidence in previous groundnut crop. The experimental design was split plot where five spacing were in main plot and three fungicides like tebuconazole, azoxystrobin, pyraclostrobin along with non-treated control were in sub plot treatments. All treatments are replicated three times. Seeds were sown in 12 m^2 (4m x 3m) plot with five different level of spacing i.e. 10 cm X 15 cm, 15 cm X 15 cm, 15 cm X 20 cm, 20 cm X 20 cm, 15 cm X 30 cm with plant population of 67.67, 44.44, 33.33, 25, and 22.22 per square meter, respectively. Gap filling was done to maintain the proper plant stand in each plot after 10 days. The well decomposed FYM at the rate of 10 ton /ha was applied during land preparation. The recommended fertilizer dose i.e. 8:24:32 kg as N, P_2O_5 and K_2O/ acre, respectively, was applied as a basal and 8 kg N/acre was top-dressed at the time of earthing up. Gypsum @ 100kg/acre was applied after first earthing up. The spray schedule was started next day of first appearance of disease symptoms. All the fungicides were sprayed at 60, 75 and 90 days after sowing. Disease incidence in each plot was recorded at harvest. The details of fungicides used in the present experiment are mentioned in Table 1. SPSS (IBM, v 16.0) was used to perform analysis of variance with GLM procedure. Means were compared and separated at significance level of p=0.05 according to Fisher protected least significance difference. The best fitted line was drawn by non linear regression analysis.

RESULTS AND DISCUSSION

High incidence of stem rot was observed with increase in plant population in closely spaced plots (Fig 1a). Stem rot incidence over plant stand was best fit to a polynomial model in both non-treated (R^2 0.99) and fungicides treated plots (R^2 0.98). The disease incidence increased from 4.5 to 24.1% with increasing plant stand ranging from 22.22 to 67.67 per square meter for both fungicides and non-treated plots. The disease incidence was more than double in non-treated plots as compared to plot treated with fungicides. Plot with lowest spacing of 10 cm x 15 cm had greater stem rot incidence (24.1%) in non-treated plot as compared to 11.6, 12.2 and 12.5% in pyraclostrobin, azoxystrobin and tebuconazole treated plot, respectively. Plot having widest spacing of 15 cm x 30 cm had almost half disease incidence than more closely spaced plot. Groundnut pod yield over plant stand was best fit to a polynomial for non-treated (R^2 0.76) and treated plot (R^2 0.87). Highest pod yield (3.412 kg/plot) was recorded in plot having spacing of 15 cm x 20 cm and treated with pyraclostrobin as compared to 1.765 kg per plot in 10 cm x 15 cm spaced non-treated plot (Fig 1b). Groundnut yield increased in closely spaced plot treated with fungicides having high plant stand. The result of the present investigation showed that stem rot incidence are higher on plot where plant sown close together. However, the slope varied across the location and years and was influenced by cultural practices and soil moisture (Augusto *et al*. 2010). Secondary root to root and above ground plant to plant contact is greater in densely planted plot and a plant bridge may permit pathogen to spread and affect more plant continuously. In closer plant spacing more plants are within the distance that mycelium of *S. rolfsii* can move easily from an infected plant. After a certain wide spacing between plants, the effect of increased spacing is reduced. The reason behind the increasing stem rot disease with increase in plant densities is possible due to the fact that the effect of plant density is due to changes in environmental conditions within the canopy or even susceptibility of individual plants to infection. In the present experiment yield initially increased with increasing low plant spacing and then decreased at densely spaced plot. It is reported that Virginia-type cultivars showed no responses to increased density above 88000 plants/ha, while maximum yield of Spanish type cultivar was recorded at 352000 plants/ha.

Table 1 : Fungicides used in this experiments

Fungicides	Formulation	Rate of application	Chemical group	Site of action	Mode of transport
Tebuconazole	25.9%EC	1.5ml/l	Triazoles	Sterol biosynthesis inhibitors	Acropetal
Azoxystrobin	25% SC	1ml/l	Methoxy acrylates	Quinone outside inhibitors	Acropetal
Pyraclostrobin	20%WG	1gm/l	Methoxy carbamates	Quinone outside inhibitors	Acropetal

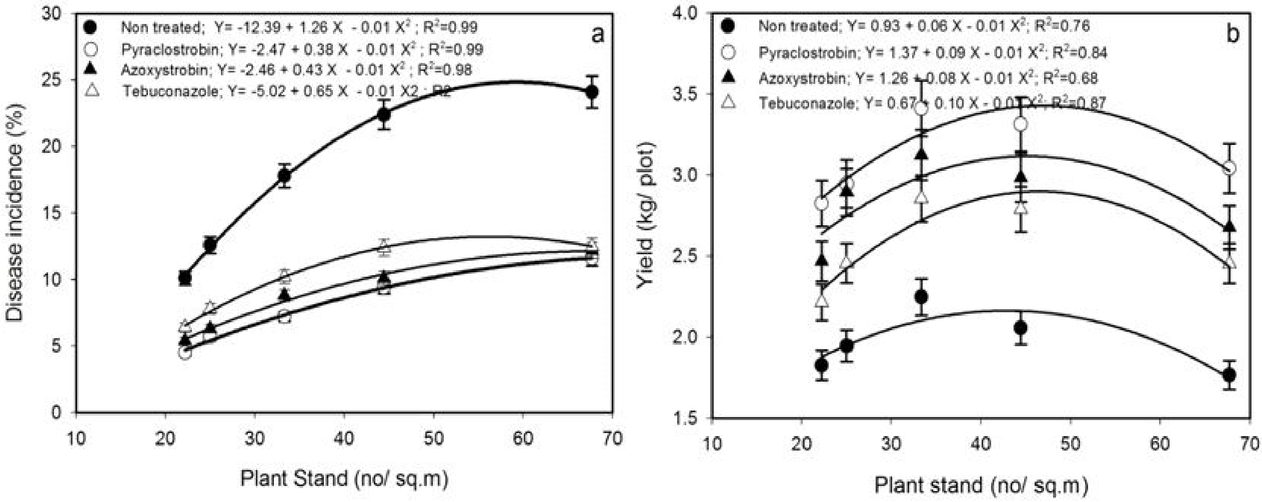

Fig. 1 : Effect of plant stand due to different spacing on stem rot incidence **(a)** and groundnut pod yield **(b)**

There are many reports of foliar spray of fungicides for managing soil borne diseases like stem rot of groundnut (Jadon *et al*. 2015; Jash and Sarkar, 2017; Jash *et al*. 2018). In the present investigation, results of foliar spray with SBI and QoI fungicides showed very good result as compared to control. Johnson and Subramanyam (2010) reported that seed treatment with hexaconazole showed the maximum reduction of stem rot (24.0%) in groundnut. When the cultivar with partial resistance to leaf spot and stem rot are used in combination with fungicides, azoxystrobin showed excellent result (Hagan *et al.* 2010). Augusto and Brenneman (2011,2012) assessed systemicity of peanut fungicides through bioassay of plant tissues against *S. rolfsii* and found acropetal protection by all fungicides and concluded that prothioconazole + tebuconazole or prothioconazole applied to foliage can sometimes reduce diseases in the lower, non-treated portions of the plant. Application of pyraclostrobin 20%WG @ 1000g/500 lit of water gave best result in controlling leaf spot of groundnut as well as produced highest pod yield (Jash *et al*. 2018). However, the site specific mode of action of pyraclostrobin indicates a high potential for development of resistance, as do QoI fungicides in general.

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