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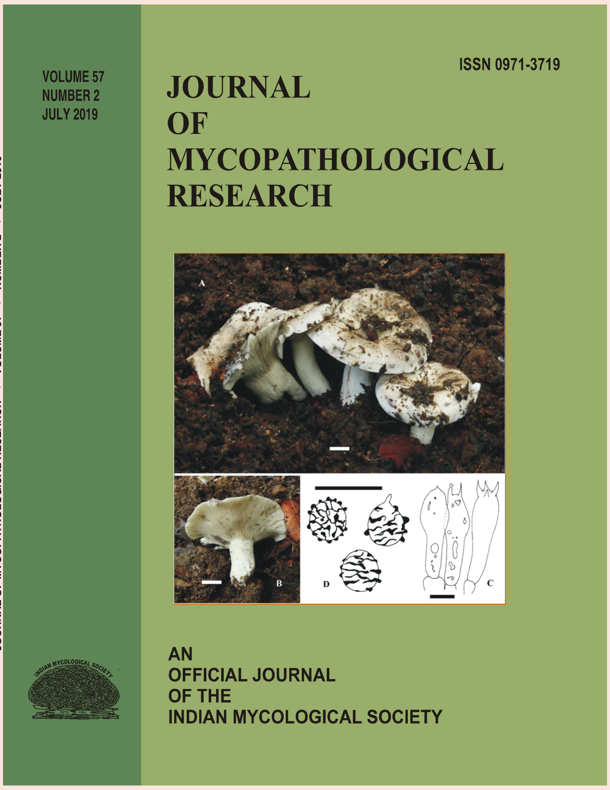

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The field experiments were conducted to determine the effect of plant spacing on stem rot development caused by *Sclerotium rolfsii* and evaluation of some curative fungicides for management. Stem rot incidence and severity decreased as plant spacing were increased. Low disease incidence and severity was recorded in a plot having a spacing of 15 cm x 30 cm whereas yield was highest in plot having spacing of 20 cm x 20 cm. Seed treatment and foliar application of pyraclostrobin @ 1g/l showed lowest disease incidence at harvest and as well as highest pod yield.

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

INTRODUCTION

Stem rot, also known as Sclerotium blight, Sclerotium rot, Sclerotium wilt, southern blight, southern stem rot, root rot, white mould and pod rot, caused by *Sclerotium rolfsii* Sacc., a necrotropic soilborne fungus, is one of the serious diseases of groundnut in India (Kumar *et al*. 2013; Doley and Jite, 2013). The disease is more severe particularly in *kharif* (wet)groundnut in the states of Gujarat, Maharashtra, Madhya Pradesh, Odisha and Tamil Nadu and causing yield losses up to 40% in India. 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 favourable 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 and produces sclerotia as resting structure that play an important role in primary source of inoculum. Sclerotia germinate in the presence of volatile compounds from decaying organic matter at temperature of 27-30°C. The fungal mycelia colonize plant debris or other organic matter before infecting living plant tissue. Any part of the groundnut plant that comes in contact with the soil is infected with fungus. 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 on development of soil borne fungal diseases in groundnut has also been reported. Continuous infection within a row or small foci of diseased plants may be scattered throughout the field. 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

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S. rolfsii are fungicides application, soil solarization, use of antagonistic microorganisms, deep ploughing, crop rotation, and incorporation of organic and inorganic residues. Nevertheless, management of the disease in the field is still challenging due to the absence of profitable rotational crops, a lack of fresh tillable land, poorly structured farm programmes, 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 (Thirumalaisamy *et al*. 2014). Spraying of fungicide, preferably protectant is initiated approximately 50 days after sowing and subsequent applications are made at 15 days interval depending upon the intensity of foliar disease. The chlorothalonil, broad spectrum protectant fungicide with no curative activity, has been used intensively as spray prior to infection in order to ensure maximum control of the late leaf spot disease but not effective against stem rot (Jash *et al*. 2018). Fungicides with curative activity such as quinine outside inhibitor (QoI), like azoxystrobin, pyraclostrobin, etc sterol biosynthesis inhibitor (SBI) like tebuconazole and prothioconazole or benzamides i.e. flutolanil are effective against stem rot of groundnut (Kemerait,*et al.* 2010; Agusto and Brenneman, 2011; Jash and Sarkar, 2017). The biochemical mode of action of QoI fungicides is to block electron transport at quinol-oxidizing site of the cytochrome bc1 complex (Complex III) in mitochondrial respiratory chain, thus halting synthesis of adenosine triphosphate. The objective of this experiment is to study the effect of plant densities on development of disease and its management by application of proper fungicides.

MATERIALS AND METHODS

The field experiment was conducted to evaluate development of stem rot of groundnut by manipulating plant spacing during the *kharif*(wet) season of 2017 and 2018 in randomized block design with four replications in subtropical climatic condition of West Bengal 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. Seeds were sown in 12m^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 800, 533.3, 400, 300, and 266.7, respectively. All seed are treated with captan @ 2.5g per kg of seeds before sowing. 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 @ 100 kg/acre was applied after first earthing up. The pathogen, *S. rolfsii*, isolated from groundnut plant was grown and maintained on potato dextrose agar at 25°C. For field application, it was multiplied on autoclaved sorghum grains for 15 days. At 30 days after sowing each plot was inoculated with pathogen mass multiplied on sorghum grain @ 20 g per plot and covered with wheat straw. Disease incidence in each plot was recorded at harvest and severity was recorded at 120 days after sowing using modified version of severity scale, where 0 = no disease, 1= 0 to 5% infection, 2 = 5 to 25% infection, 3 = 25 to 50% infection, 4 = 50 to 75 % infection, and 5 = 75 to 100% infection based on following formulae.

$$PDI = \frac{\text{Sum of all numerical rating}}{\text{Total number of observation} \times \text{Maximum rating}} \times 100$$

A separate experiment was conducted to determine the response of different application strategies i.e. seed treatment before sowing and foliar spray of three fungicides on stem rot of groundnut. The variety TAG 24 was used as test crop. Seed are sown in 12 m^2 (4 m x 3 m) plot 30 cm X 15 cm apart. The treatment schedule against stem rot as follows; T1: Seed treatment with tebuconazole @1.5 ml/l, T2: Seed treatment with azoxystrobin @ 1ml/l, T3: Seed treatment with pyraclostrobin @ 1g/l, T4: Seed treatment and foliar spray with tebuconazole@ 1.5 ml/l, T5: Seed treatment and foliar spray with azoxystrobin @1ml/l, T6: Seed treatment and foliar spray with pyraclostrobin @1g/l, T7: untreated control. The properties of fungicides used are mentioned in Table 1. The spray schedule was started next day of first appearance of disease symptoms. All three fungicides applied 15 day interval till harvest. The observation on disease intensity was recorded in each replicated plot. Per cent Soil-borne Disease incidence, Per cent efficacy of disease control (PEDC), Per cent yield increase over disease control (PIDC) was calculated by using the following formulae: Per cent Soil borne Disease incidence = (Number of infected plant units / Total number of plant units assessed) X 100, Per cent efficacy over Disease Control (PEDC) = [(Disease severity or incidence in control - Disease severity or incidence in treatment) / Disease severity or incidence in control] X 100, per cent yield increase over Disease Control (PIDC) = [(Yield in treatments - Yield in Control) / Yield in Control] X 100.

RESULTS AND DISCUSSION

When effect of different spacing on development of stem rot disease in groundnut was studied it was found that incidence and severity were significant with the different level of spacing (Table 2). Plot with spacing of 10 cm x 15 cm (T1) had greater stem rot severity (63.50%) and incidence (66.50%) as compared to other spacing. Plot having widest spacing of 15 cm x 30 cm (T5) had almost half disease severity and incidence of T1 plot. Pod yield was also significant. However, highest pod yield (1.68 kg /plot) was recorded in plot having spacing of 20 cm x 20 cm (T4) as compared to widest spaced plot.

The result of the present investigation showed that severity and incidence of stem rot are higher on plant sown close together. Secondary root to root and aboveground 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. Increasing plant densities have also been reported to increase disease on wheat, onion , strawberry and rose . The reason behind the increasing stem rot disease with increase in plant densities that the effect of plant density is due to changes in environmental conditions within the canopy or even susceptibility of individual plants to infection.

During the initial disease assessment before any spray, all the plots did show more or less uniform disease incidence. In the present experiment all the treatments were found effective for the management of stem rot of groundnut and significantly reduced the disease incidence as compared to control (Table 3). When disease incidence was assessed at harvest it was found that seed treatment along with foliar spray of pyraclostrobin (T6) showed only 11.65 % disease intensity as compared to 33.45% in untreated T7. Disease incidence was significant in all the treatments after final spraying. The highest pod yield was also recorded in T6 (3.54 kg/plot) followed

Table 1: Fungicides used in this experiments

Fungicides	Formulation	Rate of application	Chemical group	Site of action	Systemicity
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	1g/l	Methoxy carbamates	Quinone outside inhibitors	Acropetal

Table 2: Effect of different plant spacing on stem rot of groundnut

Treatment	Spacing	Plant stand	Disease severity (%)	Disease incidence (%)	Yield (kg/plot)	Estimated yield (kg/ha)
T_1	10 cm X 15 cm	800.00	63.50	66.50	1.08	897.92
T_2	15 cm X 15 cm	533.30	57.00	53.50	1.24	1035.42
T_3	15 cm X 20 cm	400.00	52.50	46.00	1.39	1154.17
T_4	20 cm X 20 cm	300.00	41.50	42.25	1.68	1395.83
T_5	15 cm X 30 cm	266.70	32.50	34.75	1.55	1293.75
	SEM (±)	-	1.18	1.99	0.07	-
	CD at 5%	-	3.62	6.12	0.20	-

Table 3: Effect of different fungicides on stem rot of groundnut

	Treatments	Disease incidence	PEDC	Yield (kg/plot)	Yield (kg/ha)	PIDC
T_1	Seed treatment with tebuconazole @1.5ml/l	22.68	32.20	2.46	2050.00	4.68
T_2	Seed treatment with azoxystrobin @ 1ml/l	20.55	38.58	2.45	2041.67	4.26
T_3	Seed treatment with pyraclostrobin @ 1g/l	19.92	40.45	2.51	2091.67	6.80
T_4	Seed treatment and foliar spray with tebuconazole@ 1.5ml/l	15.28	54.32	3.04	2530.56	29.36
T_5	Seed treatment and foliar spray with azoxystrobin @1ml/l	13.15	60.68	3.40	2830.56	44.68
T_6	Seed treatment and foliar spray with pyraclostrobin @1g/l	11.65	65.17	3.54	2947.22	50.63
T_7	Untreated control	33.45	0	2.35	1955.56	-
	SEM (±)	1.46		0.07		
	CD at 5%	4.51		0.23		

PEDC: Per cent efficacy of disease control, PIDC: Per cent yield increase over disease control

by T5 (3.40 kg/plot). Per cent efficacy of disease control of 65.17 and per cent yield increase over disease control of 50.63 was recorded in T6 as compared to untreated control (T7). However, seed treatment prior sowing only increased 4.68-6.80% yield over control.

There are many reports of application of fungicides through seed treatment and foliar spray for managing foliar and as well as soil borne diseases like stem of groundnut (Woodward *et al*. 2008; Jadon *et al*. 2015; Jash and Sarkar, 2017; Jash *et al*. 2018). In the present investigation, results of seed treatment with SBI and QoI fungicides were not so encouraging. However, Johnson and Subramanyam (2010) and Dandnaik *et al.* (2009), reported that seed treatment with hexaconazole showed the maximum reduction of stem rot (24.0%) in groundnut. Minimum incidence of pre-emergence rot and postemergence seedling rot were recorded in treatment with carbendazim (13.0%) and thiophanete methyl (43%) compared to control (49%) in cluster bean (Jaiman *et al*. 2009). When the cultivar with partial resistance to leaf spot and stem rot are used in combination with sungicides, the fungicides azoxystrobin showed excellent result (Hagan *et al*. 2010). Augusto and Brenneman (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. The flexibility of delaying initial application of pyraclostrobin without compromising leaf spot control allow farmer to reduce the number of fungicides application and associated cost. Application of pyraclostrobin 20%WG @ 1000g/500lit 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. In most cases, only one point mutation in the mitochondrial cytochrome b gene leading to an amino acid change from glycine to alanine at position 143 (G143A) may confer high level of resistance to QoI fungicides (Wise *et al*. 2008).

REFERENCES

Augusto, J. and Brenneman, T.B. 2011. Implication of fungicide application timing and post spray irrigation on diseases control and peanut yield. *Peanut Sci*. **38**:48-56.

Augusto, J., and Brenneman, T.B., 2012. Assessing systemicity of peanut fungicides through bioassay of plant tissues with *Sclerotium rolfsii*. *Plant Dis*. **96** :330-337.

Dandnaik, B.P., Patil, D.T., Chavanand, M.H., and Dandnaik, A.B., 2009. Chemical control of stem rot of groundnut caused by Sclerotium rolfsii. *J. Mycol. Plant Pathol*. **39**:185.

Doley, K. and Jite, P.K. 2013. Management of stem-rot of groundnut (*Arachis hypogaea* L.) cultivar in field. *Nat. Sci. Biol*. **5**: 316-324.

Hagan, A.K., Campbell, H.L., Bowen, K.L., Wells, L. and Goodman, R. 2010. Managing early leaf spot and stem rot with reduced fungicide inputs on disease-resistant peanut cultivars. *Peanut Sci*. **37**:129-136.

Jadon, K.S., Thirumalaisamy, P.P., Kumar, V., Koradia, V.G, and Padavi, R.D. 2015. Management of soil borne diseases of groundnut through seed dressing fungicides. *Crop Protec*. **78**: 198-203

Jaiman, R.K., Jain, S.C., Sharma, and Pankaj, 2009. Field evaluation of fungicides, bioagents and soil amendments against root rot caused by *Macrophomina phaseolina* in cluster bean. *J. Mycol. Plant Pathol.* **39**: 74-76.

Jash, J. and Sarkar, A. 2017. Implication of fungicide application regimes and post spray irrigation on late leaf spot and its residual impact on stem rot of groundnut. *Indian Phytopath*. **70**: 426-431.

Jash, S., Moinuddin, G., Sarkar, A. and Patsa, R. 2018. Pyraclostrobin: a new quinone outside inhibitors fungicides for Cercospora leaf spot of groundnut. *J. Mycopathol. Res*. **56**: 149-151.

Johnson, M., and Subramanyam, K., 2010. Evaluation of different fungicides against seed and soil borne diseases of groundnut. *Indian J. Plant Prot.* **38**: 80-83.

Kemerait, B., Brenneman, T. and Culbreath, A. 2010. *2010 peanut disease update*. In: 2010 peanut update. Beasley, J.P. (ed.). pp. 57-80. Coop. Ext. Ser. College of Agric. Environ. Sci. University of Georgia.

Kumar, N., Dagla, M.C., Ajay, B. C., Jadon, K. S. and Thirumalaisamy, P. P. 2013. Sclerotium stem rot: A threat to groundnut production. *Popular Kheti*.**1**: 26-30.

Thirumalaisamy, P.P., Kumar, N., Radhakrishnan, T., Rathnakumar, A.L., Bera, S.K., Jadon, K.S., Mishra, G.P., Rajyaguru, R. and Joshi, B. 2014. Phenotyping of groundnut genotypes for resistance to Sclerotium stem rot. *J. Mycol. Plant Pathol*, **44**: 459-462.

Wise, K.A., Bradley, C.A., Pasche, J.S., Gudmestad, N.C., Dugan, F.M., and Chen, W. 2008. Baseline sensitivity of *Ascochyta rabiei* to azoxystrobin, pyraclostrobin, and boscalid. *Plant Dis*. **92**:295-300.

Woodward, J.E., Brenneman, T.B., Kemerait, R.C. Jr., Smith, N.B., Culbreath, A.K. and Stevenson, K.L. 2008. Use of resistant cultivars and reduced fungicides programs to manage peanut diseases in irrigated and non irrigated fields. *Plant Dis*. **92**:896-902.