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Incidence of Collar Rot of Groundnut in Rajasthan and its Management

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ABSTRACT

Background: Groundnut (*Arachis hypogaea* L.) is an important legume crop of tropical and sub-tropical areas of the world. This crop suffers from several diseases like early leaf spot, late leaf spot, rust, groundnut bud necrosis, peanut clump and collar rot *etc.* But collar rot caused by *Aspergillus niger* van Teighem is one of the most important seed and soil borne diseases causing huge economic (40-50 per cent) loss in India and abroad.

Methods: A roving survey was conducted to assess the incidence of collar rot in eight major groundnut growing districts of western Rajasthan *i.e.* Bikaner, Jodhpur, Churu, Jalore, Jaipur, Sikar, Nagaur and Dausa during *Kharif* 2018. A field experiment was carried out for two consecutive years (2019 and 2020) to manage the disease through altering micro-climate under canopy with six levels of seed rates (80, 85, 90, 95, 100 and 105 kg/ha).

Result: Our investigations cleared that this disease is prevalent in all the 200 fields surveyed in eight districts of Rajasthan with 22.99 per cent overall disease incidence which varied from 17.84 to 32.38 per cent with monetary losses. Maximum disease incidence was recorded in Jaipur (28.85%) district while it was lowest in Nagaur district (20.15%). Higher disease reduction (12.97%) with increased pod yield (27.65%) was observed with higher seed rate of 105 kg/ha as compared to standard recommended seed rate (80 kg/ha) as this pathogen is favoured by higher temperature and low soil moisture, dense canopy provides shade that increases humidity under the cropped area and lowers temperature. As a result of this, plant mortality can be compensated by increasing plant population through seed rate, as it modifies the microclimate and generate an environment which is less favourable for developing collar rot disease of groundnut.

Key words: *Aspergillus niger*, Collar rot, Disease incidence, Groundnut, Seed rate, Survey.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), is an important legume crop of tropical and sub-tropical areas of the world, described in 1753 by Linnaeus (Pattee and Young, 1982). Groundnut kernels contain about 26 per cent protein, 48 per cent edible oil, 20 per cent carbohydrates and three per cent fiber and also rich in calcium, thiamine and niacin (Haveri 2017). As a source of edible oil, it finds its prime utility, as a consequence of it, this crop is gaining the status of “king of oil seed crops” (Reddy 1976). Additionally, in association with symbiotic nitrogen-fixing bacteria, it fixes and enriches the soil with 80-160 kg N/ha per season (Alam *et al*., 1988).

In India, the total coverage area under this crop is 39. 31 lakh hectares, production is 6.86 million tonnes with an average productivity of 1745 kg/hectare (Anonymous, 2019). Rajasthan stands second position in terms of area and production. The cultivation of groundnut is well adapted to the conditions prevailing in Rajasthan and is cultivated in about 7.34 lakhs hectares with annual production 1.612 million tonnes and productivity of 2195 kg/hectare (Anonymous, 2019-20).

Several abiotic and biotic factors affect the growth and development of groundnut leading to qualitative and quantitative yield losses. Diseases are most damaging and major limiting factors that cause the largest economic losses in profitable cultivation of this crop in Rajasthan. Amongst fungal diseases, collar rot of groundnut also known as seedling blight caused by *Aspergillus niger* van. Teighem is one of the important seed and soil borne diseases. Pathogenis a well known polyphagous, ubiquitous, non-target and the most destructive soil and seed inhabiting fungus (Vimalkumar and Saifulla, 2017). This disease was first reported by Jochem (1926) from Java. In Rajasthan, Bakhetia (1983) had reported disease incidence up to 50.00 per cent. Dighule *et al.* (2018) estimated yield losses in Maharashtra from 28.00 to 50.00 per cent due to collar rot of groundnut caused by *Aspergillus niger* van. Teighem.

Collar rot of groundnut prominently is distributed in countries with tropical and sub tropical climates where high temperature prevails during the rainy season and it is present in all most all the groundnut growing areas of the world. The loss due to this disease was reported upto 40-50 per cent (Chahal *et al.,* 1974). The pathogen seems to have adaptability to higher temperature and the disease occurs during July to September, which is particularly severe at pre- and post-emergence stages causing considerably losses to the yield (Kumari, 2015).

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MATERIALS AND METHODS

Survey

Roving method of survey was followed to assess the incidence of collar rot disease of groundnut. (Table 1) The survey of major groundnut growing districts of Rajasthan *i.e*. Bikaner, Jodhpur, Churu, Jalore, Jaipur, Sikar, Nagaur and Dausa was conducted during 2018 to record incidence of disease and to collect diseased samples. In each district, five villages of a Tehsil were visited. In each village, five farmer's field was surveyed for disease incidence. Samples from each field was collected and brought to the laboratory. The disease incidence was recorded in 3 m × 3 m marked area in each field from five locations and per cent disease incidence (PDI) was calculated by counting the diseased and the total number of plants per spot. The plant showing collar rot symptoms was considered as a diseased plant.

Effect of seed rate

The present investigation was carried out during Kharif 2019 and 2020 at the Agronomy Farm and Department of Plant Pathology, S.K.N. Collage of Agriculture, Sri Karan Narendra Agriculture University, Jobner, Rajasthan. Jobner is situated at latitude of 26°5′ N, longitude of 75°20′ E and altitude of 427 meters above MSL (mean sea level). This region falls under semi-arid eastern plain (Agro Climatic Zone- lll A) of Rajasthan. Seed rate is considered very important and has been shown to have considerable effects on several soil borne diseases. Additional or increased plant population may compensate with succumbed plants at early stage by the disease. To understand the role of plant population (by using different seed rates) on incidence and development of collar rot of groundnut, the experiment was carried out under artificial inoculum with susceptible groundnut variety RG-382. Inoculum, multiplied on sorghum grains was added in furrows at 20 g/m row length at the time of sowing. Six levels of seed rates (80, 85, 90, 95, 100 and 105 kg/ha) was used under simple RBD with four replications in 2.1 m × 2 m plots. The plots were irrigated as per requirement with uniform amount of water. Observations on per cent disease incidence was recorded 45 days after sowing and after 10 days of harvest pod yield was recorded.

RESULTS AND DISCUSSION

Survey

Our investigations cleared that collar rot disease incidence (Table 2) was more severe in Jaipur district (28.85%) followed by Sikar (24.94%), Jalore (23.71%) and Jodhpur (22.60%). Among all the surveyed villages (Table 1) the maximum incidence (32.38%) of collar rot was noted in the field of Babu Lal farmer belonging to Khejroli village of Chomu tehsil in Jaipur district and minimum (17.84%) in Shesma Ka Bas village of Kuchaman city in Nagaur district. As per literature reviewed, this is the premier report on systematic assessment of the disease in the different districts of Rajasthan state which is the for most aspect for a plant pathologist to carry out any further study on the disease development and management. Our findings are in accordance with the results of earlier researchers (Joshi, 1969; Aulakh and Sandhu, 1970; Kumari and Singh, 2016; Meena *et al.* 2019). In Gujarat state of India, Joshi (1969) has been surveyed groundnut growing areas and reported seedling blight incidence (*A. niger*) up to 50.00 per cent in diseased fields while Aulakh and Sandhu (1970) have also been assessed mortality (*A. niger*) of groundnut plants from 40.00 to 50.00 per cent. Kumari and Singh (2016) have also been surveyed groundnut fields in Sikar and Jaipur districts of Rajasthan and recorded 13.09 to 52.00 per cent disease incidence under natural field conditions. Similar work has also been carried out by Veena *et al.* (2019) in five districts of Andhra Pradesh and noticed economic losses to the groundnut by collar rot disease. Recently similar work has been carried out by Saran *et al* (2020) that survey was conducted in major groundnut growing areas of different tehsil of Jodhpur district, Rajasthan during kharif 2019 to assess the distribution and the incidence of collar rot diseases. The highest incidences of collar rot were observed in Phalodi (15.31%). Whereas, least collar rot incidence was observed (10.0%) in Tewari.

Effect of seed rate

Effect of plant population (by using different seed rates) on incidence of collar rot of groundnut were recorded under artificial soil inoculation conditions during *Kharif* 2019 and *Kharif* 2020. Plant population had influence on collar rot incidence of groundnut during both the years of study. Analysis of data of *Kharif* 2019 (Table 3) revealed that maximum disease reduction (13.73%) over check was observed with seed rate of 105 kg/ha followed by 100 kg/ha (12.87%) while it was lowest (6.95%) with 85 kg/ha as compared to standard check (80 kg/ha). The disease incidence of seed rate of 105 kg/ha and 100 kg/ha were found significantly superior to standard check (80 kg/ha). Maximum significant increase in pod yield (27.71%) over check was recorded in seed rate of 105 kg/ha followed by 100 kg/ha (23.89%) while it was lowest (12.42%) in seed rate of 85 kg/ha as compared to standard check (80 kg/ha). Analysis of two years pooled data (Table 3) revealed that maximum disease reduction (12.97%) over standard check was observed with seed rate of 105 kg/ha followed by 100 kg/ha (11.89%) while it was lowest (4.72%) with 85 kg/ha as compared to standard check (80 kg/ha). The disease incidence of seed rate of 105 kg/ha was found significantly superior to standard check (80 kg/ha). Maximum significant increase in pod yield (27.65%) over check was recorded in seed rate of 105 kg/ha followed by 100 kg/ha (23.49%) while it was lowest (10.87%) in seed rate of 85 kg/ha as compared to standard check (80 kg/ha). Although, the disease was not controlled in appreciable amount but increased yield was recorded, it was most probably due to increased plant population by compensatory effect to the plant mortality. Maximum disease reduction (Table 3) (12.97%) and increased seed yield (27.65%) were recorded with 105 kg/ha seed rate in comparison to recommend seed rate @ 80

kg/ha. Decrease in disease incidence and increase in pod yield are due to complimentary changes in microclimate of field due to variation in plant population by different seed rates. Our findings are parallel to the results of Kishore *et al.* (2007) who concluded that collar rot disease of groundnut is more severe in soils with low moisture and high temperature. Singh (2010) who concluded that wider plant geometry provides good ventilation and sunlight that result in decreased soil moisture and enhanced temperature in the crop; as a result, the pathogens that thrive in high humidity and high temperature are discouraged. Winter *et al.* (2013) observed that cultural practices may directly

Table 1: Places of sample collection and disease incidence in surveyed fields in eight districts of Rajasthan.

District	Name of Tehsil	Name of Village*	% disease incidence in surveyed field and sample No.					Av. PDI of village (Av. of five fields)
		Bana	16.00 (1)	20.80 (2)	22.40 (3)	23.46 (4)	24.00 (5)	21.33
		Bigga	22.10 (6)	20.40 (7)	23.24 (8)	22.67 (9)	24.94 (10)	22.67
Bikaner	Shri Dungargarh	Bigga Bas Ramsra	22.40 (11)	17.47 (12)	8.96 (13)	21.50 (14)	19.26 (15)	17.92
		Jaisalsar	24.99 (16)	23.68 (17)	20.73 (18)	24.51 (19)	25.07 (20)	23.80
		Upani	23.65 (21)	16.23 (22)	19.00 (23)	22.50 (24)	15.60 (25)	19.40
		Bandnau	22.42 (26)	15.65 (27)	21.90 (28)	20.86 (29)	23.47 (30)	20.86
		BhadasarDikhnada	23.62 (31)	17.39 (32)	23.20 (33)	21.97 (34)	23.65 (35)	21.97
Churu	Sardarsahar	BhadasarUtradha	21.23 (36)	15.41 (37)	20.74 (38)	19.75 (39)	21.63 (40)	19.75
		Swaichoti	16.65 (41)	22.95 (42)	22.42 (43)	21.35 (44)	23.38 (45)	21.35
		Swaichoti and Badi	21.16 (46)	21.66 (47)	15.11 (48)	20.15 (49)	22.67 (50)	20.15
		Bagdi	18.00 (51)	20.94 (52)	21.48 (53)	21.48 (54)	25.50 (55)	21.48
		Bilona	23.60 (56)	18.50 (57)	21.66 (58)	23.66 (59)	25.89 (60)	22.66
Dausa	Lalsot	Daulatpura	26.63 (61)	20.62 (62)	21.15 (63)	20.15 (64)	17.20 (65)	21.15
		Deedwana	21.00 (66)	19.00 (67)	18.95 (68)	16.00 (69)	19.80 (70)	18.95
		Talavgaon	23.00 (71)	24.20 (72)	24.60 (73)	26.71 (74)	25.35 (75)	24.77
		Bhutera	29.70 (76)	25.74 (77)	27.72 (78)	29.04 (79)	19.80 (80)	26.40
		Gudlia	29.43 (81)	26.08 (82)	28.09 (83)	20.06 (84)	30.09 (85)	26.75
Jaipur	Chomu	Khejroli	30.65 (86)	32.06 (87)	33.19 (88)	32.38 (89)	33.63 (90)	32.38
		Kishanmanpura	31.37 (91)	29.13 (92)	22.41 (93)	32.87 (94)	33.62 (95)	29.88
		Madho Ka Bas	21.65 (96)	28.14 (97)	30.30 (98)	31.75 (99)	32.47 (100)	28.86
		Badgaon	24.78 (101)	21.97 (102)	23.66 (103)	16.90 (104)	25.35 (105)	22.53
		Bamanwara	21.65 (106)	16.65 (107)	23.31 (108)	24.42 (109)	24.98 (110)	22.20
Jalore	Raniwara	Bhatwas	27.04 (111)	25.11 (112)	22.31 (113)	27.73 (114)	26.56 (115)	25.75
		Jaitpura	18.28 (116)	23.76 (117)	25.59 (118)	26.81 (119)	27.42 (120)	24.37
		Rupawati	26.08 (121)	23.12 (122)	24.90 (123)	17.78 (124)	26.67 (125)	23.71
		Bapini	16.19 (126)	21.04 (127)	22.66 (128)	23.74 (129)	24.28 (130)	21.58
		Chhela	25.83 (131)	26.83 (132)	20.45 (133)	25.06 (134)	24.83 (135)	24.60
Jodhpur	Lohawat	Indo Ka Bas	24.57 (136)	22.82 (137)	17.55 (138)	25.74 (139)	26.33 (140)	23.40
		Nausar	25.18 (141)	22.32 (142)	24.03 (143)	17.17 (144)	25.75 (145)	22.89
		Shaitan Singh Nagar	22.61 (146)	20.04 (147)	21.58 (148)	15.41 (149)	23.12 (150)	20.55
		Adkasar	15.48 (151)	20.12 (152)	21.67 (153)	22.70 (154)	23.22 (155)	20.64
		Chitawa	23.35 (156)	23.39 (157)	22.35 (158)	21.02 (159)	21.09 (160)	22.24
Nagpur	Kuchaman City	Kukanwali	19.25 (161)	20.87 (162)	22.47 (163)	23.34 (164)	21.08 (165)	21.40
		ShesmaKa Bas	19.62 (166)	17.39 (167)	18.73 (168)	13.38 (169)	20.07 (170)	17.84
		Todas	20.97 (171)	18.17 (172)	19.57 (173)	20.50 (174)	13.98 (175)	18.64
		Bawari	25.41 (176)	23.60 (177)	18.15 (178)	26.62 (179)	27.23 (180)	24.20
		Ghashapura	27.69 (181)	24.54 (182)	26.43 (183)	18.88 (184)	28.32 (185)	25.17
Sikar	Khandela	Kansrada	24.98 (186)	22.14 (187)	23.85 (188)	17.03 (189)	25.55 (190)	22.71
		Malikpura	26.51 (191)	25.08 (192)	29.14 (193)	29.81 (194)	28.20 (195)	27.75
		Thikariya	27.37 (196)	24.26 (197)	26.12 (198)	18.66 (199)	27.99 (200)	24.88
		Over all mean (Mean of 200 fields) 22.99						

PDI= Per cent disease incidence.

Table 2: Details of different isolates of *A. niger* collected during survey from eight districts of Rajasthan.

District	Tehsil	Details of field chosen for establishing isolate**			Representative isolate of district and their code no.	Av. PDI of district (Av. of 25 fields)
		Village	Name of farmer and sample no.	PDI of field		
Bikaner	Shri Dungargarh	Jaisalsar	Munni Ram Jat, Sample No. 20	25.07	ANBK 01	21.04
Churu	Sardarshahar	Bhadasar Dikhnada	RakeshJakhar, Sample No. 35	23.65	ANCH 02	20.82
Dausa	Lalsot	Talavgaon	MurariMeena Sample No. 74	26.71	ANDA 03	21.80
Jaipur	Chomu	Khejroli	Babu Lal Sample No. 90	33.63	ANJP 04*	28.85
Jalore	Raniwara	Bhatwas	Sita Ram Suthar Sample No. 114	27.73	ANJL 05	23.71
Jodhpur	Lohawat	Chhela	Jalam Singh, Sample No. 132	26.83	ANJD 06	22.60
Nagaur	Kuchaman City	Chitawa	Bansi Lal Sample No. 157	23.39	ANNG 07	20.15
Sikar	Khandela	Malikpura	Naveen Kajla Sample No. 194	29.81	ANSK 08	24.94

*This isolate was selected for common experiments. **Representative isolate of each district was established from the field showing highest PDI.

Table 3: Effect of seed rate on collar rot incidence and yield of groundnut.

Seed rate (Kg/ha)	PDI*						Yield* (q/ha)					
	2019	Per cent disease reduction	2020	Per cent disease reduction	Pooled	Per cent disease reduction	2019	Per cent yield increase	2020	Per cent yield increase	Pooled	Per cent yield increase
80#	54.60 (47.64)	0	56.86 (48.94)	0	55.73 (48.29)	0	15.70	-	14.10	-	14.90	-
85	50.80 (45.46)	6.95	55.40 (48.10)	2.57	53.10 (46.78)	4.72	17.65	12.42	15.38	9.08	16.52	10.87
90	49.79 (44.88)	8.80	53.38 (46.94)	6.12	51.59 (45.91)	7.42	17.90	14.01	15.90	12.77	16.90	13.42
95	48.57 (44.18)	11.04	51.10 (45.63)	9.39	49.84 (44.91)	10.57	18.35	16.88	16.81	19.22	17.58	17.99
100	47.57 (43.61)	12.87	50.63 (45.36)	10.95	49.10 (44.48)	11.89	19.45	23.89	17.35	23.05	18.40	23.49
105	47.10 (43.34)	13.73	49.90 (44.94)	12.13	48.50 (44.14)	12.97	20.05	27.71	18.00	27.66	19.02	27.65
SEm±	1.43	-	1.32	-	1.43	-	0.82	-	0.72	-	0.75	-
CD (p=0.05)	4.02	-	3.98	-	4.10	-	2.51	-	2.23	-	2.33	-
CV (%)	7.22	-	6.86	-	8.27	-	7.42	-	7.54	-	8.56	-

*Average of four replications, Figures given in parenthesis are angular transformed as: DEGREES [ASIN {SQRT (% VALUE/100)}].
Standard seed rate (80 kg/ha) as per POP of the Jaipur division of the state Rajasthan, Spreading type variety (RG-382) used during experimentation.

or indirectly affect inoculum load of soil borne plant pathogens and the incidence of their consequential root rot diseases. As *A. niger* is favoured by higher temperature and low soil moisture, dense canopy provides shade, increases humidity under the cropped area, delays drying of soil under the plants canopy, prevent aeration and radiation and lowers temperature. These conditions are un-favorable for collar rot disease. It was observed by this study that, the dense planting can be the coolest, wettest and had slightly low incidence of disease whereas the wider planting may be the warmest, driest and had higher collar rot disease. It was also cleared that the incidence of collar rot was coupled with variations in the microclimate of the crop. As a result of this, plant mortality can be compensated by increasing plant population through seed rate, as it modifies the microclimate and generate an environmenst which is less favourable for developing collar rot disease of groundnut.

CONCLUSION

During survey, maximum collar rot incidence was observed in Jaipur (28.85%) and minimum in Bikaner (21.04%) district while overall mean disease incidence of eight districts was 22.99 per cent covering 200 fields of major groundnut growing districts of Rajasthan. Among six levels of seed rate (80, 85, 90, 95, 100 and 105 kg/ha), higher disease reduction with increased pod yield was observed with seed rate of 105 kg/ha as compared to standard recommended seed rate (80 kg/ha).

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Conflict of interest: None.

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