



Management of collar rot of groundnut (*Arachis hypogaea*) by fungicides and mineral nutrients

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ABSTRACT

Collar rot disease caused by *Aspergillus niger* van Teighem is an important seed and soil borne disease of groundnut (*Arachis hypogaea* L.) which deteriorates kernel quality and reduces yield. The experiments were conducted during kharif 2019 and 2020 at SKN College of Agriculture, Jobner, Jaipur, Rajasthan. To see the interactive effect of seed treatment and drenching, fungicides and bio-agents were applied through seeds [carbendazim (0.1%), carboxin+ thiram (0.25%), hexaconazole (0.2%), carbendazim + mancozeb (0.25%), *Trichoderma harzianum* (0.6%) and *Trichoderma viride* (0.6%)] and through drenching [carbendazim (0.1%), carboxin + thiram (0.25%) and carbendazim + mancozeb (0.25%)] at 20 days after sowing (DAS). The effect of six mineral nutrients i.e. Cu (5 kg/ha), K (30 kg/ha), S (25 kg/ha), B (10 kg/ha), Fe (5 kg/ha) and Zn (5 kg/ha) was also evaluated through soil application against the disease. The lowest disease incidence (4.62%) and highest pod yield (25.86 q/ha) were recorded by treating the seeds with hexaconazole (@0.2%) and drenching with carbendazim + mancozeb (@0.25%) at 20 DAS and next best was seed treatment with hexaconazole (0.2%) and drenching with carbendazim (0.1%). Among six mineral nutrients, copper (@5 kg/ha) was most significant in reducing the disease incidence (46.05%) and in increasing pod yield (24.81%) followed by potassium. Conclusively, seed treatment with hexaconazole (@0.2%) and drenching with carbendazim + mancozeb (@0.25%) at 20 days after sowing results in significantly higher disease control with increased pod yield.

Keywords: *Aspergillus niger*, Collar rot, Fungicides, Groundnut, Mineral nutrients

Groundnut (*Arachis hypogaea* L.) is an important oil, food and feed legume crop grown over 100 countries. It provides nutrition to farm families as a source of energy and protein rich kernels and nutritious fodder (haulms) to livestock. Groundnut kernels contain about 26% protein, 48% oil, 20% carbohydrates and 3% fiber and are also rich in calcium, thiamine and niacin (Haveri 2017). 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 acreage is 39.31 lakh hectares, production is 6.86 million tonnes with an average productivity of 1745 kg/hectare (Anonymous 2019). Rajasthan occupies second position in terms of area and production with 7.34 lakh hectares area, 1.612 million tonnes annual production and 2195 kg/hectare of productivity (Anonymous 2019-20). Collar rot disease of groundnut, caused by *Aspergillus niger* van Teighem, is one of the important seed and soil borne diseases. This pathogen is polyphagous, omnipresent, non-target and the

most destructive soil and seed inhabiting in nature (Vimal Kumar and Saifulla 2017). Prominently, this disease is present in almost all the groundnut growing areas of the world. Bakhettia (1983) had reported 50% disease incidence in Rajasthan and 28 to 50% was reported by Dighule *et al.* (2018) in Maharashtra. Mineral nutrients can improve crop health and reduce the incidence and severity of many crop diseases (El-Shennawy *et al.* 2010) and got significant increase in yield attributes like plant height, number of branches, number of pods, seeds yield per plant and weight of 100 seeds which ultimately increase the yield of crop. It is emerging as a major and wide spreading problem in Rajasthan since last few years. Considering the increasing importance, the study was undertaken to investigate interactive effect of some newer fungicides applied through seed and soil drenching and mineral nutrients by soil application.

MATERIALS AND METHODS

Present study was carried out during kharif 2019 and 2020 at SKN College of Agriculture, SKN Agriculture University, Jobner (Rajasthan, India). Jobner is situated at latitude of 26°5' N, longitude of 75°20' E and altitude of 427 meters above mean sea level (MSL). This region falls under semi-arid eastern plain (Agro Climatic Zone- III A) of Rajasthan.

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Effect of fungicides: To assess the effect of fungicides and bio-agents, a total of 28 treatment combinations i.e. seed treatment alone, drenching alone and seed treatment-cum-drenching were tried under factorial RBD with three replications in artificial inoculated field conditions for two consecutive years (2019 and 2020). Experiment was laid out with susceptible variety RG-382 with total 28 treatment combinations in 2.1 m × 2 m plots. The inoculum was multiplied on sorghum grains and added in furrows @20 g/m row length to increase the disease pressure at the time of sowing. Fungicides like carbendazim (0.1 %), carboxin + thiram (0.25 %), hexaconazole (0.2 %) and carbendazim+ mancozeb (0.25%), bio-agents such as *Trichoderma harzianum* (0.6%) and *Trichoderma viride* (0.6 %) were used as seed treatment along with check and were sown separately in artificially inoculated plots. To see the combined effect of seed treatment and drenching, each seed treated plot was drenched with carbendazim (0.1%), carboxin + thiram (0.25%) and carbendazim + mancozeb (0.25%) at 20 days after sowing (DAS).

Effect of mineral nutrients: Before sowing, the soil was amended with Cu (@5 kg/ha, source=copper sulphate), K (30 kg/ha, source=MoP), S (25 kg/ha, source= sulphur dust), B (10 kg/ha, source = sodium borate), Fe (5 kg/ha, source = ferrous sulphate) and Zn (5 kg/ha, source = zinc sulphate) under simple RBD with three replications. Plots without amendment served as check. In both the experiments, the observations on disease incidence were recorded 45 days after sowing, while pod yield recorded at 10 days after harvest. Disease incidence was calculated as per the given formula.

$$\text{Disease incidence (\%)} = \frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

RESULTS AND DISCUSSION

Efficacy of seed treatment (alone): Field trials conducted over two growing seasons (2019 and 2020) provided statistically significant superior results (Table 1) over check. Among fungicidal seed application, seed treatment with hexaconazole (@0.2%) provided minimum mean disease incidence (18.00%) and higher pod yield (19.21 q/ha) followed by carboxin + thiram (18.82% and 18.94 q/ha) as compared to untreated check (56.28% and 12.56 q/ha, respectively). In bio-agents, *Trichoderma harzianum* showed lower incidence (24.74%) and higher yield (17.98 q/ha).

Efficacy of drenching (alone): Drenching only with carbendazim + mancozeb (@0.25%) at 20 days after sowing (DAS) provided minimum disease incidence (27.85%) and higher yield (17.31 q/ha) and next best drenching was with carbendazim (28.85% and 17.04 q/ha) at 20 DAS.

Interactive effect of seed treatment-cum-drenching: The lowest disease incidence (4.62%) and highest pod yield (25.86 q/ha) were recorded by treating the seeds with hexaconazole (@0.2%) + drenching with carbendazim + mancozeb (@0.25%) at 20 days after sowing (DAS) followed by seed treatment with hexaconazole + drenching

with carbendazim (5.90% and 23.73 q/ha). In bio-agents, seed treatment by *Trichoderma harzianum* and drenching with carbendazim + mancozeb gave lowest incidence (14.72%) and higher yield (20.56 q/ha). Seed treatment by *Trichoderma viride* and drenching with carboxin + thiram at 20 DAS was found the least effective among all the seed treatments and drenching combinations.

The significance of chemicals and bio-control agents cannot be denied in plant disease management, especially bio-agents that have proved to be highly effective in managing soil borne fungal plant pathogens. In present investigation, as far as disease control and yield are concerned, all the tested fungicides and bio-agents performed better in reducing per cent disease incidence and in increasing pod yield of groundnut. Our results are in agreement with the findings of Prajapati *et al.* (2016). They found that black mould rot of onion (*Aspergillus niger*) could be reduced by application of carbendazim, trifloxystrobin (25%) + tebuconazole (50%), azoxystrobin (18.2%) + difenconazole (11.4%), hexaconazole and propiconazole. Similarly, Jadon *et al.* (2015) evaluated ten fungicides against major soil borne diseases of groundnut. They recorded that tebuconazole 2 DS @1.5 g/kg seed, mancozeb 75% WP @3 g/kg/seed, carbendazim 12% + mancozeb 63% WP @3 g/kg/seed were very effective in the management of soil borne diseases including collar rot. While Kapadiya and Moradiya (2017) recorded seed treatment and two foliar spray of tebuconazole highly effective in controlling collar rot disease.

Effect of mineral nutrients: All the mineral nutrients proved effective in controlling disease with increased yield. It is evident from the first year (2019) results (Table 2) that soil application of copper (5 kg/ha) was found most effective in reducing disease (47.58%) over check followed by potassium @30 kg/ha (41.76%), sulphur @25 kg/ha (38.68%), boron @10 kg/ha (36.27%) and iron @5 kg/ha (30.12%). The minimum disease reduction (27.93%) over check was noted in zinc (@5 kg/ha). The data of pod yield indicated that highest per cent increase in pod yield (24.85%) over check was recorded in copper followed by potassium (18.37%) and sulphur (16.06%). Perusal of second year (2020) data revealed (Table 2) a similar trend of results as in 2019. Maximum disease reduction (44.66%) and highest increase in pod yield (24.76%) was observed with copper followed by potassium (40.55% and 19.81%, respectively).

Pooled analysis of 2019 and 2020 (Table 2) showed that all the nutrients were found significant in reducing disease incidence and in increasing pod yield. Among these nutrients, copper @5 kg/ha was found most effective in reducing the disease incidence (46.05%) over check followed by potassium @30 kg/ha (41.13%) and sulphur @25 kg/ha (38.21%). Disease incidence of copper, potassium and sulphur and boron, iron and zinc were found at par to each other. Two year pooled data of pod yield indicated that highest increase in pod yield (24.81%) over check was recorded in copper followed by potassium (19.07 %) and sulphur (16.40 %).

In the present investigation, copper and potassium

Table 1 Efficacy of fungicides and bio-agents against collar rot of groundnut applied through seed treatment and soil drenching

Treatment	Per cent disease incidence*					Yield (q/ha)*				
	Check (No drenching)	Drenching with carb. (0.1%)	Drenching with carboxin + thiram (0.25%)	Drenching with carb. + mancozeb (0.25 %)	Mean (36.62)	Check (No drenching)	Drenching with carb. (0.1%)	Drenching with carboxin + thiram (0.25%)	Drenching with carb. + mancozeb (0.25 %)	Mean
Check (No treatment)	56.28 (48.61)	28.85 (32.49)	29.37 (32.82)	27.85 (31.85)	35.59 (36.62)	12.56	17.04	16.83	17.31	15.94
ST with carb. (0.1%)	20.16 (26.68)	9.82 (18.26)	12.03 (20.29)	9.04 (17.49)	12.76 (20.93)	18.55	21.98	21.34	22.54	21.10
ST with carboxin + thiram (0.25%)	18.82 (25.71)	8.10 (16.54)	10.74 (19.13)	7.79 (16.21)	11.36 (19.70)	18.94	23.21	21.64	23.66	21.86
ST with hexaconazole (0.2%)	18.00 (25.10)	5.90 (14.06)	10.26 (18.68)	4.62 (12.41)	9.69 (18.14)	19.21	23.73	22.01	25.86	22.70
ST with carb. + mancozeb (0.25%)	19.45 (26.17)	8.76 (17.21)	11.50 (19.82)	8.26 (16.70)	11.99 (20.26)	18.71	22.56	21.46	22.76	21.37
ST with <i>T. harzianum</i> (0.6%)	24.74 (29.83)	14.87 (22.68)	16.13 (23.68)	14.72 (22.56)	17.61 (24.81)	17.98	20.36	20.13	20.56	19.76
ST with <i>T. viride</i> (0.6%)	26.07 (30.70)	17.24 (24.53)	17.50 (24.73)	16.58 (24.03)	19.35 (26.10)	17.56	19.66	19.46	20.08	19.19
Mean	26.22 (30.80)	13.36 (21.44)	15.36 (23.07)	12.69 (20.87)	17.64	21.22	20.41	21.82		
Seed treatment (S)	SEM+	0.28	0.81	5.61	SEM+	0.37	1.05	6.08		
Drenching (D)	SEM+	0.21	0.61		SEM+	0.28	0.79			
S × D	SEM+	0.57	1.61		SEM+	0.74	2.10			

* Average of three replications, Drenching at 20 DAS, Figures given in parenthesis are angular transformed as: DEGREES (AS IN (SQRT(% VALUE/100)))
 ST , Seed treatment; Carb., Carbendazim.

Table 2 Effect of soil application of mineral nutrients on collar rot incidence and yield of groundnut

Nutrient	Per cent disease incidence*				Yield (q/ha)*							
	2019	Per cent disease reduction over check	2020	Per cent disease reduction over check	Pooled	Per cent disease reduction over check	2019	Per cent increase in yield over check	2020	% increase in yield over check	Pooled	Per cent increase in yield over check
Cu	26.33 (30.87)	47.58	30.67 (33.63)	44.66	28.50 (32.27)	46.05	18.89	24.85	17.63	24.76	18.26	24.81
K	29.25 (32.74)	41.76	32.95 (35.03)	40.55	31.10 (33.90)	41.13	17.91	18.37	16.93	19.81	17.42	19.07
S	30.80 (33.71)	38.68	34.48 (35.96)	37.79	32.64 (34.84)	38.21	17.56	16.06	16.50	16.77	17.03	16.40
B	32.01 (34.46)	36.27	35.20 (36.39)	36.49	33.61 (35.43)	36.38	17.13	13.21	16.52	16.91	16.83	15.03
Fe	35.10 (36.33)	30.12	38.60 (38.41)	30.36	36.85 (37.38)	30.24	16.54	9.31	16.37	15.85	16.46	12.50
Zn	36.20 (36.99)	27.93	39.12 (38.72)	29.42	37.66 (37.86)	28.71	16.43	8.59	16.38	15.92	16.41	12.16
Check	50.23 (45.13)	-	55.43 (48.12)	-	52.83 (46.62)	-	15.13	-	14.13	-	14.63	-
SEm±	1.73	-	1.90	-	1.90	-	0.41	-	0.48	-	0.47	-
CD (P=0.05)	5.34	-	5.86	-	5.85	-	1.28	-	1.48	-	1.46	-
CV (%)	8.76	-	8.65	-	9.10	-	6.05	-	6.17	-	7.02	-

* Average of three replications. Figures given in parentheses are angular transformed as: DEGREES [AS IN {SQRT (% VALUE/100)}]

showed positive response in reducing the disease incidence and in increasing pod yield. The present results are in accordance with the findings of Marschner (1995) and Broadley *et al.* (2012) who concluded that copper fertilization had decreased the severity of a wide range of fungal and bacterial diseases associated by cell wall stability and lignification in plants. Kalim *et al.* (2003) obtained 44.0 to 47.8% reduced severity of root rot of cowpea (*Rhizoctonia* sp.) by the application of 20 µg/g Zn as zinc sulphate. Similarly, application of 10 µg/g Mn as manganese sulphate also reduced the disease severity by 42.0 and 42.7%. Sharma and Duveiller (2004) and Sharma *et al.* (2005) have also observed that K reduces the incidence of various diseases for instance bacterial leaf blight, stem rot, sesame leaf spot in rice, stem rust in wheat and sugary disease in sorghum, leaf spots in groundnut and seedling rot of mungbean (*Rhizoctonia solani*). Wadhwa *et al.* (2014) found that soil application with Zn at 20 mg/kg, as soil-nutritive agent, played an important role in defense mechanism and provided resistance in cluster bean seedlings against *Rhizoctonia* root rot by enhancing the activity of antioxidative enzymes, which helps in fungal invasion.

On the basis of experimental findings, it can be concluded that seed treatment with hexaconazole (0.2%) and drenching with carbendazim + mancozeb (0.25%) at 20 days after sowing results in significantly higher disease control with increased pod yield. Among nutrients, copper was found effective possibly through dual role, one as fungitoxic effect and another as plant nutrition provider, in increasing pod yield by reducing disease incidence.

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