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Management of collar rot disease of groundnut incited by *Aspergillus niger* through seed treatment

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Abstract
Groundnut (*Arachis hypogaea* L.) is an economically important edible oil seed crop of the world. Collar rot disease incited by *Aspergillus niger* is the major constraints in groundnut crop in Rajasthan and almost all groundnut growing states. Field experiment was conducted to find out effective seed treatment fungicides and bioagents (Mancozeb, Carbendazim, Tebuconazole, Hexaconazole, *Trichoderma, viride* alone and soil application with *T. viride* and seed treated with tebuconazole) for control of collar rot of groundnut. All the treatments recorded significantly more seedling emergence (84.20 - 95.23%) in comparison to control (72.62%). The highest seedling emergence (95.29%) was recorded where soil application with *T. viride* and seeds treated with tebuconazole. Among fungicides and bioagents, minimum disease incidence (8.15%) and maximum pod yield (21.33 q/ha) was recorded by soil application with *T. viride* and seed treated with tebuconazole followed by seed treatment with tebuconazole disease incidence (10.53%) and pod yield (20.71 q/ha) in comparison to other treatments.

Keywords: Groundnut, Collar rot, *Aspergillus niger*, *Trichoderma viride*

Introduction
Groundnut (*Arachis hypogaea* L.) is an economically important edible oil seed crop of the world. Groundnut is believed to be a native of Brazil (South America) and it has been introduced to East Asia from South America (Weiss *et al*. 2006) [9]. In India, though groundnut is cultivated in one or more seasons (*Kharif and Rabi* and summer) but nearly 80 per cent of the annual acreage and production comes from *Kharif* crop (June to October) season. This crop is primarily grown on a commercial scale in more than 82 countries in the world, including this country. In India, the total coverage area under groundnut is about 6.09 million hectares and production is of 10.21 million tonnes with average productivity of 1676 kg/hectare (Anon., 2020-21). Major groundnut growing states of India are Gujarat, Andhra Pradesh, Rajasthan, Karnataka, Maharashtra and Tamil Nadu. Among these states, Gujarat stand first in production while Andhra Pradesh in area. Rajasthan stands seventh in terms of area and production both. The cultivation of groundnut is well adapted to the conditions prevailing in Rajasthan and is cultivated in about 0.87 million hectares with annual production of 14.04 lakh tonnes and productivity of 2256 kg/hectare (Anon., 2020-21).

The groundnut growing major districts in Rajasthan are Bikaner, Jodhpur, Churu, Hanumangarh, Jaipur, Sikar, Nagaur and Dausa. Among the districts, Bikaner stands first in area (2.57 lakh hectares) and production (6.10 lakh tonnes) followed by Jodhpur (Anon., 2020-21). The kernels of groundnut are chiefly known for cheap source of vegetable protein. The kernels are rich source of oil (45%), protein (25.33%), carbohydrate (0.20%), fat (40.50%), fiber (3.4%) and ash (1.9%). Though, as source of oil, the groundnut finds its important use, consequently gaining the status as “King of oil seed crops”.

Groundnut is a crop which is severely suffers from several important diseases caused by fungi, bacteria, viruses. The key limiting factor in profitable cultivation of groundnut in Rajasthan is the attack of several diseases mainly incited by fungi, which takes heavy toll of the crop at all the stages of growth right from sowing to harvest and storage such as early leaf spot (*Phaeoisariopsis arichidicola*), late leaf spot (*Phaeoisariopsis personata*), rust (*Puccinia arichidis*), collar rot (*Aspergillus niger* van Tieghem), stem rot (*Sclerotium rolfsii* Sacc.), root rot (*Macrophomina phaseolina*), and afla root (*Aspergillus flavus*). Among the soil borne diseases of groundnut, collar rot caused by *Aspergillus niger* is an important disease. The collar rot (*Aspergillus niger*) of groundnut is an important seed and soil borne disease. (Rakholiya *et al*. 2012) [6].

It was first reported the *Aspergillus* blight of groundnut caused by *A. niger* in India by Jain and Nema (1952) [8]. This disease appears in pre and post-emergence phase. The seed may rot in the soil or be covered with sooty black masses of spore on germination (Kumari M, Singh M 2016) [14]. Collar rot causes heavy losses in pod and fodder yield of groundnut. *A. niger* is a saprophyte, filamentous fungus having smooth walled, hyaline conidiophores. Conidia are globose to sub globose (1.38µm-4 µm diameter), dark brown to black and rough walled (Jochem 1926) [9]. In Rajasthan due to warm climates grains are easily infected with *Aspergillus niger*. Annual world yield losses by the disease are more than 10% and fungus is prevalent in soils with the low moisture and approximately 30 °C temperature (Karthikeyan 1996, Kucuk and Kivank 2003) [11, 13]. The maximum disease incidence (25-50%) was reported in Rajasthan (Kishore *et al.* 2006) [12]. Many seed dressing fungicides are reported to be effective against collar rot of groundnut (Gangopadhyay *et al*. 1996) [4]. Looking to the losses due to this disease, field testing of combine molecules of fungicides and bioagents were necessary as a seed treatment to find out effective seed dresser fungicide for control of collar rot disease.\

Material and Methods

The field experiment was conducted during *Kharif* 2021-22 at Department of Plant Pathology S.K.N. College of Agriculture, Jobner, Sri Karan Narendra Agriculture University, Jobner, Jaipur (Rajasthan). The region falls under semi-arid eastern plain (Agro Climatic Zone- lll A) of Rajasthan. Sowing was done in the last week of June using RSG-10 cultivar of groundnut. The experiment was laid out in Randomized Block Design (RBD) with three replications and seven treatments with control using a 40×15 cm and with plot size of (3 m×2 m) for each treatment to find out effective seed treatment fungicides and bioagents (Mancozeb (2.0g/kg), Carbendazim (2.0g/kg), Tebuconazole (1.5 ml/kg), Hexaconazole (1.5 ml/kg) seed treat with *Trichoderma, viride* (8.0g/kg), alone and soil application with FYM + *T. viride* (50kg + 2.5 kg/ha), and seed treated with tebuconazole (1.5 ml/kg) along with check) for control of collar rot of groundnut. Observations of germination percentage, disease incidence and pod yield were recorded. The recommended package of practices was followed for the trial.

Percent collar rot incidence was calculated by following formula

$$\% \text{ disease incidence} = \frac{\text{Number of rotted plants}}{\text{Total number of plants}} \text{x } 100$$

The per cent disease control (PDC) over control was calculated as

$$\text{PDC over control} = \frac{\text{PDI in control} - \text{PDI in treatment}}{\text{PDI in control}} \times 100$$

The yields were recorded after harvesting the crop at maturity and the weight of pods at every plot separately for calculate the yield per hectare.

Table 1: Fungicides with following details were used under field conditions

S.N.	Common Name	Trade Name	Dose (%)
1	Mancozeb 75% WP	Dithane M-45	2.0g/kg
2	Carbendazim 50% WP	Bavistin	2.0g/kg
3	Tebuconazole 25.9% EC	Folicur	1.5 ml/kg
4	Hexaconazole 5%SC	Contaf	1.5 ml/kg
5	*Trichoderma viride*	-	8.0g/kg
6	*SA with *T. viride* +ST with Tebuconazole	-	Soil application with 2.5 kg *T. viride* /ha + Seed treatment with Tebuconazole 1.5 ml/kg
7	Control (Untreated)	-	-

Results and Discussion

The result of the experiment is presented in Plate 1, Table 1 & Fig. 1. It was very clear that all the treatments reduced the disease significantly compared to the control (untreated) plot. The efficacy of various fungicides and bioagent was evaluated for management of collar rot of groundnut by seed treatment before sowing under field conditions. All the treatments recorded significantly more seedling emergence (84.20 - 95.23%) in comparison to control (72.62. %). The highest seedling emergence (95.23%) was recorded where soil application with *T. viride* and seeds treated with tebuconazole. Among all treatments soil application with *T. viride* and seed treated with tebuconazole was found most effective against collar rot the minimum 8.15 per cent disease incidence was recorded by decreasing 79.38 per cent disease incidence which was significantly superior over other treatments. However, seed treatment with tebuconazole was second best and recorded 10.53 per cent disease incidence by decreasing 72.85 per cent disease incidence. Hexaconazole, carbendazim and *Trichoderma* were observed statistically at par with 13.81, 14.65 and 17.06 percent disease incidence. Among the fungicides maximum 18.25 per cent disease incidence was recorded in the treatment of mancozeb.

Analysis of yield data of groundnut was found statistically significant over control. Result showed that maximum 21.33 q/ha yield was recorded in soil application with *T. viride* and seeds treated with tebuconazole with increasing 60.25 per cent yield followed by seeds treated with tebuconazole 20.71 q/ha yield with increasing 55.59 per cent yield. Hexaconazole, carbendazim and *Trichoderma* recorded 18.30 q/ha, 17.50 q/ha and 16.60 q/ha yield respectively. Minimum 13.31 q/ha yield was recorded in control.

The results of this study indicate that integrated diseases management has great potential to be used to manage disease effectively and eco-friendly for the betterment of the end users. These results are in agreement with the findings of Prajapati *et al.* (2016) [15]**.** 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) [7] evaluated ten systemic seed dressing 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) [10] recorded seed treatment and two foliar spray of tebuconazole highly effective in controlling collar rot disease. Harsukh *et al.* (2011) [6] also reported that seed treatment with *Trichoderma* reduced the disease incidence in susceptible and tolerant varieties at 15 DAS, under *A. niger* infection. Seed treatment with biocontrol agents like *Trichoderma viride*, *T. harzianum* has shown some benefits in managing the collar rot of groundnut and other soil borne diseases (Gangwar *et al.* 2014) [5] (Rawal *et al.* 2013) [17], (Sharma *et al.* 2017) [18].

Plate 1: Healthy groundnut plants Infested groundnut plant Microscopic view of *Aspergillus*

Table 1: Effect of seed treatment with fungicides and bioagents on collar rot disease of groundnut under field conditions

Treatments	Germination (%)	Percent disease incidence* (%)	Disease Control (%)	Yield (q/ha)	Increase in yield over control (%)
Mancozeb	84.2 (66.62)	18.25 (25.02)	53.11	15.85	19.08
Carbendazim	89.43 (71.06)	14.65 (22.47)	62.86	17.50	31.48
Tebuconazole	92.14 (75.66)	10.53 (18.80)	72.85	20.71	55.59
Hexaconazole	90.69 (72.28)	13.81 (21.77)	66.19	18.30	37.49
Trichoderma viride	85.26 (67.43)	17.6 (24.80)	55.19	16.60	24.71
SA with *T. viride* + ST with Tebuconazole	95.23 (77.80)	8.15 (16.50)	79.38	21.33	60.25
Control (Untreated)	72.62 (58.63)	39.67 (39.00)	-	13.31	-
S.Em.±	1.32	1.48	-	0.68	-
CD (p=0.05)	3.71	4.61	-	2.06	-
CV	6.50	10.65	-	6.66	-

*Average of three replications
Figures in parentheses are angular transformed values

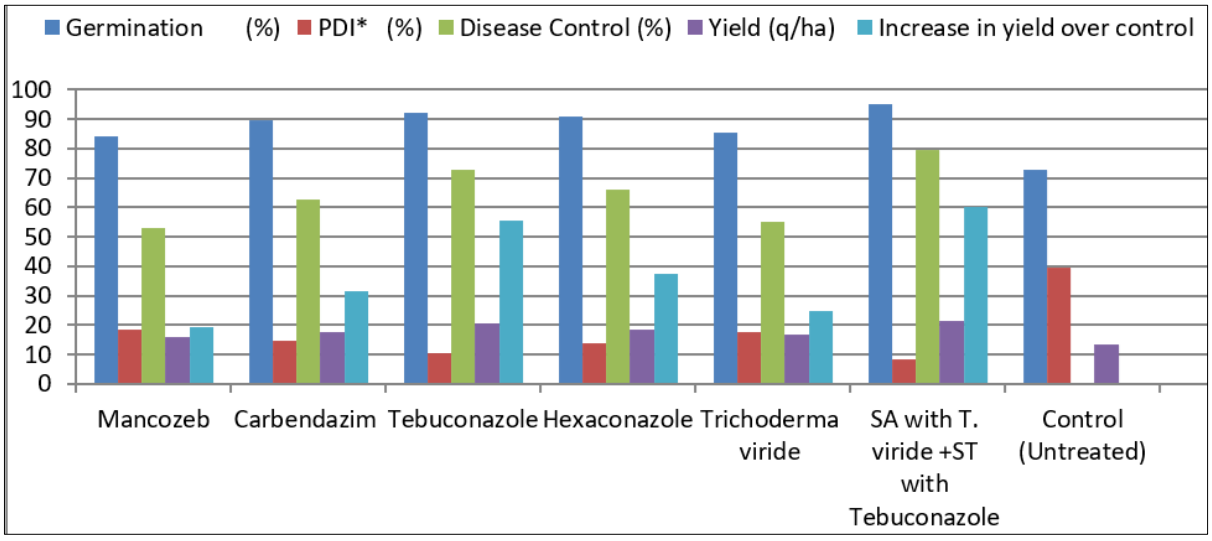

Fig 1: Effect of fungicides on powdery mildew of mustard under natural field condition

Conclusion

Among fungicides and bioagents, minimum disease incidence (8.15%) and maximum pod yield (21.33 q/ha) was recorded by soil was treated with *T. viride* and seed treated with tebuconazole followed by seed treatment with tebuconazole disease incidence (10.53%) and pod yield (20.71 q/ha) in comparison to other treatments.

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