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Management of Collar Rot in Groundnut in Coastal Sandy Soils of Andhra Pradesh

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ABSTRACT

This study investigated the efficacy of Integrated Disease Management (IDM) compared to Farmer's Practices (FP) for controlling collar rot disease in groundnut cultivated on coastal sandy soils in the Sri Potti Sriramulu Nellore district of Andhra Pradesh, India. A survey in the *rabi* season (2019-2020) revealed significant variation in disease incidence across locations, with factors like previous crop and seed treatment influencing severity. Seed treatment with carbendazim or mancozeb significantly reduced disease compared to untreated plots. Locations with watermelon as the previous crop and those lacking organic amendments like FYM exhibited higher disease incidence. A field experiment evaluated IDM practices consisting of seed and seedling protection with fungicide (Tebuconazole @ 1g/Kg), soil application of biocontrol agent (FYM enriched with *Trcihoderma asperellum*) and need based *in situ* fungicidal application (hexaconazole @ 2ml/L) and farmer's practices treatments on disease incidence at 10, 20, and 30 days after sowing (DAS). IDM consistently resulted lower disease incidence at all stages compared to FP. At 10 DAS, IDM showed a 2.46% disease incidence compared to 10.04% for FP ($p < 0.05$). This trend continued at 20 DAS (5.87% vs 17.64%, $p < 0.05$) and 30 DAS (6.64% vs 24.35%, $p < 0.05$). These findings suggested that IDM practices effectively suppress collar rot development, possibly through a combination of cultural, chemical, and biological control measures.

Key Words: *Aspergillus niger*, Coastal sandy soils, Collar rot, Groundnut, Management.

INTRODUCTION

The groundnut (*Arachis hypogaea* L.) production in India faces a decline due to various biotic and abiotic stresses. Among biotic stresses, fungal, bacterial, and viral diseases significantly impact yield. Soil borne fungal diseases are particularly noteworthy, posing a major threat with the potential for substantial yield losses. Collar rot disease caused by the omnipresent and highly destructive fungus *Aspergillus niger* van Teighem (Vimal Kumar and Saifulla, 2017), this soilborne and seedborne disease is prevalent in almost all groundnut-growing regions globally. Studies have reported alarmingly high disease incidence of 28-50% in Maharashtra (Dighule *et al*, 2018).

Groundnut, is also a significant commercial crop in Andhra Pradesh, thrives across diverse soil types, primarily in red soils. However, some locations in the state's coastal regions, particularly in SPS Nellore, Prakasam, Guntur, and Krishna districts, have seen groundnut cultivation expand into coastal sandy soils (Mohan *et al,* 2018). These coastal sandy soils, prevalent along the coastline, are characterized by several challenges for sustainable agriculture. They are known for their light texture, low nutrient content, limited water holding capacity, and reduced biological activity. Furthermore, they often exhibit low cation exchange capacity (CEC), deficiencies in essential micronutrients like zinc and boron, and generally low fertility, making them unsuitable for most crops. Despite these unfavorable conditions, farmers in these regions have developed unique local practices to cultivate groundnut and sustain their livelihoods. In the Vidavaluru and TP Gudur

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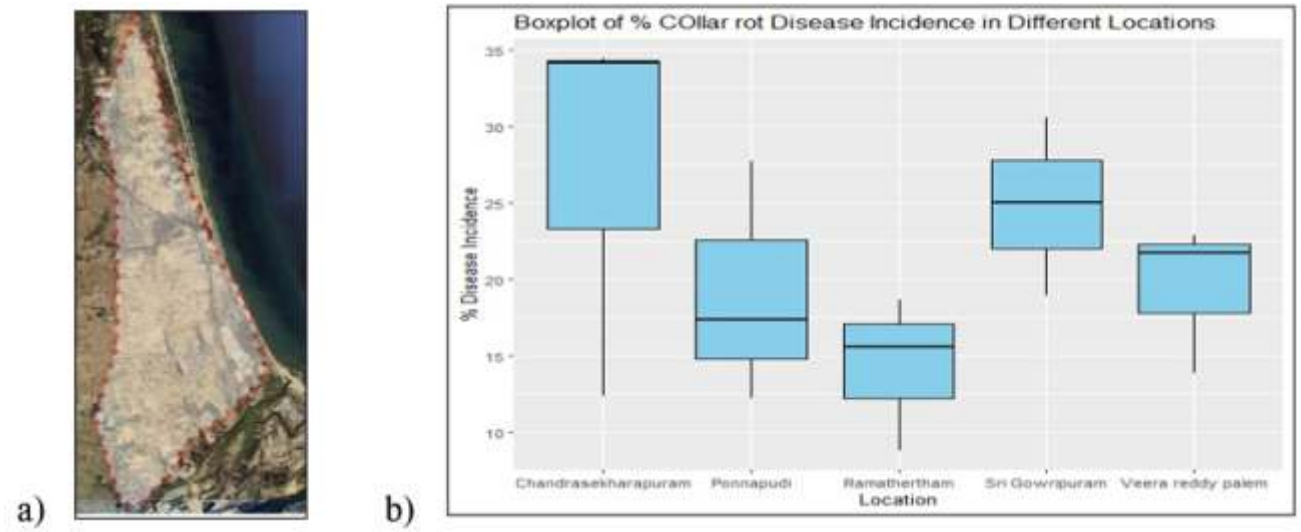

Fig 1: a) Geographical area showing groundnut cultivation in Coastalareas of SPSR Nellore district, AP
b) Boxplot showing collar rot disease incidence surveyed areas

Fig 2: Collar rot symptoms observed in the field

mandals of SPSR Nellore district, a specific case study exists. This area, encompassing ten settlements spread across three revenue villages, has witnessed intensive monoculture of groundnut covering roughly 1618.74 hectares for the past three decades. Notably, groundnut cultivation serves as the sole source of income for all farmers in this region. During past years (2015-17), there was an incremental increase in disease occurrence of collar rot in this region. Therefore, experiment in this area in collaboration between KVK researchers and farmers were taken up to develop location-specific interventions and technologies that can benefit not only this specific ecosystem but also similar coastal sandy soils where groundnut cultivation is prevalent.

MATERIALS AND METHODS

A survey was conducted in 15 random locations of Vidavalur and TP Gudur mandals of SPSR Nellore district of Andhra Pradesh during *rabi* 2019-20 (Fig 1). During the survey the essentially percent disease incidence was calculated along with other parameters presented in Table 1. Micronutrient status of surveyed locations was collected from Soil Health Cards

(SHCs) provided to respective farmers by State Department of Agriculture, Andhra Pradesh. The per cent disease incidence in these areas was calculated using the following formula (5 random locations in each field in one sq metre area)

A management trial with two treatments were analysed in 10 locations in farmer's fields (0.25 ha each) on susceptible groundnut variety TAG-24. The management module (IDM) consisted of seed treatment with tebuconazole 5.36 % w/w FS @ 1 g /kg of seed, *Trcihoderma asperellum* (Regional Agricultural research Station (ANGRAU), Tirupati) application @ 2kg with 90 kg FYM and 8 kg Neem cake before sowing and need based soil drenching with hexaconozole 5% SC @ 2 ml/L was evaluated against the farmers' practice. Farmers' practice consisted of either no fungicidal treatment or treatment with mancozeb 75% WP @ 2.5g/kg seed was considered as another treatment. The observations on disease incidence were recorded 10, 20 and 30 days after sowing, while pod yield recorded at 10 days after harvest.

RESULTS AND DISCUSSION

The survey data on collar rot disease incidence in groundnut during the *rabi* season of 2019-20 revealed significant variation in disease incidence percentages. During early stages of crop growth, the main symptoms of infected seeds were black masses of spores covering the seeds with soft, watery internal tissues (seedling blight) or brown, circular spots appearing on the young seedling's cotyledons (crown rot). Discolored spots on the stem at the collar region were observed in subsequent stages. The affected area on the stem becomes soft and rotten leading to wilting and death of the plants (Fig 2). Chandrasekharapuram recorded the highest disease incidence at 34.20%, and Ramathertham exhibited relatively lower disease incidences of 8.81% and 15.61%. The results revealed seed treatment with fungicide carbendazim and mancozeb resulted in a disease lower disease incidence of 15.61% and 18.98% respectively, which was significantly lower compared to the untreated plots (Table 1, Fig1b) overall with an exception at one location (Ramatheerthm, 8.81%). The variety TAG-24 was consistently used across all locations, and despite similar varietal choices, disease incidence varied. This indicates that other factors, such as soil health and management practices, might have contributed to disease development. The deficit micro-nutrient status was reported in all locations obtained from soil health cards, suggesting higher collar rot disease incidence. FarmYard Manure (FYM) application in some locations associated with relatively less disease incidence indicating possible disease suppression by beneficial microbial activity. Thus, the survey data suggested that collar rot disease incidence is influenced by a combination of factors, including seed treatment, previous crop, micro-nutrient status, and organic amendments emphasizing the importance of diversified and sustainable agricultural practices.

This study also investigated the efficacy of Integrated Disease Management (IDM) compared to Farmer's Practice (FP) in controlling collar rot disease in groundnut at different growth stages. The mean percentage of collar rot disease incidence in IDM and FP treatments at different stages of groundnut growth is presented in the Table 2 (Fig 2). Notably, IDM consistently recorded lower disease incidence compared to FP at all stages. IDM showed 2.46% disease incidence, significantly lower than FP with 10.04% indicating a highly significant difference after 10 DAS. The same trend was observed after 10 days from initial observation (20 DAS) wherein IDM exhibited 5.87% disease incidence, while FP records a significantly higher collar rot incidence (17.64%) implying the substantial disparity (Pvalue <0.05). IDM maintained its effectiveness with 6.64% disease incidence, as compared to FP's 24.35% even after 30DAS (Pvalue<0.05). The findings affirm the superiority of IDM over FP in managing collar rot disease in groundnut. The consistent reduction in disease incidence across all observations demonstrated the efficacy of integrated disease management practices. The IDM treatments constituting a combination of cultural, chemical, and biological control measures, have demonstrated their ability to suppress the development of collar rot. Seed

Table 1: Survey data on collar rot disease incidence in Groundnut during*abi* 2019-20								
Sr.No.	Place	% Disease incidence	Days after sowing	Seed treatment	Previous crop	Variety	Micro-Nutrient status	Organic manure applied/Not
1	Ramathertham	8.81	10	No	Water melon	TAG-24	Deficit	FYM
2	Ramathertham	18.63	10	Yes (Carbendazim)	Water melon	TAG-24	Deficit	FYM
3	Ramathertham	15.61	15	Yes (Carbendazim)	Groundnut	TAG-24	Deficit	FYM
4	Veera reddy palem	22.90	15	No	Groundnut	TAG-24	Deficit	Not applied
5	Veera reddy palem	13.90	15	No	Groundnut	TAG-24	Deficit	FYM
6	Veera reddy palem	21.75	12	No	Groundnut	TAG-24	Deficit	Not applied
7	Sri Gowripuram	30.58	15	No	Groundnut	TAG-24	Deficit	Not applied
8	Sri Gowripuram	18.98	20	Yes (Mancozeb)	Groundnut	TAG-24	Deficit	FYM
9	Sri Gowripuram	25.02	20	No	Groundnut	TAG-24	Deficit	Not applied
10	Chandrasekharapuram	34.20	15	No	Groundnut	TAG-24	Deficit	Not applied
11	Chandrasekharapuram	12.39	10	No	Watermelon	TAG-24	Deficit	Not applied
12	Chandrasekharapuram	34.49	15	No	Groundnut	TAG-24	Deficit	Not applied
13	Ponnapudi	17.40	13	No	Watermelon	TAG-24	Deficit	FYM
14	Ponnapudi	27.75	10	No	Groundnut	TAG-24	Deficit	Not applied
15	Ponnapudi	12.22	8	No	Groundnut	TAG-24	Deficit	Not applied
Mean		20.97						
St. deviation		8.08						

Table 2. Collar rot incidence at different stages groundnut in IDM and Farmer's Practice

Sr.No.	Collar rot per cent disease incidence					
	10 DAS*		20 DAS		30 DAS	
	IDM	FP	IDM	FP	IDM	FP
1	1.93	10.32	6.24	14.79	6.30	24.63
2	2.68	8.77	6.47	12.63	6.54	18.22
3	2.11	14.23	7.89	25.13	8.20	25.70
4	2.82	7.00	5.10	10.65	6.11	17.89
5	2.91	12.57	4.73	22.01	5.11	29.27
6	1.57	9.10	3.92	13.44	4.01	22.00
7	2.29	5.88	5.63	19.76	8.21	24.15
8	2.84	13.45	7.25	24.71	8.64	30.17
9	2.33	7.32	6.01	24.05	7.00	29.11
10	3.10	11.79	5.45	9.23	6.30	22.33
Mean	2.46	10.04	5.87	17.64	6.64	24.35
St.error	0.70	1.70	1.08	2.48	1.20	2.09
P-value	<0.05		<0.05		<0.05	
t Stat	8.17		5.9		12.17	

*DAS-Days after Sowing

treatment and soil health management play crucial role for management of collar rot in intial stages of crop growth which was addressed through above treatments

In contrast, the higher disease incidence in FP suggested that traditional or conventional farming practices may be less effective in mitigating collar rot. Farmers who are relying solely on routine practices may benefit by adopting integrated disease management strategies to enhance crop health and yield. Fungus *Aspergillus niger* can devastate crops, especially during the vulnerable seedling stage. Studies have shown that seed treatment with fungicides can significantly reduce these losses. Kumari *et al* (2016) identified Companion (a combination of carbendazim and mancozeb) as the most effective fungicide, followed by carbendazim and vitavax. Nathawat *et al* (2014) identified tebuconazole and propiconazole as

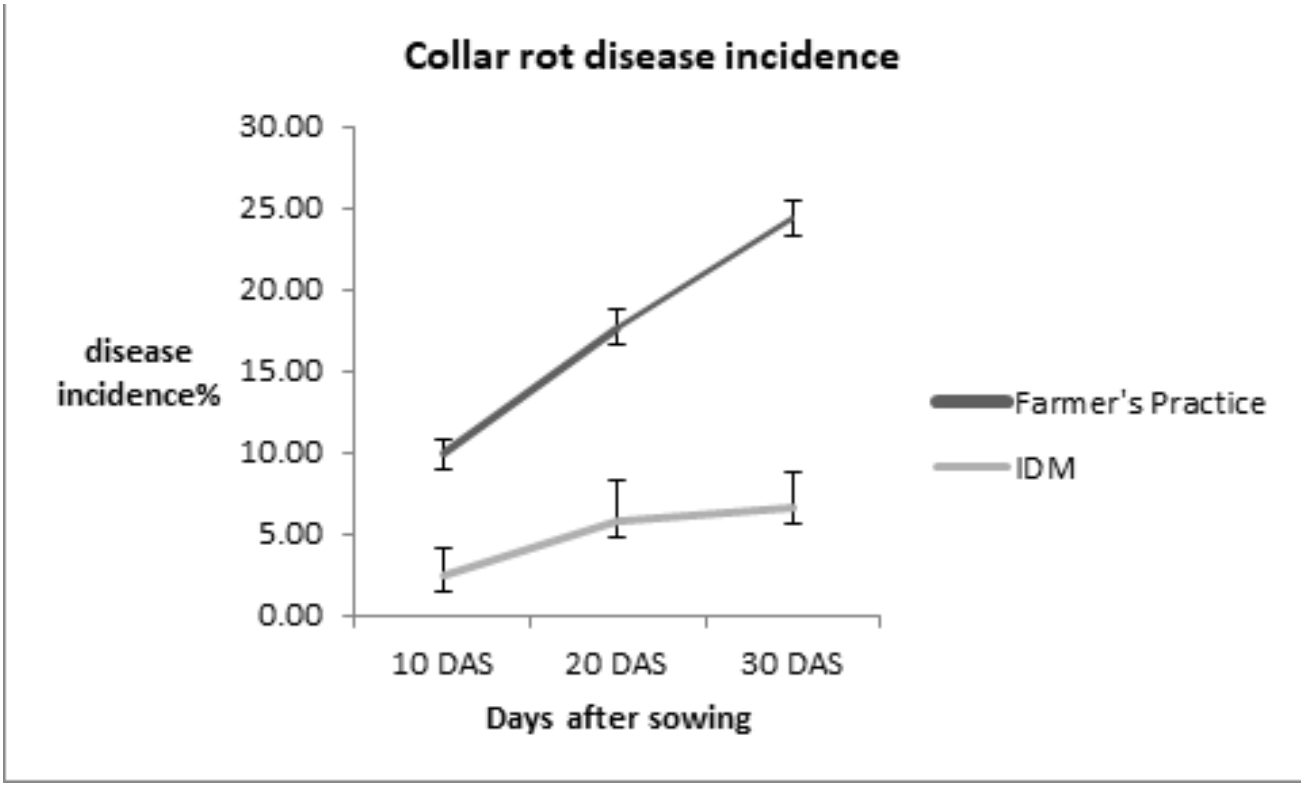

Fig 2: Graphical representation of collar rot incidence over 30days of sowing in two treatments

highly effective fungicides. Jadon *et al* (2015) evaluated ten fungicides against major soilborne diseases of groundnut. Their research found tebuconazole 2 DS @1.5 g/kg seed, mancozeb 75% WP @3 g/kg seed, and carbendazim 12% + mancozeb 63% WP @3 g/kg seed to be very effective in managing soilborne diseases, including collar rot. This finding corroborated with Kapadiya and Moradiya's (2017) work, where it was observed that seed treatment and two foliar sprays of tebuconazole were highly effective in controlling collar rot disease.

Charitha *et al* (2009) observed that *Trichoderma* species and *Pseudomonas fluorescens* displayed antifungal properties against *A. niger* in pot culture experiments. Furthermore, their study demonstrated that combining *T. viride* seed treatment with the fungicide Captan significantly reduced collar rot disease incidence in peanuts. Latha (2013) demonstrated the collar rot incidence was least (20.4%) in bioformulation mixture of Pf1 (*P fluorescens*)+ Tv1 (*T. viride*) + neem cake + FYM as against 60.0% in untreated control. The maximum pod yield was recorded in Pf1+Tv1+ Neem cake + FYM (1321kg ha) which was significantly high over the untreated control (933 kg ha). This suggests that IDM practices are more effective in enhancing crop productivity. IDM's higher BC Ratio also suggests that it provided a better return on investment compared to FP (Table 3).

CONCLUSION

This research investigated factors such as micronutrient deficiencies, non-fungicidal seed treatment, monoculture are contributing collar rot disease incidence in groundnut, a major problem for groundnut cultivation in sandy soils of SPSR Nellore district. The study also revealed the importance of IDM through seed treatment with fungicide and soil enrichment with bio control agents and organic matter in reducing collar rot disease incidence in early stages of groundnut cultivation. Other potential cultural practices such as crop rotation, incorporation of green manure crops, organic amendments *etc* needs to be explored further to improve soil health against collar rot for sustainable yields.

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