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Front line demonstration of technological interventions for collar rot and stem rot management in groundnut in southern telangana zone

A. Ramulamma*[1], S. Srinivasarao[2], K. Chandrashaker[1], S. Pallavi[1], T. Himabindu[1], M. Shankaraiah[3], M. Shankar[4] and T. Bharath[5]

[1]*Krishi Vigyan Kendra, Kampasagar, Professor Jayashankar Telangana Agricultural University, Hyderabad – 500 030, Telangana, India*
[2]*AICRP on Forage crops, Rajendranagar, Professor Jayashankar Telangana Agricultural University, Hyderabad – 500 030, Telangana, India*
[3]*AICRP on Micronutrients ISHM, ARI, Rajendranagar, Professor Jayashankar Telangana Agricultural University, Hyderabad – 500 030, Telangana, India*
[4]*RegionalAgricultural Research Station, Palem, Nagarkarnool, Professor Jayashankar Telangana Agricultural University, Hyderabad – 500 030, Telangana, India*
[5]*Agricultural Research Station, Madhira, Khammam, Professor Jayashankar Telangana Agricultural University, Hyderabad – 500 030, Telangana, India*

ABSTRACT

AIMS: *Groundnut is an important legume oilseed crop grown in India. It is known as the "King of Oilseeds" in India. Groundnut cultivation is often subjected to significant yield losses annually due to biotic and abiotic stresses. Stem rot and collar rot are major diseases in groundnut, causing significant yield losses. Stem rot, caused by Sclerotium rolfsii Sacc, and Collar rot, caused by Aspergillus niger, are both soil-borne pathogens that survive in the soil for many years. These are the major constraints to groundnut (Arachis hypogaea L.) production in India. Stem rot causes a yield loss of about 25 – 80 %. Collar rot is a seed and soil-borne disease that affects groundnut in tropical and subtropical climates. It causes significant yield losses and deteriorates kernel quality. Therefore, to minimise the yield losses due to the incidence of collar rot and stem rot diseases in Groundnut, the present study was conducted to identify the strategy of disease management through the adoption of technological interventions in Groundnut crop. This will be useful to enhance the groundnut area in Telangana.*

Place and Duration of Study: *The study was conducted during the rabi seasons of 2021-22, 2022-23, and 2023-24 at farmers' fields of Southern Telangana Zone by Krishi Vigyana Kendra, Kampasagar, Nalgonda district, Professor Jayashankar Telangana Agricultural University, Telangana, India.*

Methodology: *A total of 30 demonstrations(10 demonstrations per year) were conducted in farmers' fields under natural epiphytotic field conditions of Nalgonda district during 2021-22, 2022-23, and 2023-24 as a front-line demonstration (Demo plot). The groundnut fields without the application of technological interventions were taken as the Farmers' Practice (Control plot). Disease estimation in the demo plot and control plot was done as per the standard methodology to assess the Performance.*

Result: *The result of study revealed that, with the following of technological interventions i.e., Seed treatment with tebuconazole @ 1g/kg seed, Soil treatment with Trichoderma harzinaum developed by mixing 180 kg FYM + 20 kg neem cake + 4 kg Trichoderma harzinaum and Soil drenching with tebuconazole @ 1ml/l around the infected plants in Demo plot the yields were enhanced (19.9%) compared with existing farmers practice. Recorded minimum collar rot incidence (10.08%), stem rot incidence (11.91%), and highest pod yield (3664 kg/ha). Significantly, demonstrations were superior as compared to existing farmers' practice, where maximum collar rot incidence (28.24%) and stem rot incidence(23.43%) minimum pod yield (30.53 kg/ha) were recorded. As regards BCR, the maximum BCR ratio (3.03) was recorded in demonstrations.*

Conclusion: *Overall, the results revealed the scope of integrating the bio agents with fungicides in managing the collar rot and stem rot diseases in groundnut.*

Keywords: *Groundnut, collar rot, stem rot, Diseases, Demonstration, Extension gap, Farmers' practice, BCR, Technological intervention.*

1. INTRODUCTION

Groundnut (*Arachis hypogaea L.*) is an important self-pollinated food and oilseed crop. It is a rich source of oil (48-52%), protein (24-30%), sugar (5-8%), and dietary fiber (8.5%), which provides 564 kcal of energy. It is the 13th most important food crop and the 4th most important oilseed crop of the world [1]. In India, it is one of the important tropical oilseed crops [2][3]. India stands first in groundnut area (54.20 lakh ha) in the world and second in terms of production (101.00 lakh tonnes) with a productivity of 1863 kg/ ha during 2021-22 [4]. Most of it is cultivated by small and medium farmers in the semi-arid zones of India [5]. In Telangana, Groundnut has been sown in around 6859.2 ha with a productivity of 2050 kg ha-1 [6]. The Districts of Southern Telangana Zone, i.e., Gadwal district, occupies the first position in terms of area coverage, 3024.8 ha, followed by

*Corresponding Author: ***A. Ramulamma***

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Wanaparthy (1862.0 ha) under groundnut cultivation.

Groundnut cultivation is often subjected to significant yield losses annually due to biotic and abiotic stresses, which are the major limiting factors for attaining high productivity in India. Constraints are many and varied, for Groundnut production, but diseases are generally regarded as major constraints throughout the region [7]. More than 55 diseases have been reported so far to cause considerable losses in groundnut [8][9][10]. Amongst these diseases, the collar rot incited by *Aspergillus niger* van Tiegham and stem rot caused by the fungus *Sclerotium rolfsii* are both the most damaging [11] [12][13][14], with up to 40% losses [15]. It is a widespread disease that occurs during the seed and seedling stages. The disease manifests as pre-emergence seed rot and post-emergence collar rot in the seedlings as Aspergillus blight [16]. The disease is more widespread at high temperatures of about 30±1°C. Occasionally, collar rot can persist up to the crop harvesting stage, thereby, causing damage to the seeds [17]. A survey in Telangana and Andhra Pradesh states indicated that the disease incidence of collar rot and stem rot was high, 16.82% and 10.06% in Telangana, because groundnut is grown as a sole crop under irrigated conditions. Up to 30% yield losses were recorded in India by various researchers in farmers' fields. The incidence of stem rot and Collar rot has been enhanced year by year due to the spread of the host range of the pathogen and survival of the sclerotia for several years in the soil.

Management of the diseases in the groundnut field are still challenging due to lack of profitable rotational crops and fresh tillable land, poorly structured farm programmes, un decomposed previous crop residues in the field which act as substrate for the fungal growth, tolerance of the pathogen to the fungicide and unavailability of resistant varieties to the groundnut growers [18]. However, there are few technological interventions in groundnut production reported to reduce the incidence of stem rot and collar rot diseases [19].

2. MATERIAL AND METHODS

The districts of the Southern Telangana Zone have major Groundnut cultivating districts in Telangana. The Present study was undertaken in the districts of the Southern Telangana zone by Krishi Vigyan Kendra, Kampasagar. Selected suitable farmland in 3 villages, namely Errabelly of Nidmanoor mandal, Indugula of Thipparthy mandal, and Nellikal village of Thirumalagiri Sagar mandal, during the *rabi* seasons 2021-22, 2022-23, and 2023-24. The area of 12 hectares was covered in all 3 villages of 3 mandals in sandy loamy soils with irrigated conditions. The study was conducted with the active participation of farmers to demonstrate the technological interventions for collar rot and stem rot disease management in Groundnut, so as to establish production potentials and expand the area under the crop in the district. The present study with respect to Demonstrations and farmers' practices is given in Table 1. The soils in selected villages were sandy loam. Farmers were trained to follow the package of practices for groundnut cultivation as recommended by the State Agricultural University, and need-based input materials were provided to the farmers.

2.1 Implementation design

Groundnut production technology with the improved variety Kadiri Lepakshi was used for the demonstration. The good agronomic practices were followed to raise the groundnut crop during the third week of November for all the years of the *rabi* season 2021-22, 2022-23, 2023-24, respectively. The row planting method was employed, and a spacing of 30cm between rows and 10 cm between plants was used for the demonstration trial. The recommended seed rate of 200 kg/ha was used for sowing. The observations on disease incidence throughout the crop season, starting from 15 days after sowing up to 15 days before harvest, were recorded.

Table 1. Particulars showing the details of Groundnut grown under FLD (Demonstrations) and farmers' practice

Operation	Farmers' practice	Demonstrations
Sowing	Manual dibbling (proper spacing not maintained)	Spacing 30 cm between rows and 10 cm between plants.
Use of variety	Kadiri 6	Kadiri Lepakshi(K 1812)
Seed treatment	No seed treatment	Seed treatment with tebuconazole @ 1.25g/kg seed
Collar rot and stem rot	No tolerance	Multiple resistances to drought, pests, and diseases
Weed management	No Weed management	Weeds control by using herbicide Pendimethalin 1kg / ha in 500 liter of water as pre-emergence treatment for effective control of weeds within two days after sowing.
Nutrient management	Blanket application fertilizers	Recommended dose of fertilizers
Pest and disease management	Completely depended on fungicides and Insecticides	All other Management practices followed

Table 2: Details of treatments in FLD (Demonstration) and Farmers' Practice

Farmers' Practice (T1)	Demonstration (T2)
1. Sole dependence on Fungicide application after noticing the disease incidence. 2. Three sprays with fungicides i.e, carbendazim + mancozeb @2.5 g/l, hexaconazole @2ml/l or carbendazym @ 1g/l during the crop period	1.Seed treatment with tebuconazole @ 1.25g/kg seed. 2. Soil treatment with *Trichoderma harzinaum* developed by mixing 180 kg FYM + 20 kg neem cake + 4 kg *Trichoderma harzinaum.* 3. Soil drenching with tebuconazole @ 1ml/l around the infected plants.

2.2 Training

Pre-sowing trainings were organized with involving the selected farmers on the crops. Conducted Farmer training programmes to create awareness and improve the associated skill gap on improved agronomic practices of Groundnut production technology. At each stage of the groundnut production, different awareness creation works were done regarding seed treatment, Soil application and Soil drenching etc.

2.3 Data collection and analysis

The data concerning grain yield from Demonstration plots and from Farmers' Practice in the area were collected and evaluated. Regular visits by the scientist helped in the proper execution of trials as well as collecting farmers' opinions on the demonstration. The performance of the interventions in the trials was judged visually as well as quantitatively by farmers themselves. The potential groundnut yield was calculated using a standard plant population of 404,440 plants per hectare and an average yield per plant of 22.5 grams under the recommended package of practices with 30 X 10 cm crop geometry [20]. Different parameters, as suggested by Samui et al., 2000 [21], were used for gap analysis, and calculating the economics.

The details of different parameters and formulas adopted for analysis are as under.

Extension gap = Demonstration yield - Farmers' practice yield
Technology gap = Potential yield - Demonstration yield
Potential yield - Demonstration yield

Technology index = X 100
Potential yield

Disease incidence (%) = Number of diseased plants ×100
Total number of plants observed

3. RESULTS AND DISCUSSION

3.1 Effect of Technological Interventions

Seed germination (%): Based on pooled data (Table: 3) across the years (rabi, 2021-22, 2022-23, 2023-24), seed germination (plant stand) 77.86% was observed with the treatment of tebuconazole @ 1.25g/kg. In farmers' Practice without seed treatment, the germination (plant stand) percentage was recorded as 73.53. No significant improvement in plant stand was noticed. Several researchers have reported the significant improvement in groundnut seedling stands by protecting the plants from collar rot fungus using tebuconazole [22].

Disease Incidence (%): Results on Front Line Demonstration of Technological Interventions for collar rot and stem rot Management in groundnut in Southern Telangana Zone during rabi, 2021-22, 2022-23, 2023-24 (Table:3) indicated that the seed treatment with tebuconazole, Soil treatment with *Trichoderma harzinaum* developed by mixing 180 kg FYM + 20 kg neem cake + 4 kg *Trichoderma harzinaum and* Soil drenching with tebuconazole @ 1ml/l around the infected plants has recorded minimum collar rot incidence (10.08%), stem rot incidence (11.91%). Significantly, demonstrations were superior as compared to existing farmers' practice, where maximum collar rot incidence (28.24%) and stem rot incidence (23.43%) were recorded.

Prophylactic application of tebuconazole in the present study as seed treatment might have contributed to protecting the seeds from rotting fungi such as A. niger, thereby reducing the subsequent collar rot incidence in the present study. Since the stem rot pathogen S. rolfsii is soil-borne in nature and it is very difficult to manage the pathogen because of its resting structures, sclerotia, which are produced by the pathogen during unfavourable conditions and survive for a longer time in the soil in the absence of the host. Several researchers reported the effect of bioagents and fungicides under field and greenhouse conditions in reducing the incidence and increasing the pod yields. Seed treatment+soil application of bioagent T. harzianum not only reduced the stem rot incidence but also enhanced the pod yields.

Triazoles such as tebuconazole, cyproconazole, and difeniconazole provide excellent control of foliar fungal diseases and some soil-borne diseases, including stem rot. Fungicides belonging to the triazoles group inhibit the biosynthesis of ergosterol, which plays an important role in the structure of cell membrane of fungi [23]. These fungicides have systemic character and can penetrate inside the seed and can be used as seed treatment and applied to green plants safely [24].

Table 3: Percentage of Collar rot and Stem rot incidence in Demonstration and farmers Practice

Perticulars	2021-22		2022-23		2023-24		Pooled Mean	
	Demonstration	Farmers' Practice	Demonstration	Farmers' Practice	Demonstration	Farmers' Practice	Demonstration	Farmers' Practice
% of seed germination	77.5	72.8	74.75	74.2	81.4	73.6	77.86	73.53
% of Collar rot	12.06	29.23	11.32	28.61	6.87	26.90	**10.08**	**28.24**
% of Stem rot	11.29	24.80	14.12	21.3	10.32	24.21	**11.91**	**23.43**

3.2 Yield and yield components

The result of the study revealed that the productivity of Groundnut with its technological interventions was better than the farmers' practice (Table 4). Thus, the mean grain yield of improved sesame was 0.737 ton/ha, and the yield of the local variety was 0.58 ton/ha in similar production years in the study area. This implies that improved sesame had a higher yield advantage over the local variety. This greater yield advantage was achieved through the proper use of recommended technology packages, such as the use of the improved variety, chemicals, seed rates, and good management practices. Production of crop depends on the qualities of the seed [25]. A similar yield result was also reported by Birhane et al 2019 [26]. The result suggested the positive effects of improved technology demonstrations over the existing farmers' practice towards enhancing the yield of sesame, with its positive effect on yield attributes.

3.3 Extension analysis

The study (Table 4) revealed that an extension gap of 610.3 kg/ha was found between demonstrated technology and farmers' practice, which emphasized the need to educate the farmers through various means for the adoption of technological interventions for disease management to reverse this trend of wide extension gap. The technology gap was 336 kg/ha, which was lowest due to better performance of recommended technological interventions and more feasibility of technology during the course of study. Similarly, the technology index for all demonstrations in the study was in accordance with technology gap. The new technologies will eventually lead to the farmers to discontinuance of existing practise with the new technology. The technology index shows the feasibility of the evolved technology at the farmer's field. The lower value of the technology index (8.40) reflects the feasibility of the technology is more [27]. Higher technology index reflected the inadequate transfer of proven technology to growers and insufficient extension services for transfer of technology. Hence, it can be inferred that the awareness and adoption of technological interventions have increased the ground nut yield during the study period. The technology index was (8.40), which shows good performance of demonstrations in Telangana soil conditions and this will accelerate the adoption of newer technologies to increase the productivity of Groundnut in this area.

Table 4: Yield and Extension analysis of Demonstration and Existing farmers practice

Year	Average Yield(kg/ha)		Percent increase in Yield	Technology gap (q/ha)	Extension gap (q/ha)	Technology index (%)
	Front Line Demonstration	Farmers' Practice				
2021-22	3666.3	2975.2	23.2	333.7	691.1	8.34
2022-23	3550.7	3061.3	15.98	449.3	489.4	11.25
2023-24	3775.0	3124.6	20.81	225	650.4	5.62
Mean	3664	3053.7	19.9	336	610.3	8.40

3.4 Economic analysis

Economic returns as a function of pod yield and MSP sale price varied during different years. The maximum gross returns of Rs. 241600/- and net returns of Rs. 186325/- were obtained in the year 2023-24. The higher additional returns and effective pod obtained under demonstrations could be due to reduced incidence of Collar rot and Stem rot, and in the year 2023-24. The mean benefit- cost ratio of demonstrations and farmers' practice was 3.03 and 2.19, respectively (Table 5). Recorded lower Cost of Cultivation in demonstrations, i.e., an average of Rs.3000/- compared with farmers' practice, it may be due to the lower incidence of diseases and reduction of fungicide sprays in demonstrations. Year-to-year variability in cultivation costs can be explained by differences in the local social and economic conditions. The higher cost of production in farmers' practice might be due to the indiscriminate use of chemical fungicides. The findings are in uniformity with the findings of Tunvar et al. (2017), Subbaiah and Jyothi (2019)[28][29].The gross return calculated was presented in Table 5. Demonstration fields recorded higher net returns (Table 5) and benefit cost ratio in comparison to farmers' practice; these results are in line with the results of Sirisha *etal.* (2024)[30].

Table 5: Economic analysis of Demonstration and Farmers' Practice

Year	Cost of Cultivation (Rs/ha)		Gross returns (Rs/ha)		Net Returns (Rs/ha)		B:C ratio	
	Demonstration	Farmers'Practice	Demonstration	Farmers'Practice	Demonstration	Farmers'Practice	Demonstration	Farmers' Practice
2021-22	52860	54,560	203479.7	165123.6	150619.7	110563.6	2.84	2.02
2022-23	53650	58435	209491.3	180616.7	155841.3	122181.7	2.9	2.09
2023-24	55275	57660	241600	199974.4	186325	142314.4	3.37	2.46
Mean	53928.33	56885	218190.3	181904.9	164262	125019.9	3.03	2.19

4. CONCLUSION

From the study, it can be concluded that Groundnut under Demonstrations has higher yields than farmers' practice. The technological interventions for the Management of Collar rot and stem rot incidence in groundnut increased yield, input use efficiency, and economic benefits. It can be concluded that, under present circumstances, adopting technological interventions in groundnut for disease management in endemic areas could achieve higher economic benefits than farmers'-practice. The results revealed that there is further scope for investment in these factors to obtain optimum production from groundnut crop with disease resistant varieties in the study area. This should influence more farmers to adopt the technology for groundnut in the Southern Telangana Zone.

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COMPETING INTERESTS

Conflict of interest: Authors do not have any conflict of interest to declare. The manuscript has not been submitted for publication in other journal.

AUTHORS' CONTRIBUTIONS

Author 1' designed the study, wrote the protocol, and wrote the first draft of the manuscript. 'Author 2' and 'Author 3' managed the analyses of the study. 'Author 4, 5, 6, 7' managed the literature searches. All authors read and approved the final manuscript.

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