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Survey and collection of different isolates of *Sclerotium rolfsii* from different groundnut growing areas of *Erstwhile* Khammam District

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ABSTRACT

The groundnut crop is affected by various diseases caused by fungi, bacteria and viruses, among these diseases, stem rot is the most predominant, devastating as well as yield reducing factor of groundnut. In Telangana state, Khammam district is one of the important groundnut cultivating areas growing different varieties. In the recent past, the incidence of stem rot has increased at an alarm level. The survey would ultimately indicate the areas with high disease incidence which can be managed timely to avoid any disease epidemic. Keeping because of the importance of the disease, a roving survey was conducted and a collection of 15 isolates was done during October- December 2022 in the groundnut growing areas of erstwhile Khammam district. The study revealed variations in per cent disease incidence in major groundnut growing areas of erstwhile Khammam district. The per cent disease incidence was recorded highest in Thimminenipalem village of chintakani mandal (52.0) followed by keshavapuram village of kusumanchi mandal (45.0) of Khammam area. A minimum per cent disease Incidence was observed in Dhammapet village of Dhammapeta mandal, Khammam district (7%). The results have also shown that among the 15 isolates collected from the different groundnut cultivars grown in the mentioned groundnut growing areas shown variations in the per cent disease incidence in the decreasing order of SR12 (52.00), SR 13 (46.00), SR7 (45.00), SR11 (44.10), SR8 (42.02), SR15, (41.00), SR9 (36.00), SR3 (33.00), SR14 (32.34), SR4 (32.30), SR2 (28.00), SR10 (28.00), SR6 (23.53), SR5 (17.01) and SR1 (7.10), respectively.

Keywords: *Survey, Groundnut, Stem rot, Per cent incidence, Sclerotium rolfsii.*

INTRODUCTION

Groundnut (*Arachis hypogea* L.) also known as peanut, earth nut, wonder nut, monkey nut, goobers, is an annual leguminous plant. It is called as king of oil seed. Today groundnut is widely distributed and is cultivated in more than eighty countries in tropical and sub-tropical regions of the world [9]. It belongs to the family of Fabaceae, subfamily Papilionaceae and contains **a** valuable source of all nutrients. India is the second largest producer of groundnut after China. China ranks first in groundnut production with 17.57 million tonnes, followed by India 6.73 million tonnes. In India, groundnut was sown in an area of 6014.95 thousand hectares with a production of 10244.08 thousand tonnes and a productivity of 0.1703 tonnes ha^{-1}. In Telangana State, during the year 2020-21, groundnut was cultivated in an area of 127.0 thousand hectares with a production of 290.26 thousand tonnes and a productivity of 0.2286 tonnes ha^{-1} [2]. In Telangana state, the major groundnut growing regions in the state are Khammam, Wanaparthy, Mahabubnagar, Gadwal, Mahababad, Vikarabad, Suryapet, and Nalgonda. In India among the soilborne fungal diseases of groundnut, stem rot is caused by *Sclerotium. rolfsii* is a potential threat to production and is of considerable economic significance for groundnut grown under irrigated conditions. Stem rot is an important disease, causing significant yield losses in several groundnut growing countries [5]. The pathogen attacks the host plant at all stages when conditions are favorable [6]. *S. rolfsii* the incitant of groundnut stem rot is a soil inhabitant, polyphagous, facultative parasite. The pathogen has a wide host range of over 500 plant species in 100 families, throughout the world [4]. This fungus survives in the soil for many years by producing sclerotial bodies and causing the disease either in the form of stem rot or foot rot or root rot or collar rot in addition to leaf blight on several of its hosts [8]. The symptoms of stem rot produced by *S. rolfsii* on groundnut plants under field conditions were characterized by the formation of a

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deep brown lesion on the stem region of the plant just near the ground followed by yellowing of groundnut leaves and than by loss of vigor and premature death. The fungus infects the stem preferentially by forming a whitish mycelial mat, but it can also infect any part of the plant including leaf, pod, and root. The infected plant showed poor root growth and rotting of the stem region. Death of the plant occurred more rapidly under dry conditions during which necrosis instead of browning appeared. On young pods light brown lesions were noticed mycelium and sclerotia developed on even inside the pods. Kernels were infected in the advanced stage of plant growth, such kernels were small and shriveled in size [11].

In order to increase self-sufficiency in groundnut production, the area is being increased to yield good productivity and the disease is being reduced by taking up plant protection measures. Since, in Telangana there is no systematic study taken on stem rot disease and their control measures. The survey would ultimately help indicate the areas with high disease incidence which can be managed timely to avoid any disease epidemic.

MATERIAL AND METHODS

A comprehensive roving survey was conducted from October to December 2022. The collection of isolates was taken up in the groundnut growing areas of *erstwhile* Khammam district of Telangana. The collection was done during the months of October to December 2022. A total of 15 isolates were collected randomly from the groundnut cultivars grown in the groundnut growing areas. The external signs and symptoms such as the presence of white mycelial growth, sclerotia, lesion on the stem, wilting, drying or dead plants were used to determine the incidence of the stem rot disease in the fields surveyed. Five plots measuring 1 m x 1 m were selected such that one plot was in the center of the field and the rest were randomly placed on the four corners leaving 1 m from the border. A total number of plants and a number of stem rot infected plants were counted in each plot and per cent disease incidence was calculated by the following formula:

Per cent Disease Incidence (PDI)

$$= \frac{\text{Number of plants infected by a particular disease} \times 100}{\text{Total number of plants observed}}$$

STATISTICAL ANALYSIS

The statistical analysis was done by using the collected data on the per cent disease incidence. Scoring was given based on common variables and characters. Principal Component Analysis of recorded survey data was done using SPSS software [3]. Survey data of erstwhile Khammam district was clustered into the accurate selection of the most varied individuals based on Hierarchial analysis by using unweighted pair group method arithmetic mean (UPGMA) analysis of NTSYS –PC Software [10].

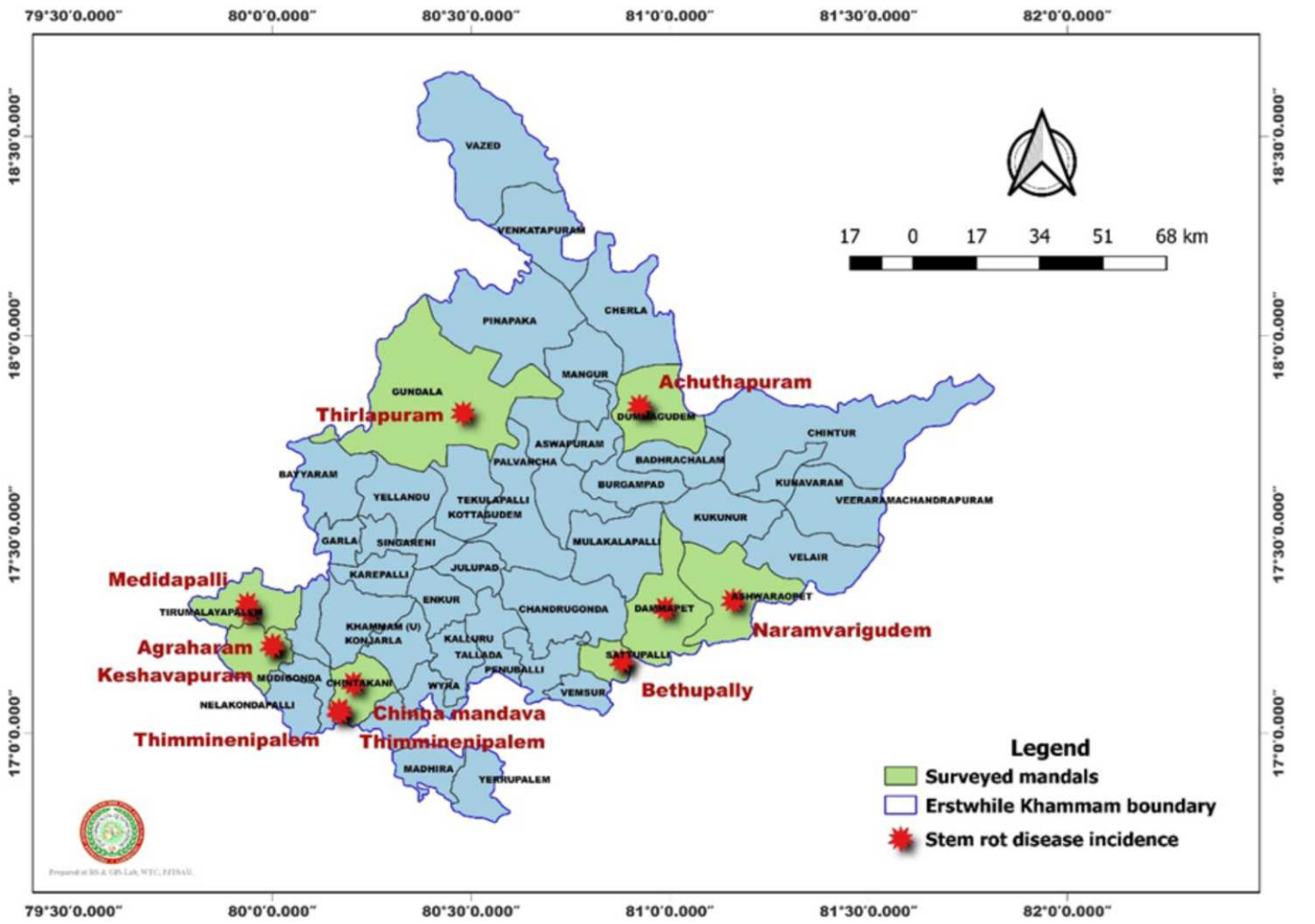

Fig.1. QGIS Map showing groundnut stem rot disease incidence observed from major groundnut growing areas of erstwhile Khammam district during a roving survey conducted in the year 2022 - 2023.

Fig. 2a. Infected stems showing whitish mycelial growth, brown lesions

Fig. 2. Symptoms of groundnut stem rot disease observed under field conditions during the roving survey conducted in the year 2022-2023.

Fig.3. Pure cultures of different isolates of S. rolfsii collected during survey conducted in erstwhile Khammam district during 2022-2023

RESULTS AND DISCUSSION

Survey on the incidence of stem rot groundnut growing areas of erstwhile Khammam District

A roving survey was conducted during October to December 2022 in major groundnut growing areas of *erstwhile* Khammam district *viz*., Khammam and Bhadradri kothagudem areas of Telangana to know the occurrence of groundnut stem rot disease caused by *S. rolfsii*. A total of fifteen fields were covered in eleven villages of Khammam and Bhadradri kothagudem areas during the survey. The information on latitude, longitude, variety/ hybrid, soil type, previous crop, type of irrigation and per cent Disease Incidence in these areas were collected. Based on the number of plants infected and a total number of plants, per cent Disease Incidence was calculated and the details are given in Table.1

Khammam: nine villages from five mandals of Khammam area *viz*., Dhammapeta Sathupalli, Kusumanchi, Thirmulayapalem and Chintakani respectively. Dhammapet village of Dhammapeta, Bethupally village of sathupalli was surveyed in the month of November -2022. Groundnut crop was grown in both sandy soils and red soils in these villages. In these villages they followed mostly sprinklers for irrigating groundnut fields. TAG24 is the major hybrid grown in these villages. A total of three isolates were obtained, one isolate (SR1) from Dhammapet village, where the least per cent disease incidence was observed (7.01) and two isolates (SR6, SR5) from Bethupally with per cent disease incidence of (23.53 and17.01, respectively).

Seven villages from three mandals *viz.,* Keshavapuram and Agraharam villages of Kusumanchi mandal, Beerolu and Medidapalli villages of Thirmulayapalem mandal, Thimminenipalem, Chinna mandava, Thirlapuram villages of Chintakani mandal, were surveyed during December -2022. Groundnut crop was grown in both sandy soils and red soils in these villages. In these villages both sprinkler and flooding type of irrigation. K6 is the major hybrid grown in these villages. Disease samples were collected during the vegetative stage, flowering stage and pod formation stages of the crop. The highest per cent disease incidence was observed in Thimminenipalem village (52.00), followed by Chinna mandava village (46.00) and Thirlapuram(32.34) of chintakani mandal, Medidapalli village(44.1) and Beerolu(36.00) of Thirmulayapalem, Keshvapuram village(45.00) and Agraharam village(42.02) of Kusumanchi mandal.

Bhadradri kothagudem: two villages from Aswaraopet mandal *viz.,* Naramvarigudem and Achuthapuram of Bhadradri kothagudem area, were surveyed during the month of November -2022. Groundnut crop was grown in red soil in these villages. The survey was done during pod formation stage of the crop. TAG24 is the major hybrid grown in these villages. Sprinkler type of irrigation was observed in these villages. Per cent disease incidence in Achuthapuram village (33.00), Naramvarigudem village (28.00) of Aswaraopet mandal was observed. Similar findings reported by [7] that the stem rot incidence ranged from 7.4 to 10 per cent in major groundnut growing areas of Andhra Pradesh and Telangana. shivakumar *et al.* (2016) conducted a survey to assess the occurrence of stem rot in major growing areas of Tamil Nadu. The survey's findings showed that the incidence of stem rot ranged from 7.88 to 32.02 %. The Cuddalore district's Adhivaraganallur village recorded the highest incidence at 32.33 %. [1] reported that stem rot incidence ranged between 6.0 to 22.7 per cent in regions of Kadapa and Chittoor districts of Andhra Pradesh.

Comparison of per cent Disease Incidence of 15 different isolates of Sclerotium rolfsii pathogen collected from different groundnut growing areas of erstwhile Khammam district

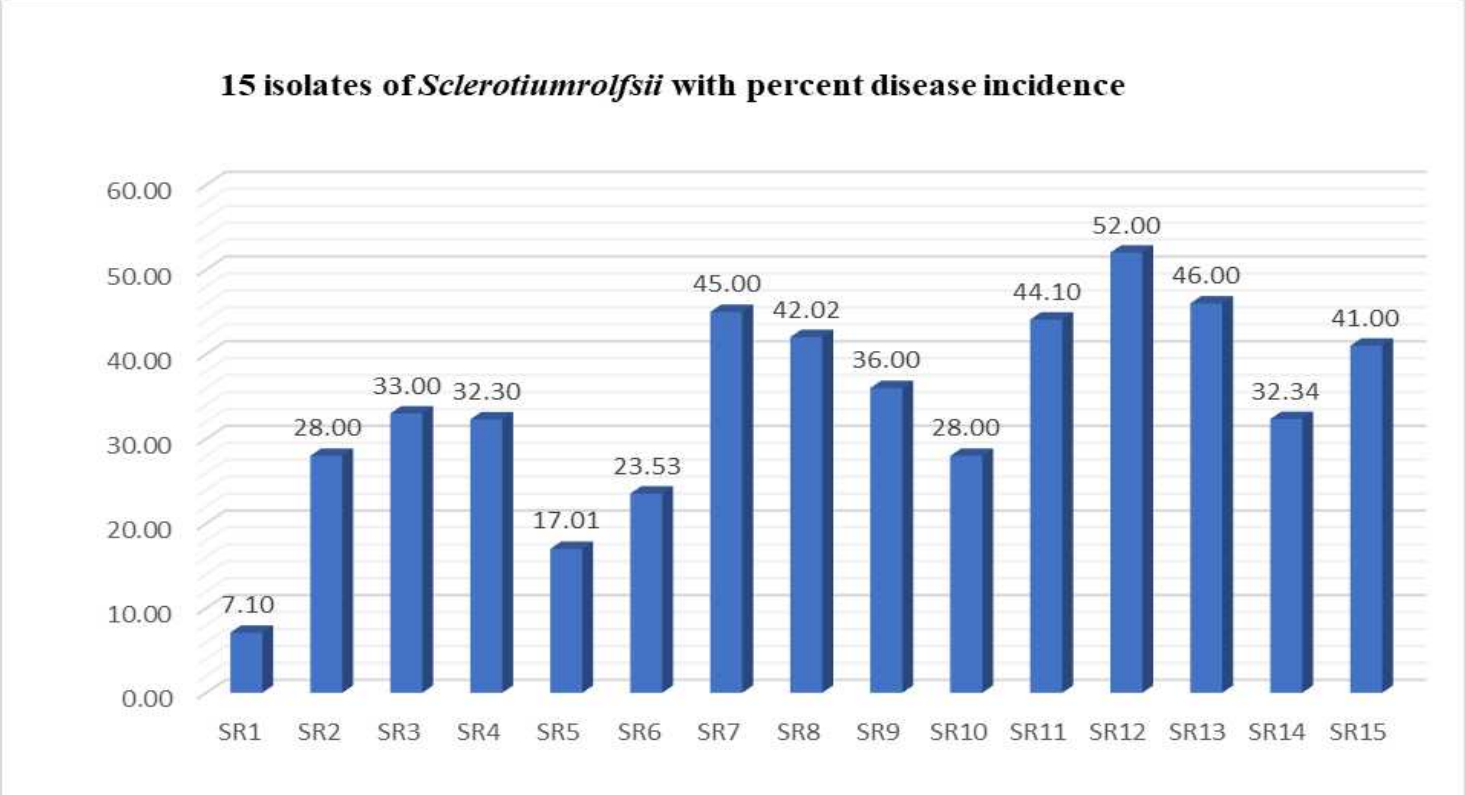

Fig.4. Graph representing the comparison of per cent Disease Incidence of 15 different isolates of S. rolfsii pathogen collected from different groundnut growing areas of erstwhile Khammam district.

Name of the isolate	Area	Mandal	Village	Latitude	Longitude	Variety	Soil type	Previous crop	Crop stage	Type of irrigation	Per cent disease incidence
SR1	Khammam	Dhammapeta	Dhammapet	17.31^0	80.9^0	TAG24	Sandy	groundnut	pod formation	sprinkler	7.10
SR2	Khammam	Aswaraopet	Naramvarigudem	17.26^0	81.08^0	TAG24	Sandy	Maize	pod formation	sprinkler	28.0
SR3	Bhadradri kothagudem	Aswaraopet	Achuthapuram	17.23^0	81.02^0	TAG24	Red soil	Groundnut	pod formation	sprinkler	33.0
SR4	Bhadradri kothagudem	Aswaraopet	Achuthapuram	17.20^0	81.02^0	TAG24	Red soil	Maize	pod formation	sprinkler	32.30
SR5	Khammam	Sathupalli	Bethupally	17.27^0	81.00^0	TAG24	red soil	Banana	Flowering stage	sprinkler	17.01
SR6	Khammam	Sathupalli	Bethupally	17.18^0	80.80^0	TAG24	red soil	groundnut	pod formation	sprinkler	23.53
SR7	Khammam	Kusumanchi	Keshavapuram	17.23^0	79.90^0	K6	Sandy	groundnut	Flowering stage	Flooding	45.00
SR8	Khammam	Kusumanchi	Agraharam	17.23^0	80.00^0	K6	Sandy	groundnut	Flowering stage	Flooding	42.02
SR9	Khammam	Thirmulayapalem	Beerolu	17.32^0	79.90^0	K6	Red soil	groundnut	pod formation	Sprinkler	36.00
SR10	Khammam	Thirmulayapalem	Beerolu	17.30^0	79.94^0	K6	Red soil	Maize	Vegetative stage	Sprinkler	28.00
SR11	Khammam	Thirmulayapalem	Medidapalli	17.32^0	79.93^0	K6	Sandy	Groundnut	Vegetative stage	Flooding	44.1
SR12	Khammam	Chintakani	Thimminenipalem	17.05^0	80.16^0	K6	Red soil	Groundnut	Pod formation	Flooding	52.00
SR13	Khammam	Chintakani	Thimminenipalem	17.07^0	80.16^0	K6	Red	groundnut	pod	Flooding	46.00
							soil		formation		
SR14	Khammam	Chintakani	Chinna mandava	17.02^0	80.17^0	K6	Red soil	groundnut	pod formation	Flooding	32.34
SR15	Khammam	Chintakani	Thirlapuram	17.80^0	80.48^0	K6	Red soil	groundnut	pod formation	Flooding	41.00
										C.D.	1.5
										SE(m)	0.517
										SE(d)	0.731
										C.V.	2.646

Table.1 Details of survey on incidence of Sclerotium rolfsii in groundnut growing areas of erstwhile Khammam District Among the 15 isolates, the highest per cent disease incidence was recorded in SR12 (52.00), SR 13 (46.00), SR7 (45.00), SR11 (44.10), SR8 (42.02), SR15, (41.00), SR9 (36.00), SR3 (33.00), SR14 (32.34), SR4 (32.30), SR2 (28.00), SR10 (28.00), SR6 (23.53), SR5 (17.01) and SR1 (7.10) in the decreasing order of per cent disease incidence, respectively.

Principal Component Analysis of Sclerotium rolfsii population of different survey variables

The data collected during the survey was scored based on common variables and characters. Further, Principal Component Analysis of recorded survey data was done using SPSS software and the results are shown in Table 2.

Table.2. Principal Component Analysis of Sclerotium rolfsii population of different survey variables

COMPONENTS	EIGENVALUES	PROPORTION	CUMULATIVE PROPORTION(%)
Mandals	2.555	0.511	0.511
Villages	1.296	0.259	0.77
Soil type	0.746	0.149	0.919
Crop stage	0.384	0.077	0.996
Per cent disease incidence	0.02	0.004	1

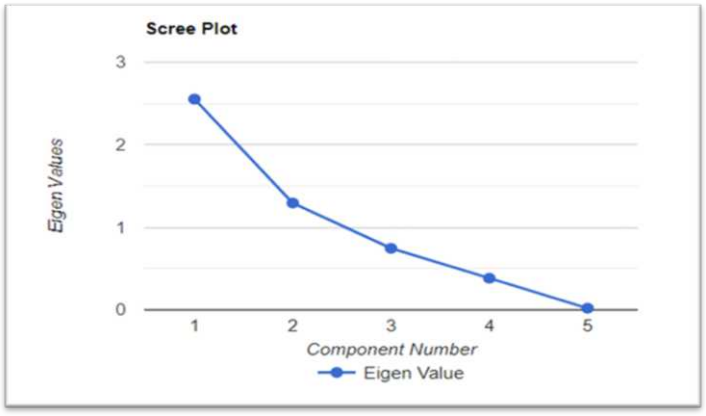

Fig.5 Screen plot for survey data of erstwhile Khammam district by using Principal Component Analysis.

According to Principal Component Analysis, Eigen value≥ 1 i.e., mandal and Village components was considered for the existence of variability among 15 different isolates of *S. rolfsii* pathogen. The results from the Principal Component Analysis of recorded survey data was shown in the form of Eigen values, which shows that the highest Eigen value recorded at mandal level indicating greater variability with regard to geographical location.

Dendrogram of 15 isolates of Sclerotium rolfsii generated by unweighted pair group method arithmetic mean (UPGMA) analysis of survey data of erstwhile Khammam district.

The data collected during the survey data in *erstwhile* Khammam district was clustered into the accurate selection of the most varied individuals based on Hierarchial analysis by using unweighted pair group method arithmetic mean (UPGMA) analysis of NTSYS –PC Software and a dendrogram was prepared and the phylogenic classification revealed existence of diverse isolates within the same species. Scores derived from the survey profile showed 77.7% similarity within the isolates of *S.rolfsii*. Based on UPGMA clustering, 195isolates were grouped into 6 clusters.

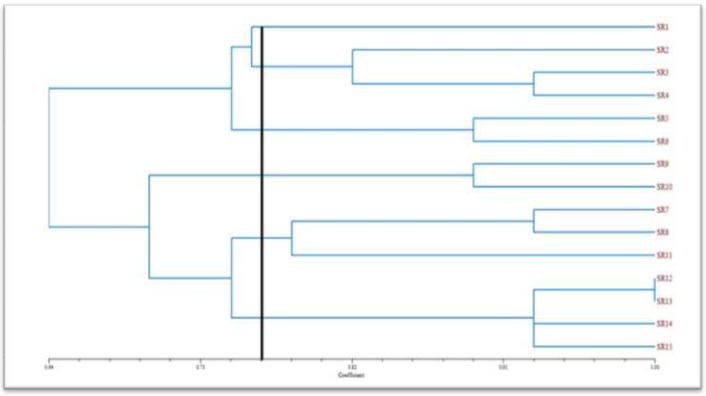

Fig.6. Dendrogram of 15 isolates of S.rolfsii generated by unweighted pair group method arithmetic mean (UPGMA) analysis of survey data of erstwhile Khammam district.

Among the 6 clusters, cluster-1 consist of 1 isolate *i.e.*, SR1 collected from Dhammapet village of Dhammapeta mandal, Khammam area, having 7.01 per cent disease incidence.

Cluster-2 consists of three isolates collected from two villages *viz*., Naramvarigudem, Achuthapuram of Aswaroapet mandal, Bhadradri Kothagudem area comprises of isolate SR2, SR3 and SR4 which in turn categorized into two subgroups. Frist subgroup consist of isolate SR2 collected from Naramvarigudem village having per cent disease incidence of 28.00 and the second sub-group constitutes two isolates SR3 and SR4 from Achuthapuram village having per cent disease incidence of 33.00 and 32.30 respectively.

Cluster -3 consists of SR5 and SR6 isolates collected from Bethupally village of Sathupalli mandal, Khammam area having per cent disease incidence of 17.01 and 23.53 respectively.

Cluster-4 consists of SR9 and SR10 collected from Beerolu village of Thirumalayapalem mandal, Khammam area having per cent disease incidence of 36.00 and 28.00 respectively.

Cluster-5 constitute three isolates which were further categorized into two subgroups. Isolate SR7 and SR8 were collected from Keshavapuram and Agraharam villages of Kusumanchi mandal having per cent disease incidence of 45.00 and 42.02 respectively. SR11 was collected from Medidapally village of Thirumalayapalem mandal which reported a per cent disease incidence of 44.10.

Cluster-6 consists of 4 isolates which were further categorized into 3 subgroups. The first sub-group constitutes SR12 and SR13 collected from Thimminenipalem village of Chintakani mandal of Khammam area having per cent disease incidence of 52.00 and 46.00 respectively. The second sub-group consists of isolate SR14 collected from Chinna mandava village of Chintakani having per cent disease incidence of 32.34. The third sub-group constitutes of isolate SR15 collected from Thirlapuram of Chintakani mandal having a per cent disease incidence of 41.00.

CONCLUSION

The present findings from the survey conducted and collection of 15 isolates done during the months of October- December 2022 in the groundnut growing areas of *erstwhile* Khammam district *viz*., Khammam and Bhadradri kothagudem of Telangana grown in this areas respectively to record the disease incidence of stem rot in groundnut revealed the variations in per cent disease incidence in major groundnut growing areas of *erstwhile* Khammam district. Of all the locations, The highest per cent disease incidence was recorded in Thimminenipalem village of Chintakani mandal of Khammam district (52.0) and the lowest per cent disease incidence was observed in dhammapet village of dhammapeta mandal (7.1%). The results also shown that among the 15 isolates collected from the groundnut cultivars grown in the mentioned groundnut growing areas shown variations in the per cent disease incidence in the decreasing order of isolate SR12 (52.00), followed by isolates SR 13 (46.00), SR7 (45.00), SR11 (44.10), SR8 (42.02), SR15, (41.00), SR9 (36.00), SR3 (33.00), SR14 (32.34), SR4 (32.30), SR2 (28.00), SR10 (28.00), SR6 (23.53), SR5 (17.01) and SR1 (7.10) respectively. The data generated will help in the identification and application of suitable control methods based on the per cent disease incidence recorded in different cultivars and different locations.

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Conflict of interest

The authors declare that they have no conflict of interest

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors.

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REFERENCES

1. Deepthi, K.C and Reddy, N.E. 2020. Disease incidence assessment of stem rot and collar rot of groundnut (*Arachis hypogaea* L.) in Kadapa and Chittor districts of Andhra Pradesh. *Journal of Pharmacognosy and Phytochemistry*. *9*(2):725-726.

2. Indiastat.com, 2021. WWW.Indiastat.com.

3. Joliffe, I.T and Cadima, J. 2016. Principal Component Analysis: A review and recent developments. *The Royal Society Publishing*. 374.

4. Kuldhar, D.P and Suryawanshi, A.P. 2017. Integrated management of stem rot and pod rot (*Sclerotium rolfsii*) of groundnut (*Arachis hypogaea* L.). *Agriculture Update*. 12: 238-246 .

5. Mehan, V.K., Mayee, C.D and McDonald, D. 1994. Management of *Sclerotium rolfsii*-caused stem and pod rots of groundnut a critical review. *International Journal of Pest Management*. 40:313-320.

6. Punja, Z.K. 1985. The biology, ecology, and control of *Sclerotium rolfsii*. *Annual Review of Phytopathology*. 23:97-127.

7. Rani, V.D., Sudini, H., Reddy, P.N., Devi, G.U and Kumar, K.V.K., 2016. Survey for the assessment of incidence of stem rot and collar rot diseases of groundnut in major groundnut growing areas of Andhra Pradesh and Telangana States. *Annals of Biological Research*, *7* (7): 6-8.

8. Rashmi, K.H., Bireswar, Sinha., Pramesh, K.H and Sobita Devi, P.H. 2017. Native *Trichoderma spp* for the Managemet of stem rot of Groundnut Caused by *Sclerotium rolfsii* Sacc. Manipur, India. *International Journal of Current Microbiology and Applied Science*. 6(10): 1343- 1351.

9. Madhusudhana, B. 2013. A Survey on Area Production and Productivity of Groundnut Crop in India. *Journal of Economics and Finance*. 1(3): 01-07.

10. Sattar, A., Riaz, A., Gondal, A.S., Mehmood, N and Hyder, S. 2016. Survey of chilli anthracnose; a potential threat to chilli crops- A focus on Punjab, Pakistan. *Journal of Phytopathology.* 28(1): 81-86.

11. Sivakumar, T., Sanjeevkumar, K and Balabaskar, P., 2016. Variability in *Sclerotium rolfsii* Sacc. causing Stem rot of groundnut. *Bulletin of Environment Pharmacology and Life Science.[Spl. Issue 2].92*:99.