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Management of stem and collar rot disease incidence and yield parameters in groundnut

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Abstract
Groundnut (*Arachis hypogaea* L.), is a legume major oil seed crop in Andhrapradesh. Three isolates of *Trichoderma spp* were isolated by collecting soil samples from rhizosphere of groundnut. Field experiments were conducted and the results revealed that the seed treatment with combination of Tebuconazole @1g+Trichoderma spp @8g was found significantly superior to all other treatments low collar rot incidence 11.6% t 40 DAS and low stem rot incidence at 39.9% 80 DAS and 52.6 % at 100 DAS. Further it also increased yield attributes Pod yield (1641 kg/ha), haulm yield (2800 kg/ha).

Keywords: stem rot, collar rot, *S. rolfsii*, *Aspergillus niger*, *Trichoderma spp*, groundnut, fungicides, insecticides

Introduction
Groundnut (*Arachis hypogaea* L.) a legume major oil seed crop in the world. The major production constraints are unreliable and erratic distribution of rainfall and appearance of unpredictable diseases and pests accounting low productivity. Diseases are one of the major constraints responsible for the low productivity. Among the different pathogens attacking the crop, *Aspergillus Niger*, *A.fl*avus, *Rhizoctonia bataticola* and *sclerotium rolfsii* are the most important fungi causing seed and seedling rots and stem rot diseases (Ahmed and Ravinder Reddy, 1993) [1]. The yield loss estimated was 5 to 50% with *A.niger* (Harshukh Gajera 2011) [2] and 25 -40% with *S.rolfsii* (Johnson *et al* 2000). Management of stem rot, collar rot diseases are difficult because of soil borne nature and the chemical methods are very expensive and will not be that good affect against the pathogen and also have a wide host range. Biological control of Plant Pathogens by antagonistic microorganisms is a potential non-chemical means and is known to be cheap and effective ecofriendly method for the management of crop diseases (Baker and Cook, 1983). Hence *Trichoderma Spp* has been successfully used for Biological control of several plant pathogens. These diseases can be effectively managed by the integration of Biological and conventional methods. At present mancozeb, tebuconazole fungicides and imidacloprid, chlorpyriphos insecticides are recommended as seed treatment chemicals.

Materials and Methods
Experiment**s** pertaining to the present research work were conducted in the Department of Plant Pathology, Agricultural College, Mahanandi. Seeds of the groundnut cv.Kadiri-6 were obtained from the Farm Section, Agricultural College, Mahanandi. Field experiment was laid out in a randomized block design with 12 treatments replicated thrice with a plot size 4m x 3m.The spacing adopted was 30 cm x 10 cm and care was taken to maintain optimum plant population.

Collection of soil samples
Soil samples were collected at 75 days after sowing from the rhizosphere of groundnut cultivar K-6 grown in red soils of Mahanandi region, Kurnool district. Sampling was made at the rhizosphere of healthy groundnut plants adjacent to collar rot and stem rot affected plants as described by Sharma and Sen (1991). The selected plants were pulled out carefully and were shaken to remove the bulk of the extraneous soil. The soil adhering to the roots was collected and mixed to provide a composite rhizosphere soil.

Isolation and Identification of *Trichoderma Spp.*
For isolation of *Trichoderma spp.* from rhizosphere/rhizoplane of groundnut, the dilution plate method proposed by Aneja (2001) was followed. One g of soil from each sample was taken in a 250 ml conical flask with 100 ml of sterile distilled water. The sample was agitated to pr epare a thorough suspension. Serial dilutions of soil suspensions were prepared. One ml of required dilution 1: 1000 (10^3) and 1: 10000 (10^4) for fungi were poured in sterilized petriplates containing suitable media *viz.*, potato dextrose agar media for fungi and the petriplates were incubated at room temperature (25 – 28ºC). Five replications were maintained for each dilution tested. Observations on number of colonies per g of rhizosphere/rhizoplane soil, and the number of days were taken for appearance of each fungal colonies on plates were recorded. The isolated *Trichoderma spp.* were identified up to the level of genus (or) species based on their cultural and morphological characters (Branett and Hunter, 1972 and Subramanian 1971). The isolated *Trichoderma spp.* were transferred to culture tubes containing appropriate medium for further studies. Efficacy of two fungicides, two insecticides and Trichoderma spp were tested at recommended field concentrations using seed treatment.

Table 1: Details of fungicides and insecticides evaluated for the Compatability of *Trichoderma spp.*

S. No	Trade name	Chemical name	Active ingradient	Concentration (ppm)
1	Indofil M-45	Mancozeb	75% WP	3000
2	Raxil	Tebuconazole	2% DS	1000
3	Confidor	Imidachloprid	17-18% SL	2000
4	Force	Chloropyriphos	20% EC	6000

Preparation of sick plot

A sick plot of *S. rolfsii and A. Niger* was prepared by applying biomass of the infected plants collected from previous year. The pathogen grown on sorghum seeds was applied to the soil @ 150 gm/m^2 area (Elad *et al* 1980). Biomass with groundnut plant debris was evenly spread and incorporated into soil by ploughing. The same area was used for conducting the field experiments. Collar rot incidence was recorded at 40DAS and Stem rot incidence was recorded at 100 DAS.

Results and Discussion

Rhizosphere mycoflora were isolated from groundnut *cv* K -6 following serial dilution plate counting technique (Aneja, 1995) at 75 days after sowing and at the time of harvest. Samples were collected from red soils to isolate potential native antagonists to be tested against *S. rolfsii* and *Aspergillus niger* Different microorganisms were isolated consistently from rhizosphere of groundnut cultivars in red soil of Mahanandi Farm *viz*.., *Trichoderma spp., Aspergillus flavus, A. niger, Fusarium spp*, *Rhizopus spp* and *S. rolfsii*. The information on the number of fungal colonies per gram of rhizosphere soil (cfu/g dry soil) was recorded. The results are presented in the Table 4.1 revealed that at 75 DAS more number of rhizosphere population of 5.2 x 10^3 was recorded with *T. viride*, followed by *A.flavus* (4.4x10^3), *A. niger* (4x10^{-3}), *S.rolfsii* (3.47 x 10^{-3}), Which were on par with each other and significantly superior to *Fusarium spp*, *Rhizopus spp*. Lowest population of 1.0 x 10^3, 1.4 x 10^3, were recorded with *Fusarium spp*, *Rhizopus spp* per gram of soil respectively and were on par with each other.

Table 2: Frequency of rhizosphere mycoflora (10^3) per gram of red Soils of Groundnut in Mahanandi Farm

Mycoflora	At 75 DAS *
Aspergillus niger	4.0 (11.53)
Aspergillus flavus	4.4 (12.08)
Fusarium sps	1.0 (5.06)
Rhizopus sps	1.4 (6.69)
Trichoderma	5.2(12.47)**
Sclerotium rolfsii	3.4(13.16)
CD at 5 %	2.25
SEm ±	0.76

*Mean of three replications

**Figures in the parenthesis are angular transformed values

DAS: Days after sowing

Combination of Fungicides and Insecticides with *Trichoderma spp.* and their Effect on Collar Rot and Stem rot disease.

The percent disease incidence of collar rot was estimated at 40 DAS. All the seed treatments were found effective in controlling the collar rot disease in groundnut (Table 3) Fig 2.Collar rot incidence was ranged from 11.66 to 51.66.The lowest disease incidence of 19.8 per cent was recorded with the combination of tebuconazole and *Trichoderma* which was significantly superior over all other treatments. Highest disease incidence of 26.6% was recorded in the treatment control, followed by the combination of tebuconazole (1g) chlorpyriphos (6ml) and *Trichoderma* (8g). The Per cent disease incidences in the remaining treatments were on par with the treatment with the combinations of tebuconazole and *Trichoderma*. These results were similar with the findings of Johnson and subramanyam (2010) [3] reported that seed treatment with tebuconazole resulted in minimum collar rot and stem rot incidence followed by hexaconazole + captan and carboxin + thiram compared to other treatments. In the present study percent disease incidence of stem rot was recorded at (Table 4) Lowest incidence of stem rot was observed in combinations of tebuconazole + *Trichoderma* (8g) (39.9) which was significantly superior over all other treatments except in mancozeb + *Trichoderma* (8g) (42.4), imidachloprid (2ml) + *Trichoderma* (8g) (53.8), chlorpyriphos (6ml) + *Trichoderma* (8g) (51.4), mancozeb (3g)+ imidachloprid (2 ml) (55.0), mancozeb (3g) + imidachloprid (2ml) + *Trichoderma* (8g) (55), mancozeb (3g) + chlorpyriphos (6ml) + *Trichoderma*(8g) (45.7), mancozeb (3g) + imidachloprid (2ml)+ chlorpyriphos were (6ml) + *Trichoderma* (8g) (51.4), tebuconazole (1g) + imidachloprid (2ml)+ chlorpyriphos (6ml) + *Trichoderma* (8g) (50.1).These treatments were significantly on par with tebuconazole (1g) + *Trichoderma* (8g). Highest incidence of stem rot was recorded in controlled plot (72.3) which was significantly superior over all other treatments followed by *Trichoderma* (8g) (65.8). Moderate incidence of stem rot were observed in tebuconazole (1g) + imidachloprid (2ml) + *Trichoderma* (8g) (58.1), tebuconazole (1g) + chlorpyriphos (6ml) + *Trichoderma* (8g) (49.4). At 100DAS, the disease incidence varied from 52.6 (tebuconazole @ 1g + *Trichoderma* @ 8g) to 85.8 (control) (Table 4.4.4). There was an increase in incidence of stem rot at 100 DAS compared to 80 DAS in all the treatments. Lowest incidence of stemrot was observed in combinations of tebuconazole(1g) + *Trichoderma* (8g) (52.6) which was significantly superior over all other treatments except in imidachloprid (2ml) + *Trichoderma* (8g) (63.1), chlorpyriphos (6ml) + *Trichoderma* (8g) (77.8), mancozeb(3g) + chlorpyriphos (6ml)+ *Trichoderma*(8g)(74.1), tebuconazole(1g) + imidachloprid (1 ml) + chlorpyriphos (6ml) + *Trichoderma* (8g) (76.1), tebuconazole(1g) + chlorpyriphos (6ml) + *Trichoderma*(8g) (73.1), mancozeb(3g) + imidachloprid (1ml) + chlorpyriphos(6ml) + *Trichoderma* (8g) (78.1), these treatments were significantly on par with tebuconazole(1g) + *Trichoderma* (8g). Highest incidence of stem rot was recorded in control (85.83) and was significantly superior among all other treatments followed by mancozeb(3g) + *Trichoderma* (8g) (65.76), tebuconazole (1g) + Imidachloprid (2ml) + chlorpyriphos (6ml) + *Trichoderma* (8g) (65.9).Moderate incidence of stem rot was recorded in mancozeb (3g) + imidachloprid (2ml)+ *Trichoderma* (8g) (79.9). These results were similar to the reports of Manjula *et* *al.*, (2004) [4] reported that combined application of fungicide tolerant biocontrol agents and fungicide improved the control of groundnut stem rot. Johnson and subramanyam (2010) [3] reported that seed treatment with tebuconazole resulted in minimum collar rot (9.1%) and stem rot (22.6%).Similar results were also recorded in the present study.

Combination of Fungicides and Insecticides with *Trichoderma spp.* on Yield/ Yield Parameters

Among the treatments Maximum Pod yield of 1641.6 kg /ha was recorded in combination of tebuconazole (1g) + *Trichoderma* (8g) which was significantly superior to all other treatments except mancozeb @ 3g + imidachloprid (2ml) + *Trichoderma* (8g) (1509.7 kg ha^{-1}), mancozeb @ 3g + chlorpyriphos (6ml) + *Trichoderma* (8g) (1493.0 kg ha^{-1}) which are on par. While the Pod yield in tebuconazole (1g) + chlorpyriphos (6ml) + *Trichoderma* (8g) (1331.9 kg ha^{-1}), tebuconazole (1g) + imidachloprid (2ml) + *Trichoderma* (8g) (1316.6 kg ha^{-1})which were at par.The Pod yields recorded in other treatments were mancozeb @ 3g + imidachloprid (2ml) + chlorpyriphos (6ml) + *Trichoderma* (8g) (1193 kg ha^{-1}), imidachloprid (2ml) + *Trichoderma* (8g) (1176.3 kg ha^{-1}), *Trichoderma* (8g) (1177.7 kg ha^{-1}), tebuconazole (1g) + imidachloprid (2ml) + chlorpyriphos (6ml) + *Trichoderma* (8g) (1173 kg ha^{-1}) which were on par with control (1045.8).

In the present study combination of tebuconazole @ 1g + *Trichoderma* @ 8g recorded highest haulm yield of 2800 kg ha^{-1} and were significantly superior to all other treatments. Haulm yields recorded in other treatments were 2400 in mancozeb @ 3g + imidachloprid @ 2ml + chlorpyriphos @ 6ml + *Trichoderma* @8g, 2350 in mancozeb @ 3g + imidachloprid @ 2ml + *Trichoderma* @ 8g, 2300 in mancozeb @ 3g + chlorpyriphos @ 6ml + *Trichoderma* @ 8g, 2216 in tebuconazole @ 1g + imidachloprid @ 2ml + *Trichoderma* @8g, 2200 in imidachloprid @ 2ml + *Trichoderma* @ 8g were significantly on par with each other. Lowest haulm yields were recorded in control (1666.6) followed by chlorpyriphos @ 6ml + *Trichoderma* @ 8g (1733) were on par. These results of this study corresponded with the findings of Johnson and Subramanyan (2010) which showed that treatments, hexaconazole+captan and tebuconazole recorded significantly more pod yield (737 kg ha$^{-1,}$707 kg ha$^{-1,}$) and haulm yield (1340 kg ha^{-1}, 1299 kg ha^{-1}).

Table 3: Combination of fungicides and insecticides with *Trichoderma*and their effect on stem rot collar rot disease incidence and yield parameters in Groundnut.

No	Treatments	Collar rot % Disease Incidence	Stem rot % Disease incidence		Pod yield Kg/ha	Haulm yield Kg/ha
		40DAS	**80 DAS**	**100 DAS**		
T_1	ST with Mancozeb @ 3g + *Trichoderma spp.* @ 8g/kg of seed	16.3*(23.8)**	45.7*(42.4)**	65.7*(54.5)**	1305	2010
T_2	ST with Tebuconazole @ 1g + *Trichoderma spp.* @8g/kg of seed	11.6(19.8)	39.9(39.1)	52.6(46.5)	1641	2800
T_3	ST with Imidachloprid @ 2ml + *Trichoderma spp.* @8g/kg of seed	21.6(27.6)	53.8(47.2)	79.3(63.1)	1236	2200
T_4	ST with Chlorpyriphos @ 6ml + *Trichoderma spp.* @8g/kg of seed	21.3(27.4)	51.4(45.7)	77.8(61.9)	1176	1733
T_5	ST with *Trichoderma spp.* @ 8g/kg of seed	20.0(26.4)	65.8(54.2)	75.6(60.9)	1177	1900
T_6	T_1 + T_3 + *Trichoderma spp.* @ 8g/kg of seed	17.3(24.5)	55.0(47.8)	79.9(63.4)	1509	2350
T_7	T_1+ T_4 + *Trichoderma spp.* @ 8g/kg of seed	21.0(27.2)	45.7(42.5)	74.1(59.7)	1493	2300
T_8	T_2+ T_3+ *Trichoderma spp.* @ 8g/kg of seed	19.0(25.7)	58.1(49.7)	76.1(60.7)	1316	2216.6
T_9	T_2+ T_4+ *Trichoderma spp.* @ 8g/kg of seed	23.3(28.8)	57.5(49.4)	73.1(59.1)	1331	2316.6
T_{10}	T_1+T_3+T_4+ *Trichoderma spp.* @ 8g/kg of seed	20.0(26.5)	51.4(45.8)	78.1(62.3)	1193	2400
T_{11}	T_2+T_3+T_4+ *Trichoderma spp.* @ 8g/kg of seed	19.6(26.2)	50.1(45.1)	65.9(54.3)	1173	1900
T_{12}	Control(no seed treatment)	26.6(31.0)	72.3(58.4)	85.8(67.9)	1045	1666.6
	CD at 5 %	3.3	8.5	9.9	196.5	226.6
	SEm ±	1.1	2.8	3.3	66.5	76.6

*Mean of three replications

**Figures in the parenthesis are angular transformed values

Conclusion

Overall performance of the study indicated that combination of tebuconazole @1g and *Trichoderma @8g* were found effective in controlling stem rot incidence and collar rot incidence They also significantly improved the pod yield and haulm yield.

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