**Management of Soil Borne Diseases in Groundnut** **through IPM Modules**

**ABSTRACT**

 The present work was carried out to find out effective IDM module for the management soil borne diseases in groundnut. Groundnut (*Arachis hypogea* L.), is one of the most important oil seed crops of India is affected by several soil-borne diseases *viz*., collar rot and stem rot and pod rot etc. Seed and soil borne diseases causes severe seedling mortality resulting in the patchy crop stand mostly in the sandy loam soils and reduces yield from 25 to 50%. This study was conducted for the development of IPM module for the management of these soil-borne fungi using fungicides and biocontrol agents. Among the nine modules tested, module with deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM + Seed treatment with Tebuconazole 2DS 1.5 g/kg of seeds followed by seed treatment with PGPR @ 625 g for per kg seeds + Soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha at 35 and 70 DAS recorded significantly highest Seed germination ( 87 %), significantly lowest Collar rot incidence (5.31 % ), Stem rot incidence at harvest (11.0 %), Pod rot incidence ( 2.60 % ) and at the same time this treatment also showed significantly highest pod ( 1521 kg/ha) and haulm yield (3235 kg/ha), respectively as compared to control and rest of the treatments. Soil-borne diseases can be managed by integrating cultural practices like deep summer ploughing by MB plough before sowing, seed treatment with Tebuconazole 2 DS 1.5 g/kg seeds followed by soil application of Trichoderma @ 4 kg/ha enriched in 250 kg FYM at 35 and 70 DAS and would be effective against reducing soil borne pathogens of groundnut such as collar rot, stem rot and pod rot.

*Keywords* : *IPM module, soil borne*, *Groundnut*, fungicides

**1. INTRODUCTION**

 “The significant problems caused by soilborne pathogens in crop production worldwide include reduced crop performance, decreased yield, and higher production costs. Soilborne diseases are considered a major limitation to crop production” (Panth et al., 2020). “Integrated management of diseases by combining chemical and biological method would be an effective method for the management of diseases compared to adopting single method” (Jakhar et al., 2020). “Groundnut is an important leguminous oilseed crop, belonging to the family Fabaceae” (Nordern *et al*., 1982). “Groundnut is one of the most important oil seed crops of India, contributing about 36% of the world's oil seed production. The botanical name of Groundnut, (*Arachis hypogaea* L.) is derived from two Greek words, *Arachis* (arachos) meaning a ‘weed’ and hypogaea meaning ‘below ground’. According to botanist, a more popular name for groundnut would be ground pea because groundnut is a pea and not a nut. The term ‘nut’ has perhaps been added, since the pea has a shell and flavour similar to the shells of many true nuts. It is native to South America, and originated between Southern Bolivia and Northern Argentina, from where it spread throughout the new world. Groundnut was introduced in India around 16th century by the Portuguese. It is grown under a wide range of environmental conditions encompassing latitudes between 40° South and 40° North of the equator. The major peanut-growing states area Gujarat, Andra Pradesh, Tamil Nadu, Rajasthan and Maharashtra which contributes around 90% of the area and production. Andhra Pradesh and Gujarat contribute >55% of the total area and production of groundnut” (Anonymous., 2014). “Seed and soil-borne diseases cause severe seedling mortality resulting in a patchy crop stand mostly in the sandy loam soils and reduces yield from 25 to 50%. A large number of diseases attack to groundnut in India and cause severe damage during any stage of crop growth, and yield losses of over 25%” have been reported by Mayee and Datar (1988). “Among the soil-borne diseases, Collar rot (*Aspergillus niger* Van Tieghem), Stem rot (*Sclerotium rolfsii* Sacc) and Dry root rot (*Macrophomina phaseolina* (Tassi Goid) = *Rhizoctonia bataticola* (Taub.) Butler) have been recognized as a major disease..The fungicides *viz*., Azoxystrobin, Chlorothalonil and Tebuconazole were found to be effective for the management of leaf spot and stem rot in groundnuts” (Hagan *et al*., 2010). Integrated management of diseases by combining chemical and biological methods would be an effective method for the management of diseases compared to adopting a single method. With this view, the present work was carried out to find out effective IDM module for the management soil borne diseases in groundnuts.

 **2**. **METHODOLOGY**

 The field trials were conducted to test the efficacy of different fungicides for the management of soil borne diseases in groundnuts during 2017-18, 2018-19 and 2019-20 in *Kharif* season at the Experiential Farm of Oilseeds Research Station, Jalgaon. The Groundnut Var. JL-501, was used for sowing at 30x 10 cm spacing in 15 m2 (5m x 3m) plots and the plots were laid out in Randomized Block Design (RBD) with three replications. Treatments were given as per schedule. The incidence of collar rot stem rot and pod rot was recorded by Percent disease incidence (PDI). The pod and haulm yield were also recorded after harvest.

**Table 1. The modules / treatments used for the study**

|  |  |  |
| --- | --- | --- |
| **T0** |  | Control |
| **T1(M5)** | **:** | Popular variety + Deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM + Seed treatment with Tebuconazole 2DS 1.5g/kg seed |
| **T2(M10)** | **:** | Popular variety + Deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM + Seed treatment with *Trichoderma @* 10/kg seed + Soil application of *Trichoderma* @ 4 kg/ ha enriched in FYM at 35 DAS. |
| **T3(M11)** | **:** | Popular variety + Deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM + Seed treatment with Tebuconazole 2DS 1.5 g/kg of seeds + Soil application of *Trichoderma* @ 4 kg/ ha enriched in FYM at 35 DAS. |
| **T4** | **:** | Deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM + Seed treatment with Tebuconazole 2DS 1.5 g/kg of seeds followed by seed treatment with PGPR @ 625 g for per kg seeds + Soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha at 35 and 70 DAS. |
| **T5** | **:** | Popular variety + Deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM+ seeds treatment with PGPR @625 g /ha of seeds + Soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha at 35 and 80 DAS  |
| **T6** | **:** | Popular variety + Deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM + Seed treatment with Tebuconazole 2DS 1.5g/kg seed+ Soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha at 35 and 80 DAS |
| **T7** | **:** | Deep Summer Ploughing |
| **T8** | **:** | Farmers Practice |

**3. RESULTS AND DISCUSSION**

 The pooled results of the three years (2017-18, 2018-19 and 2019-20) trial data indicated that all the treatments recorded germination percentage more than 80 %. Among the nine modules/treatments tested, T4 treatment *i.e*. Deep summer ploughing with mould board plough + Soil application of *Trichoderma* @ 4kg/ha enriched in FYM + Seed treatment with Tebuconazole 2DS 1.5 g/kg of seeds followed by seed treatment with PGPR @ 625 g for per kg seeds + Soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha at 35 and 70 DAS recorded significantly highest Seed germination ( 87 %), significantly lowest Collar rot incidence (5.31 % ), Stem rot incidence at harvest (11.0 %), Pod rot incidence ( 2.60 % ) and at the same time this treatment also showed significantly highest pod ( 1521 kg/ha) and haulm yield (3235 kg/ha), respectively as compared to control and rest of the treatments. The seed germination per cent, collar rot incidence, stem rot incidence at harvest, pod rot incidence, pod yield and haulm yield in control treatment was 72.90%, 11.98%, 21.92%, 6.38%, 1150 kg/ha and 2374 kg/ha, respectively. These research findings are in agreement with the earlier workers Rakholia and Jadeja (2010). They demonstrated that seed treatment with Tebuconazole 1.25 g/ kg was effective in controlling *S. rolfsii* and increasing pod yield in groundnut. (Annual Groundnut Workshop Report, 2016) where deep summer ploughing with MB plough, seed treatment with Tebuconazole and follow up soil application of *T. viride* resulted in minimum disease incidence and higher pod yield than any other treatment. Jadon *et al*., (2017) conducted “an experiment on integrated disease management of foliar and soil-borne diseases with fungicides, Castor cake and *Trichoderma* in Groundnut and reported that the lowest incidence of soil-borne diseases was recorded in seed treatment with Mancozeb and seed treatment with Tebuconazole compared to untreated control”. Vineela *et al*., 2018 conducted “field experiment during *Kharif* 2016 and *Rabi-summer* 2017 on Integrated management of soil-borne diseases of Groundnut in the coastal ecosystem of Odisha and reported that the treatment *i.e* Deep summer ploughing with mould board plough + Seed treatment with Tebuconazole 2DS 1.5 g/kg of seeds + Soil application of *T.viride* @ 4kg/ha enriched in 250 kg FYM /ha at 35 and 70 DAS was found most effective and reduced both stem rot by 2.13 % and collar rot by 1.73 % incidence significantly and improved germination percentage 85.00 % and pod yield 1688 kg/ha”. The same treatment was also found effective in reducing collor rot by 1.67 %, stem rot by 2.00 % and improved pod yield up to 1967 kg/ ha during *Rabi-summer* 2017 (Ushamalini Chinnaswamy, 2022). Conducted experiment for the development of IPM module on management of soil borne diseases using fungicides and bio control agents. Among the nine modules tested, module with deep summer ploughing using mould board plough combined with soil application of *Trichoderma* @ 4 kg/ ha enriched in 250 kg FYM/ha and seed treatment with Tebuconazole 2DS @ 1.5 g/kg seed recorded minimum incidence of stem rot (9.5 %) with higher pod and haulm yield of 2566 kg/ha and 6428 kg /ha respectively.

**Table 2. Validation of management modules for soil borne diseases ( Pooled data : 2017-18, 2018-19 and 2019-20 )**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  **Treat****ments** | **Seed Germination %** | **Collar Rot % at 30 DAS** | **Stem rot % at 70 DAS** | **Stem rot % at Harvest** |
| 2017-18 | 2018-19 | 2019-20 | Pooled Mean | 2017-18 | 2018-19 | 2019-20 | Pooled Mean | 2017-18 | 2018-19 | 2019-20 | Pooled Mean | **2017-18** | 2018-19 | 2019-20 | Pooled Mean |
| T1 | 85.22 | 74.00 | 82.51 | 80.58 | 6.73(15.04) | 11.91(29.19) | 6.74(15.05) | 8.46 | 12.28(20.52) | 11.33(19.67) | 8.42(16.87) | 10.68 | 16.40(23.89) | 18.83(25.71) | 13.30(21.39) | 16.18 |
| T2 | 90.00 | 74.58 | 82.12 | 82.23 | 6.79(15.10) | 10.67(19.06) | 7.84(16.26) | 8.43 | 13.93(21.91) | 10.19(18.61) | 8.57(17.02) | 10.90 | 17.73(24.90) | 16.00(23.58) | 14.64(22.50) | 16.12 |
| T3 | 85.89 | 78.42 | 82.89 | 82.40 | 6.99(15.33) | 7.83(16.25) | 6.54(14.82) | 7.12 | 15.45(23.14) | 8.55(17.00) | 7.67(16.08) | 10.56 | 18.70(25.62) | 15.41(23.12) | 11.13(19.49) | 15.08 |
| T4 | 91.00 | 83.67 | 86.34 | 87.00 | 5.77(13.89) | 6.03(14.21) | 4.12(11.71) | 5.31 | 8.44(16.89) | 6.20(14.42) | 4.52(12.27) | 6.39 | 12.71(20.88) | 11.08(19.44) | 9.21(17.67) | 11.00 |
| T5 | 79.22 | 74.83 | 82.62 | 78.89 | 8.13(16.57) | 10.52(18.92) | 6.62(14.91) | 8.42 | 18.34(25.35) | 9.83(18.27) | 8.32(16.76) | 12.16 | 21.45(27.59) | 16.20(23.73) | 12.17(20.42) | 16.61 |
| T6 | 84.33 | 74.75 | 84.37 | 81.15 | 7.84(16.26) | 10.81(19.19) | 4.87(12.75) | 8.84 | 16.41(23.89) | 10.31(18.73) | 6.61(14.90) | 11.11 | 19.05(25.88) | 16.70(24.12) | 10.27(18.69) | 15.34 |
| T7 | 83.61 | 67.42 | 77.38 | 76.14 | 7.52(15.92) | 13.21(21.31) | 8.77(17.23) | 9.83 | 16.46(23.94) | 13.17(21.28) | 11.23(19.58) | 13.62 | 20.36(26.82) | 21.14(27.93) | 17.24(24.53) | 19.58 |
| T8 | 83.06 | 73.33 | 78.34 | 78.24 | 7.97(16.40) | 10.82(19.20) | 8.29(16.73) | 9.03 | 16.54(24.00) | 11.48(19.80) | 9.53(17.98) | 12.52 | 19.94(26.52) | 18.14(25.20) | 16.33(23.83) | 18.14 |
| T9 | 78.61 | 65.58 | 74.52 | 72.90 | 9.40(17.86) | 15.83(23.45) | 10.71(19.10) | 11.98 | 16.64(24.07) | 13.50(21.56) | 11.47(19.80) | 13.87 | 24.11(29.41) | 21.89(27.89) | 19.77(26.40) | 21.92 |
| SEm± | 1.76 | 1.86 | 2.59 | 1.35 | 0.51 | 0.90 | 0.51 | 0.72 | 1.07 | 1.12 | 0.62 | 0.82 | 1.29 | 1.36 | 0.89 | 0.91 |
| CD at 5% | 5.15 | 5.44 | 7.58 | 4.06 | 1.50 | 2.63 | 1.50 | 2.16 | 3.14 | 3.28 | 1.83 | 2.44 | 3.77 | 3.97 | 2.62 | 2.73 |

**Table 3. Validation of management modules for soil borne diseases ( Pooled data : 2017-18, 2018-19 and 2019-20 )**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treat****ments** | **Pod rot (%)** | **Pod yield Kg/ha** | **Haulm Kg/ha** |
| 2017-18 | 2018-19 | 2019-20 | Pooled Mean | 2017-18 | 2018-19 | 2019-20 | Pooled Mean | 2017-18 | 2018-19 | 2019-20 | Pooled Mean |
| T1 | 4.58(12.36) | 4.24(11.89) | 4.94(12.84) | 4.59 | 1230 | 1389 | 1279 | 1299 | 3588 | 2551 | 2462 | 2867 |
| T2 | 5.22(13.21) | 3.22(10.33) | 5.11(13.06) | 4.52 | 1418 | 1444 | 1268 | 1377 | 3570 | 2630 | 2454 | 2885 |
| T3 | 5.88(14.04) | 4.02(11.56) | 4.67(12.47) | 4.86 | 1354 | 1445 | 1322 | 1374 | 3833 | 2619 | 2517 | 2990 |
| T4 | 2.57(9.23) | 2.19(8.50) | 3.04(10.03) | 2.60 | 1484 | 1597 | 1481 | 1521 | 3987 | 3008 | 2710 | 3235 |
| T5 | 7.00(15.34) | 5.00(12.92) | 4.79(12.63) | 5.60 | 1255 | 1359 | 1273 | 1296 | 3762 | 2561 | 2476 | 2933 |
| T6 | 5.87(14.02) | 5.02(12.95) | 4.16(11.77) | 5.02 | 1251 | 1345 | 1337 | 1311 | 3750 | 2445 | 2577 | 2924 |
| T7 | 6.55(14.83) | 5.04(12.98) | 5.72(13.83) | 5.77 | 1194 | 1260 | 1222 | 1225 | 3188 | 2286 | 2372 | 2615 |
| T8 | 6.57(14.85) | 5.28(13.28) | 5.41(13.44) | 5.75 | 1202 | 1281 | 1226 | 1236 | 3219 | 2459 | 2391 | 2689 |
| T9 | 6.70(15.00) | 5.58(13.66) | 6.87(15.19) | 6.38 | 1115 | 1184 | 1142 | 1150 | 2805 | 2163 | 2154 | 2374 |
| SEm± | 0.58 | 0.50 | 0.42 | 0.33 | 70.3 | 58.36 | 108 | 78.91 | 250.81 | 134.22 | 184.22 | 187.45 |
| CD at 5% | 1.70 | 1.47 | 1.23 | 0.99 | 205.41 | 170.36 | 317.38 | 236.08 | 732.01 | 391.76 | 537.71 | 569.72 |

**4. CONCLUSION**

 Soil borne diseases can be managed by integrating cultural practices like deep summer ploughing by MB plough before sowing, seed treatment with Tebuconazole 2 DS 1.5 g/kg seeds followed by soil application of *Trichoderma* @ 4 kg/ha enriched in 250 kg FYM at 35 and 70 DAS and would be effective against reducing soil-borne pathogens of groundnut such as collar rot, stem rot and pod rot.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE**)

 We hereby declare that NO generative AI technologies such as Large Language Models (Chat GPT, COPILOT, etc) and text to image generators have been used during writing or editing of manuscripts.

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