SUMMARY

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Peanut is considered one of the most important export crops in Egypt, however this export amount has regressed in the last few years because of pod rot infection and seed contamination with aflatoxins. Peanut pod rot is a serious worldwide disease where it occurs on fruits that develop below ground. Since the flowers developed above ground to form the fruits underground, the pods are subjected to attack with numerous soil borne pathogens such as *Fusarium* spp., *Sclerotium* sp., *Rhizoctonia solani Aspergillus* spp. *etc.* which causing different symptoms of pod rots. Thus, this work is aiming to draw a peanut pod rot diseases pathogens map; demonstrates the distribution of the different peanut pod rot diseases fungi all over the main Egyptian peanut productive governorates; to look for the best and effective agricultural praxis *i.e.* fertilization, irrigation, and date of sowing; and looking for the most safely effective control methods (chemicals or biological) and their side effects on the environmental components *i.e.* peanut plant characters and the soil microflora specially the beneficial microorganisms with references to the biological soil activities.

The obtained results could be summarized as follows:

1- Surveying studies of peanut pod rot diseases were carried out in twenty localities lied in six governorates *i.e.*, Sohag (Sohag, Shandawill and Akhmim), Menia (Menia, Samallot and Mallawy), Giza (Alsaff and Embaba), Sharkya (Belbies, Abou-Hammad, Fakos and El-Husnia), Ismaellia (Fayed, Abou-Soltan, El-Kassasin, Abou-Souir and Sarabium) and Behira (South-Tahrir, Kom-Hamada and El-Nobariya) during season 2001. The highest pod rot infection % was recorded in all Sharkya localities (Belbies, Fakos, Abou-Hammad and El-Husnia respectively) followed by Akhmim-Sohag and Alsaff-Giza. Meanwhile the lowest pod rot infection % was recorded in El-Nubariya-Beheira.

2- As for peanut pod rot categories, the highest infection of pods with dry brown lesions was recorded in Fakos-Sharkya followed by Fayed-Ismaellia and Belbies-Sharkia while, the lowest one was recorded in Menia, Abou-Souir and El-Nubariya localities which lied in El-Menia, Ismaellia and Beheira governorates respectively.

3- The highest percentage of pods having pink discoloration was recorded in Fakos, Belbies and Mallawy meanwhile, the least one was recorded in El-Kassasin-Ismaellia followed by Shandawill-Sohag, Fayed-Ismaelia and South-Tahrir-Beheira.

4- The highest infection% of pods with general break-down was recorded in Abou-Hammad-Sharkya followed by Al-Saff-Giza and Akhmim-Sohag meanwhile, the lowest readings were recorded in Fayed-Ismaellia.

5- The isolated fungi from shells and seeds of diseased peanut pods collected from different localities were identified as *Fusaium* spp. (*Fusarium oxysporum, F. solani, F. roseum, F. tricinctum, F. moniliforme* and *F. semitectum*), *Rhizoctonia solani, Aspergillus* spp. (*Aspergillus niger, A. flavus, A. parasiticus, A. terreus, A. ochraceus,* and *A. fumigatus*), *Macrophomina phaseolina, Sclerotium rolfsii* and other known fungi (*Alternaria* spp., *Diplodia* spp., *Penicillium* spp., *Pythium* spp., *Rhizopus* spp. and *Thrichoderma* spp.).

6- Isolation trials yielded 1828 fungal isolates from shells and 1204 fungal isolate from seeds. Among isolated fungi from shells, *Fusarium* spp. were the most dominant as they recorded the highest isolate number (633 isolates) followed by *Rhizoctonia solani* (507 isolates), *Aspergillus* spp. (404 isolates), *Macrophomina phaseolina* (101 isolates), *Sclerotium rolfsii* (73 isolates) in addition to 110 isolates of other fungi.

7- As for the isolated fungi from seeds, *Fusarium* spp. were the most dominant on the peanut seeds (472 isolates) followed by *Aspergillus* spp. (332 isolates), *R. solani* (282 isolates), *M.*

phseolina (35 isolates) and *S. rolfsii* (22 isolates) in addition to 61 isolates of the above mentioned other fungi.

8- Concerning localities of the surveyed governorates, *Rhizoctonia solani* followed by *Aspergillus* spp. were the most dominant fungi on shells of peanut pods collected from Giza governorate while, *Rhizoctonia solani* followed by *Fusarium* spp. were the most dominant on peanut shells collected from Sharkyia governorate. Meanwhile, *Fusarium* spp. recorded the highest isolate number on shells of peanut samples collected from Akhmim and Sohag localities (Sohag governorate) whereas, its lowest isolate number was recorded on shells of peanuts obtained from Abou-Soltan (Ismaellia governorate). Also, *Aspergillus* spp., recorded high frequency on shells of peanuts collected from Akhmim-Sohag. As for *Macrophomina phaseolina*, its highest number was recorded on shells of peanuts collected from El-Husnia-Sharkyia whereas it was never isolated from Abou-Soltan and El-Kassasin (Ismaellia) or El-Nobariya (Behira). Similarly, *Sclerotium rolfsii* recorded its highest number on shells of peanuts collected from Samallot–Menia and Embaba-Giza while it was not isolated from Shandawill-Sohag, Fayed, Abou-Souir and Sarabium (Ismaellia). The highest isolate number of other fungi was isolated from shells of peanuts collected from Fayed-Ismaellia but never isolated from Belbies-Sharkyia.

9- On the other hand, *Fusarium* spp. was more dominated on peanut seedsobtained from Sohag governorate than those obtained from Menia, Shrkyia, Behira, Ismaellia and Giza, respectively. Peanut seeds from Sohag locality (Sohag) and Fakos (Sharkyia) recorded the highest number of *Fusarium* spp., while the locality of Fayed recorded the lowest one. However, *Aspergillus* spp. were dominated on peanut seeds obtained from Giza governorate comparing with those obtained from Ismaellia, Sohag, Behira and Menia and Sharkyia, respectively. Concerning localities, the

highest isolate number of *Aspergillus* spp. were obtained from peanut seeds collected from Kom-Hamada-Behira and Abou-Souir-Ismaellia while its lowest number was obtained from seeds obtained from Fakos-Sharkyia. Also, both *M. phaseolina* and *S. rolfsii* showed the lowest across all surveyed localities comparing with the above mentioned three fungi. On the other hand, *M. phaseolina* was not isolated from peanut seeds collected from Akhmim-Sohage, Al Saff-Giza, Belbies-Sharkyia and Kom-Hamada-Behira. While, *S. rolfsii* was not isolated from peanut seeds collected fromSohag and Shandawill (Sohag), Menia and Mallawy (Menia), Fakos and El-Husnia (Sharkyia) and El-Nobariya (Behira). Both fungi, however, were never isolated from peanut seeds collected from Belbies (Sharkia), Fayed, El-Kassasin and Abou-Souir (Ismaellia).

10- Pathogenicity tests of the isolated fungi from infected pods indicated that all tested isolates caused pod rot infection of peanut ranged between 10-55% when tested for their pathogenic abilities. The highest pod rot infection % was recorded with *R. solani* (Ismaelia isolate) followed by *M. phaseolina* (Giza isolate) and *R. solani* (El-Menia isolate). On the other hand, the lowest pod rot infection was recorded with *A. falvus* (Sohag and Giza isolates), *F. moniliforme* (Sohag isolate) and *S. rolfsii* (El-Menia isolate).

11- Fertilization with NPK fertilizers had a great effect on peanut pod rot infection during two successive seasons 2002 and 2003. Also, it is pronounced from the results that increasing K fertilizer level singly or in combination with P specially decreased the infection with pod rot. Meanwhile, using N fertilizer singly at the high units increased pod rot infection while using P and K fertilizers with high units in combination with N fertilizer decreased the pod rot infection to moderate levels. Moreover, no addition of K in presence of high levels of N increased the percentage of break down and brown rot as well as pink rot comparing with the

treatments applied with K at high units. Also, addition of NPK fertilizers at all tested levels increased the yield of peanut pods comparing with un-treated ones.

12- The results revealed that irrigation system had a great role on incidence of pod rot infection when tested during the growing seasons 2002 and 2003 in two Egyptian governorates. The results of first and second season indicated that the best irrigation system was spray system when applied in Beheira and Sharkyia governorates where, it reduced the infection with total pod rot infection and then reduced also the infections of pods with break down, brown and pink rots. Also, drip irrigation system caused the highest total peanut pod rot infection specially in Sharkyia and then increased the infection of pods with break down, brown and pink rots in this governorate.

13- The results revealed that the early sowing of peanut during the 1st April decreased the infection with pod rot infection and then reduced the infection of pods with break down, brown and pink pods comparing to the other tested sowing dates in two governorates (Beheira and Sharkyia) during two growing seasons (2002 and 2003). It is pronounced also that delaying the sowing time after 1st April increased gradually the pod rot infection to rich their maximum infections during the two seasons in the two governorates at 1st Juni.

14- The results of using some antagonists in controlling peanut pod rot infection in Beheira and Sharkyia governorates during two growing seasons 2002 and 2003 revealed the superiority of *Trichoderma harzianum* followed by *Chaetomium bostrycoides* and *Giliocladium penicilloides* than each of the other tested commercial products *i.e.* Rhizo-N, Plantguard and Multi-VAM (mycorrhiza) in reducing peanut pod rot infection. On the other hand, all of tested antagonists whether the free or those in commercial formula reduced peanut pod rot infection more than

the un-treated one (control). Also, using all of tested antagonists whether, the free (*Trichoderma*, *Chaetomium* and *Gliocladium*) or those in commercial formula (Rhizo-N, Plantguard and Multi-VAM) increased the yield of pods in the two governorates comparing with the un-treated ones with significant differences between the treatment and without significance between Beheira and Sharkyia governorates during the two seasons.

15- Results in of using fungicides in controlling peanut pod rot infections in two governorates during two growing seasons (2002 and 2003) revealed that all tested fungicides reduced peanut pod rot infection to percentages much lower than those of un-treated ones during the two seasons. The fungicides, Vitavax-T-T, Sumisclex and Rizolex-T were the best followed by Benlate, Balir, Noplit, Daconil and Clorocip which had a moderate action while, Daconil was the least tested fungicide in reducing peanut pod rot infection during the two growing seasons in Beheira and Sharkyia governorates. In addition, using fungicides increased peanut pod yield in most cases of treating during the two seasons but Rizolex-T was the best followed by Vitavax-T-T and Sumisclex in this respect.

16- The integration between the best previously tested fungicides (Vitavax-T or Rizolex) with different levels of fertilizers (NPK) at two sowing times (15th April or 1st May) in two localities (South-Tahrir and Abou-Hammad) reduced greatly the total pod rot infections and consequently their pod rot infections with break down, brown and pink rots as well as increased the total yield of peanut pods. In this respect, the Vitavax-T with $N_2P_2K_2$ fertilizers at sowing date 15th April was the best treatment followed by Rizolex-T with $N_2P_2K_2$ at the same sowing time. Moreover, the results indicate that using the integrated control with Vitavax-T-T and Rizolex-T in combination with $N_2P_2K_2$ and $N_2P_2K_3$ was better at 15th April than those used at 1st May. Generally, the integration

between fungicides and fertilizers (NPK) at certain sowing time controlled effectively the pod rot infection and increased the total peanut pods more than the individual treatment with any of them whether in South-Tahrir or in Abou-Hammad.

17- Treating peanut seeds with fungicides before sowing suppressed the growth of fungi, bacteria, spore formers bacteria, Actinomyces, Azotobacter bacteria, Nitrobacter bacteria, algae and cellulose decomposers as well as reduced the total count of them in the the rhizosphere of peanut plants up to 120 day after sowing comparing with tested antagonists, Zero time (the soil before sowing) and control treatments (Control-1&2). In this respect, all of the tested fungicides *i.e.* Benlate, Vitavax-T, and Rizolex-T, Benlate were the highest effective ones while Daconil was the least effective one in this field.

18- Also, all tested antagonists *i.e.* Plantguard, Rizo-N and Mycorrhiza were less effective in reducing the growth of fungi, bacteria, spore formers bacteria, Actinomyces, Azotobacter bacteria, Nitrobacter bacteria, algae and cellulose decomposers in the peanut rhizosphere where the determined total count of them were high to values near to those of control treatments. The effect of tested antagonists on increasing or decreasing the total count of determined microorganisms in peanut rhizosphere was differed according to the type of these microorganisms.

19- Treating peanut seeds with fungicides or antagonists before sowing increased the activity of cellulase enzyme comparing with zero time (soil before sowing) and infected soil without sowing (control-3) as well as normal soil without sowing.(control-4). The increase in activity was raised gradually from the third day after sowing till 120 days post sowing although, all determined values of cellulose activity stayed lesser than those of all antagonists treatments and untreated seeds in infected soil (control-1) as well as untreated seeds in normal soil (control-2).

20- Treating seeds with fungicides (Benlate, Vitavax-T, Rizolex-T and Daconil) before sowing decreased the activity of dehydrogenase enzyme in the rhizosphere of peanut plants comparing with antagonists and untreated seeds in infected soil (control-1) as well as untreated seeds in normal soil (control-2). On the other hand, treating seeds with antagonists do not affect or increased the activity of dehydrogenase enzyme in most cases of tested antagonists comparing to untreated seeds in infected soil (control-1) as well as untreated seeds in normal soil (control-2).

21- Treating peanut seeds with fungicides (Benlate, Vitavax-T, Rizolex-T and Daconil) before sowing reduced the activity of nitrogenase enzyme comparing with treated seeds with antagonists and untreated seeds in infected soil (control-1) as well as untreated seeds in normal soil (control-2) on activity of nitrogenase enzyme in the rhizosphere of resulted peanut plants. On the other hand, the activity of nitrogenase enzyme was high in case of treating peanut seeds with antagonists before sowing where their determined activities were near to those of untreated seeds in infected soil (control-1) as well as untreated seeds in normal soil (control-2).

22- Treating the soil with fungicides (Vitavax-T, Rizolex-T, Benlate and Daconil) at 45 day post sowing reduced greatly the total count of fungi, bacteria, spore formers bacteria, Actinomyces, Azotobacter bacteria, Nitrobacter bacteria, algae and cellulose decomposers in the treated soil of peanut plants up to 120 day after sowing comparing with untreated, infested soil (control-1) and untreated un-infested soil (control-2) as well as antagonists treatments and soil before treating at 45 days.

23- Also, all tested antagonists i.e. Plantguard, Rizo-N and Mycorrhiza were less effective in reducing the growth of fungi, bacteria, spore formers bacteria, Actinomyces, Azotobacter bacteria, Nitrobacter bacteria, algae and cellulose decomposers in the treated soil

comparing to fungicides treatments where the determined total count of them were more higher than in case of fungicides but lower than those of untreated, infested soil (control-1) and untreated, un-infested soil (control-2) at all ages of grown peanut plants in most cases.

24- Treating the cultivated soil with fungicides or antagonists increased the activity of cellulase enzyme at all determination intervals comparing with the cultivated soil at 45 days before treating, untreated infested soil (control-1), untreated, un-infested soil (control-2), infected soil without sowing (control-3) and normal soil without sowing.(control-4).

25- Treating the cultivated soil with fungicides (Benlate, Vitavax-T, Rizolex-T and Daconil) at 45 days old of peanut plants affected negatively the activity of dehydrogenase enzyme in cultivated soil with peanut plants comparing with antagonists and untreated, infested soil (control-1) as well as untreated, un-infested soil (control-2) at all determination intervals. On the other hand, treating the soil with antagonists increased the activity of dehydrogenase enzyme specially at 48, 52 and 60 days old of the cultivated plants.

26- Treating the soil with fungicides at 45 days old of the cultivated peanut plants decreased the activity of nitrogenase enzyme in the treated soil comparing with the treated soil with antagonists as well as untreated, infested soil (control-1) and untreated un-infested soil (control-2) at all determination intervals. On the other hand, the activity of nitrogenase enzyme was high in case of treating the soil with antagonists at 45 days post sowing where their determined activities were more than those of untreated infested soil (control-1) as well as untreated un-infested soil (control-2).

27- Treating peanut seeds before sowing with antagonists or fungicides affected positively the growth characters of grown

peanut plants more than control treatments. In this respect, Benlate was the best effective fungicide where it increased the length, fresh and dry weight as well as nodule count of peanut plants more than other fungicides and all tested antagonists while, treating the seeds with Vitavax-T gave the highest nodule weight and nitrogenase activity in nodules of peanut plants. In general, the three fungicides *i.e.*, Benlate, Vitavax-T and Rizolex-T were the best effective treatments in this field.

28- All determined growth characters were affected positively by soil treatments more than by seed treatments. Soil treatments recorded the highest average values of shoot length, fresh weight and dry weight comparing with seed treatments. Concerning seed treatments, Benlate was the best of all for improving shoot length, fresh and dry weights followed by fungicide Vitavax-T-T for shoot length and fresh weight and fungicide Daconil for dry weight/plant.

29- The investigated growth characters responded differently by the tested soil treatments as the biocide Rizo-N exhibited the highest shoot length followed by Vitavax-T-T, Benlate, Rizolex-T and Daconil fungicides, respectively. While, Benlate and Vitavax-T-T recorded the highest values of fresh weight/plant followed by Rizolex-T, Rizo-N and Multi-VAM, respectively. As for dry weight/plant, Rizolex-T was the superior soil treatment followed by Rizo-N, Benlate, Vitavax-T-T and Multi-VAM, respectively. The lowest values of all determined growth characters were recorded in control treatments i.e. untreated seeds sown in soils non-infested or infested with pod rot pathogens.

30- The number and weight of peanut root nodules/plant and nitrogenase enzyme in the nodules were affected in similar way as growth characters by tested seed and soil treatments. The mean values of all these parameters were obviously higher in soil than seed treatments. With few exceptions, the fungicides Benlate and

Vitavax-T-T produced the highest values of parameters determined while the lowest values were recoded by the biocide Plantgaurd. Concerning with parameter of nodule weight, the biocide Rizo-N used soil treatments was better than Vitavax-T-T and came in the second rank after Benlate. Daconil fungicide ranked after Benlate and preceded Vitavax-T-T for increasing activity of nitrogenase enzyme in root nodules when all were used as soil treatments. However, both controls (1 & 2) were the inferior treatments in this respect.

31- On the other hand, the average percentages of the total protein in foliage and seed oil content were obviously higher in seed than soil treatments while the opposite trend was noticed concerning the protein content in seeds. The superiority of tested fungicides and bio-agents was greatly varied concerning protein and oil contents. Benlate and Plantgaurd produced the highest increase in protein content of peanut seeds when used as seed and soil treatments, respectively. While, Rizo-N and Vitavax-T-T used as seed and soil treatments, respectively produced the highest values of protein content in peanut foliage.

32- With regard to oil content in peanut seeds, both controls 1 & 2 (untreated seeds) were the superior while Benlate and Rizo-N used as seed and soil treatments, respectively were the inferior in this respect.

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