

## Fungi Associated with Peanut Pods Collected from Different Egyptian Governorates

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Surveying peanut pod rot diseases in six governorates of Egypt during growing season 2001 revealed that the highest pod rot infection percentage was recorded from Sharkiya localities (Belbies, Fakos, Abou-Hammad and El-Husiniya, respectively) followed by Sohag (Akhmim) and Giza (Alsaff). The highest infection of pods with dry brown rot was recorded in Fakos-Sharkya followed by Fayed-Ismaellia and Belbies-Sharkya. Meanwhile, the highest percentage of pods having pink discoloration (caused by *Fusarium moniliforme*) was recorded from Fakos, Belbies and Mallawy counties. Also, the highest infection percentage of pods with general break-down was recorded from Abou-Hammad-Sharkya, followed by Al-Saff-Giza and Akhmim-Sohag. The isolated fungi from shells and seeds of diseased peanut pods collected from different localities were identified as *Fusarium* 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*, *Alternaria* spp., *Diplodia* spp., *Penicillium* spp., *Pythium* spp., *Rhizopus* spp. and *Thrichoderma* spp. Isolation trials yielded 1828 fungal isolates from shells and 1204 fungal isolate from seeds. Among the isolated fungi from shells and seeds of peanut pods, *Fusarium* spp. were the most dominant followed by *Rhizoctonia solani*, *Aspergillus* spp., *Macrophomina phaseolina* and *Sclerotium rolfsii*, respectively. Pathogenicity testes revealed that isolates caused pod rot infection of peanut ranged between 10-55%.

**Key words:** peanut pod rots, fungal isolates, pathogenicity.

Peanut is one of the most important field crops in the world. Its flowers developed above ground to form their fruits underground, the pods are subjected to be infected by numerous soil born pathogens. In this respect, many of soil borne fungi genera were reported to be associated with pod rot diseases, the isolated fungi could be classified into about 20 fungal genera as mentioned by many researchers all over the world. However, the most common genera are *Alternaria* spp., *Aspergillus* spp., *Diplodia* spp., *Fusarium* spp., *Rhizoctonia solani*, *Penicillium* spp., *Pythium* spp., *Sclerotium* spp., *Rhizopus* spp., and *Thrichoderma* spp. (Porter and Garren, 1970; El-Sherif, 1983; Reddy *et al.*, 1986, Zayed *et al.*, 1986 and Filonow and

Russell, 1991). Moreover, Marei (2000) isolated *Rhizoctonia solani*, *Pythium* sp., *Trichoderma* sp and others from groundnuts rotted pods collected from Ismaellia and Giza governorates of Egypt. Abdel-Ghany (2001) reported that *Fusarium solani*, *F. oxysporum*, *F. moniliforme*, *Rhizoctonia solani*, and *Penicillium* sp. were the main fungi isolated from groundnut rotted pods collected from different localities in Egypt. *Fusarium solani* resulted in higher percentage of pre-emergence damping-off than *F. oxysporum* and *F. moniliforme*. While, Adiver and Anahosur (2002) stated that *Rhizoctonia solani*, *Aspergillus flavus*, *A. niger* and *Sclerotium rolfsii* were the most dominant fungi isolated from infected peanut pods, after *Fusarium* spp., during their surveys in Karnataka, India, at rabi/summer seasons of 1992/93, 1993/94, and 1994/95. Also, Brown *et al.* (2005) found that *Aspergillus* spp. were associated with groundnuts pod rot. This genus represents a great challenge to the peanut growers, since two species of this genus, *Aspergillus flavus* and *Aspergillus parasiticus*, are known to produce aflatoxins which can severely affect the liver and cause human cancer. Other fungi genera with minor importance were also recorded *i.e.* *Absidia*, *Botrydiplodia*, *Chaetomium*, *Cladosporium*, *Curvularia*, *Cylindrocladium*, *Drechslera* and *Helminthosporium* (Porter and Garren, 1970; Reddy, *et al.*; 1986, and Abdel-Ghany, 2001).

This work aimed to survey the associated fungi with the naturally infected peanut pods in different localities of some Egyptian governorates.

## Materials and Methods

### *Survey of pod rot diseases:*

Twenty localities selected in six governorates *i.e.*, Sohag (Sohag, Shandawill and Akhmim), Menia (Menia, Samallot and Mallawy), Giza (Alsaff and Embaba), Sharkiya (Belbies, Abu-Hammad, Fakos and El-Husnia), Esmaellia (Fayed, Abou-Soltan, El-Kassasin, Abu-Souir and Sarabium) and Beheira (South-Tahrir, Kom-Hamada and El-Nobariya) were surveyed for peanut pod rot diseases. Six hundred peanut pods of the different cultivated peanut cultivars were chosen randomly from each locality then categorized into four classes according to the visual morphological symptoms *i.e.*, brown, pink rot, break down and apparently healthy pods. Number of pods in each category was counted then percentage was calculated.

### *Isolation of the involved fungi:*

The isolation trials were carried out according to Garren and Porter (1970) using the rotted and healthy looking peanut pod samples collected from the abovementioned surveyed localities. The pods in each sample were shelled, then shells and seeds with intact testa were cut into small pieces (about 1 cm<sup>2</sup>). The sample pieces were washed thoroughly with tap water, surface sterilized in 3% sodium hypochlorite for one minute, then rewashed in sterilized distilled water. The sterilized shell or seed pieces were dried up between two sterilized filter papers then mounted onto potato dextrose agar (PDA). Plates were examined after 7 days of incubation at 25°C. The grown colonies were subcultured on PDA medium, purified using single spore culture- or hyphal-tip techniques then identified according to Gilman (1957), Ram, *et al.* (1970); Subermanian (1971); Barnett and Hunter (1972); Booth (1971); Domsch *et al.* (1980) and Sneh *et al.* (1991) and verified by the

Fungi Taxonomy & Identification Research Department, Plant Pathology Research Institute, ARC. The frequency number of the isolated fungi, in each location, was calculated as mentioned by Qasem and Christensen (1958).

#### *Pathogenicity test:*

Pathogenicity testes of six isolates from each of *Rhizoctonia solani*, *Sclerotium rolfsii*, *Macrophomina phaseolina*, *Fusarium moniliforme* and *Aspergillus flavus* which were isolated from shells of peanut pods were performed under the greenhouse conditions of Integrated control Research Dept., Plant Pathology Research Institute, Agricultural Research Center (ARC), Giza. The selected isolates of each fungus were chosen depending on their high frequency in the six surveyed governorates. Previously sterilized plastic pots (50 cm  $\phi$ ) by dipping in 5% formalin solution for 5 minutes were filled each with 20 kg sterilized sand clay soil (2:1 w/w). Soil was sterilized by 5% formalin solution, covered with polyethylene for a week then exposed to air for 2 weeks to insure complete evaporation of formalin. Inocula of each of the selected fungal isolates were prepared using CMS medium (corn meal and sand at rates 1:1 w/w) according to Filonow *et al.* (1988). Flasks 250 ml containing 100g of CMS plus 30 ml tap water were, shaken well and autoclaved twice for 1h for 2 successive days. After cooling, flasks were inoculated separately as usual with the selected fungi then incubated for 3 weeks in the dark at 26°C. Surfaced sterilized healthy seeds of peanut Giza-5 cv were sown at rate of 10 seeds/pot. Fifty days after planting, about 2-kg soil were carefully removed from the pegging zone around plants of each pot. Soil removed from 4 pots (replicates) was mixed thoroughly with CMS slurry prepared by comminuted contents of 3 flasks containing CMS cultures of a known fungal isolate plus a little tap water in a blender. After that, the infested soil was returned to its original pots. Potted peanut plants were allowed to grow for 120 days then the formed peanut pods were harvested and investigated for pod rot infection as above mentioned in survey studies.

## Results

#### *a - Surveying studies:*

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 (Al Saff and Embaba), Sharkyia (Belbies, Abou-Hammad, Fakos and El-Husnia), Ismaellia (Fayed, Abou-Soltan, El-Kassasin and Sarabium) and Beheira (South-Tahrir, Kom-Hamada and El-Nubariya) during season 2001. Percentages of natural occurrence of different categories of pod rots and frequency of fungi associated with each group onto seeds and shells in the different locations were recorded.

Data in Table (1) indicate that the highest pod rot infection % was recorded in all Sharkyia localities to be 78, 76, 74, and 74% in Belbies, Fakos, Abou-Hammad and El-Husnia respectively, followed by 72% in Akhmim-Sohag and 70% in Al Saff-Giza. Meanwhile the lowest pod rot infection % was recorded in El-Nubariya-Beheira.

As for peanut pod rot categories, the highest infection with dry brown lesions was recorded in Fakos-Sharkyia (42%) followed by Fayed-Ismaellia (37%) and

Belbies-Sharkia (36%) while, the lowest occurrence of dry brown rot (14-15%) was recorded in Menia (Menia), Abou-Souir (Ismaellia) and El-Nubariya (Beheira) localities.

Also, the highest percentage of pods having pink discoloration was recorded in Fakos (14%), Belbies (13%) and Mallawy (12%) meanwhile, the least one was recorded in El-Kassasin-Ismaellia (2%) followed by Shandawill-Sohag, Fayed-Ismaellia and South-Tahrir-Beheira (3%). Moreover, the highest infection % of pods with general breakdown was recorded in Abou-Hammad-Sharkyia (46%), followed by Al-Saff-Giza (40%) and Akhmim-Sohag (38%) meanwhile, the lowest reading (16%) were recorded in Fayed-Ismaellia.

Table 1. Survey of natural infection with peanut pod rot in different governorates during season 2001

| Governorates | Localities   | Total pod rot % | Types of pod rots |          |                | Apparently healthy pods |
|--------------|--------------|-----------------|-------------------|----------|----------------|-------------------------|
|              |              |                 | Brown rot         | Pink rot | Break down rot |                         |
| Sohag        | Sohag        | 65              | 23                | 8        | 34             | 35                      |
|              | Shandawill   | 60              | 29                | 3        | 28             | 40                      |
|              | Akhmim       | 72              | 28                | 6        | 38             | 28                      |
|              | Average      | 65.7            | 26.7              |          |                |                         |
| El-Menia     | Menia        | 50              | 14                | 6        | 30             | 50                      |
|              | Samallot     | 56              | 20                | 8        | 28             | 44                      |
|              | Mallawy      | 60              | 16                | 12       | 32             | 40                      |
|              | Average      | 55.3            | 16.7              |          |                |                         |
| Giza         | Al Saff      | 70              | 20                | 10       | 40             | 30                      |
|              | Embaba       | 62              | 18                | 8        | 36             | 38                      |
|              | Average      | 66.0            | 19.0              |          |                |                         |
| Sharkyia     | Belbies      | 78              | 36                | 13       | 29             | 22                      |
|              | Abou-Hammad  | 74              | 18                | 10       | 46             | 26                      |
|              | Fakos        | 76              | 42                | 14       | 20             | 24                      |
|              | El-Husnia    | 74              | 28                | 10       | 35             | 26                      |
|              | Average      | 76.5            | 31.0              |          |                |                         |
| Ismaellia    | Fayed        | 56              | 37                | 3        | 16             | 44                      |
|              | Abou-Soltan  | 60              | 32                | 6        | 22             | 40                      |
|              | El-Kassasin  | 48              | 28                | 2        | 18             | 52                      |
|              | Abou-Souir   | 52              | 14                | 8        | 30             | 48                      |
|              | Sarabium     | 62              | 26                | 7        | 29             | 38                      |
|              | Average      | 55.6            | 27.4              |          |                |                         |
| Beheira      | South-Tahrir | 48              | 26                | 3        | 19             | 52                      |
|              | Kom-Hamada   | 52              | 28                | 6        | 18             | 48                      |
|              | El-Nubarya   | 42              | 15                | 5        | 22             | 58                      |
|              | Average      | 47.3            | 23.0              |          |                |                         |

*Visual morphological pod rot symptoms could be summarized as follows (Fig. 1):*

- 1- Dry brown rot: Symptoms on pods include the development of light to dark brown lesions sunken or superficial, varying in size from small specks to entire peg blemish. Symptoms on pods appear as brown to black lesions on immature or mature pods. Spots may be angular, rough, or sunken. Extreme cases result in total decay and shredding.

- 2- Pink discoloration rot: Pods have turned dark inside the hull and the seed coats are pink to red in color. Immature seed coats are white to pale pink.
- 3- General break down rot: Pod breakdown rot occurred when more than one soil borne fungi infect peanut pods. Symptoms on pods appear as brown to black lesions on immature or mature pods. Spots may be angular, rough, or sunken. Extreme cases result in total decay and shredding. Pod symptoms are scattered black dots or large blackened areas on the pod surface. Usually the discoloration is superficial, but the decay may extend into the pod causing kernel discoloration. Under severe disease pressure, numerous black spots (lesions) form on the pegs resulting in pod loss during harvest.
- 4- Apparently healthy pods: Healthy pods appear normal in size shape and color, kernels usually filled the pods entirely.

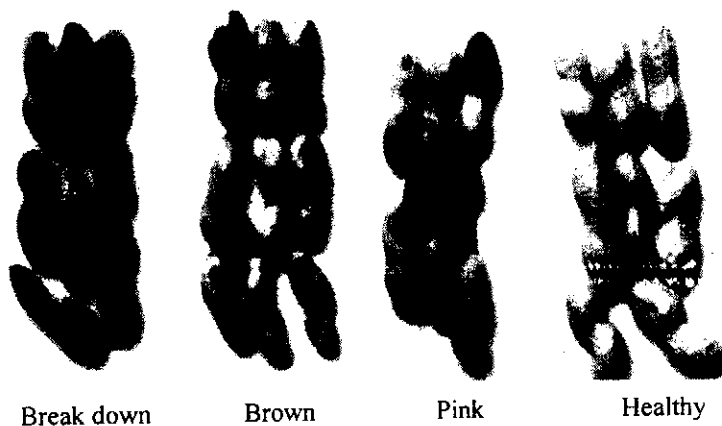


Fig. 1. The visual morphological pod rot symptoms

*b - Isolation of peanut pod rot causal fungi:*

*l - Isolation from peanut shells:*

The obtained data (Table, 2a) indicate that the fungi isolated from shells of diseased peanut pods collected from different localities were identified as *Fusarium* spp. (*Fusarium oxysporum*, *F. solani*, *F. roseum*, *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.).

Isolation trials yielded 1828 fungal isolates. Among isolated fungi, *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. This trend was evenly true in most localities of the surveyed governorates with slight exceptions. However, *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 Sharkya governorate.

Concerning surveyed localities, *Fusarium* spp. recorded the highest isolate number on shells of peanut samples collected from Akhmim (50 isolate) and Sohag (42 isolate) localities (Sohag governorate) whereas, its lowest isolate number (14 isolates) was recorded on shells of peanuts obtained from Abou-Soltan (Ismaellia governorate).

As for *Rhizoctonia solani*, shells of peanuts collected from Belbies (Sharkyia) and El-Kassasin (Ismaellia) recorded the highest and lowest isolate numbers i.e. 43 and 7 isolates, respectively. Regarding with *Aspergillus* spp., the same figures were recorded on shells of peanuts collected from Akhmim-Sohag (31 isolate) and Fakos-Sharkyia (9 isolates), respectively. As for *Macrophomina phaseolina*, its highest isolate number (18 isolate) was recorded on shells of peanuts collected from El-Husnia-Sharkyia whereas it was never isolated (0 isolate) from those collected from Abou-Soltan and El-Kassasin (Ismaellia) or El-Nobariya (Beheira). Similarly, *Sclerotium rolfsii* recorded its highest isolate number (10 isolates) on shells of peanuts collected from Samallot-Menia and Embaba-Giza while it was not isolated from those collected 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-Ismiaellia (9 isolates) but never isolated from those collected from Belbies-Sharkyia.

Table 2a. Number of isolated fungi which associated with shells of peanut pods collected from different localities

| Governorate<br>Localities |              | <i>Fusarium</i><br>spp. | <i>R.</i><br><i>solani</i> | <i>Aspergillus</i><br>spp. | <i>M.</i><br><i>phaseolina</i> | <i>S.</i><br><i>rolfsii</i> | Others | Total |
|---------------------------|--------------|-------------------------|----------------------------|----------------------------|--------------------------------|-----------------------------|--------|-------|
| Sohag                     | Sohag        | 42                      | 32                         | 17                         | 8                              | 3                           | 5      | 107   |
|                           | Shandawill   | 37                      | 22                         | 22                         | 8                              | 0                           | 5      | 94    |
|                           | Akhmim       | 50                      | 19                         | 31                         | 3                              | 6                           | 6      | 115   |
|                           | Average      | 43.0                    | 24.3                       | 23.3                       | 6.3                            | 3.0                         | 5.3    | 105.3 |
| Menia                     | Menia        | 26                      | 20                         | 16                         | 7                              | 3                           | 7      | 79    |
|                           | Samallot     | 38                      | 36                         | 23                         | 4                              | 10                          | 5      | 116   |
|                           | Mallawy      | 33                      | 12                         | 18                         | 16                             | 3                           | 8      | 90    |
|                           | Average      | 32.3                    | 22.7                       | 19.0                       | 9.0                            | 5.3                         | 6.7    | 95.0  |
| Giza                      | Al Saff      | 23                      | 42                         | 27                         | 4                              | 3                           | 6      | 105   |
|                           | Embaba       | 30                      | 32                         | 31                         | 3                              | 10                          | 8      | 114   |
|                           | Average      | 26.5                    | 37.0                       | 29.0                       | 3.5                            | 6.5                         | 7.0    | 109.5 |
| Sharkyia                  | Belbies      | 41                      | 43                         | 17                         | 4                              | 0                           | 0      | 105   |
|                           | Abou-Hammad  | 31                      | 32                         | 18                         | 3                              | 6                           | 2      | 92    |
|                           | Fakos        | 23                      | 25                         | 9                          | 4                              | 7                           | 7      | 75    |
|                           | El-Husnia    | 19                      | 18                         | 30                         | 18                             | 4                           | 7      | 96    |
|                           | Average      | 28.5                    | 29.5                       | 18.5                       | 7.3                            | 4.3                         | 4.0    | 92.0  |
| Ismiaellia                | Fayed        | 19                      | 36                         | 19                         | 2                              | 0                           | 9      | 85    |
|                           | Abou-Soltan  | 14                      | 20                         | 12                         | 0                              | 1                           | 6      | 53    |
|                           | El-Kassasin  | 33                      | 7                          | 26                         | 0                              | 6                           | 8      | 80    |
|                           | Abou-Souir   | 40                      | 41                         | 18                         | 2                              | 0                           | 4      | 105   |
|                           | Sarabium     | 29                      | 13                         | 18                         | 4                              | 0                           | 7      | 71    |
|                           | Average      | 27                      | 23.4                       | 18.6                       | 1.6                            | 1.4                         | 6.8    | 78.8  |
| Beheira                   | South-Tahrir | 28                      | 30                         | 20                         | 8                              | 4                           | 2      | 92    |
|                           | Kom-Hamada   | 37                      | 16                         | 13                         | 3                              | 5                           | 4      | 78    |
|                           | El-Nobariya  | 40                      | 11                         | 19                         | 0                              | 2                           | 4      | 76    |
|                           | Average      | 35.0                    | 19.0                       | 17.3                       | 3.7                            | 3.7                         | 3.3    | 82.0  |
| Grand Total               |              | 633                     | 507                        | 404                        | 101                            | 73                          | 110    | 1828  |

## 2 - Isolation from peanut seeds:

The same above mentioned fungi namely *Fusarium* spp., *Rhizoctonia solani*, *Aspergillus* spp., *Macrophomina phaseolina*, *Sclerotium rolfsii* as well as the other fungi were isolated also from peanut seeds (Table, 2b). The obtained results indicate that 1204 fungal isolate could be isolated from peanut seeds of samples collected from different surveyed localities. *Fusarium* spp. were the most dominant on the peanut seeds (472 isolates) followed by *Aspergillus* spp. (332 isolates), *R. solani* (282 isolates), *M. phaseolina* (35 isolates) and *S. rolfsii* (22 isolates) in addition to 61 isolates of the above mentioned other fungi.

*Fusarium* spp. was more dominated on peanut seeds obtained from Sohag governorate (aver. 32.3 isolate) than those obtained from Menia (aver. 27.7 isolate), Sharkya (aver. 26.5 isolate), Beheira (aver. 21.3 isolate), Ismaellia (aver. 17.6 isolate) and Giza (aver. 17 isolates), respectively. Peanut seeds from Sohag locality (Sohag) and Fakos (Sharkya) recorded the highest isolate number of *Fusarium* spp. (37 isolates) while those from Fayed (Ismaellia) recorded the lowest one (9 isolates).

However, *Aspergillus* spp. were dominated on peanut seeds obtained from Giza governorate (22 isolates) comparing with those obtained from Ismaellia (20.4 isolate), Sohag (19.3 isolate), Beheira (19 isolates) and Menia (11 isolates) and Sharkya (9.5 isolate), respectively. Concerning localities, the highest isolate number of *Aspergillus* spp. were obtained from peanut seeds collected from Kom-Hamada-Beheira (25 isolates) and Abou-Souir-Ismaellia (24 isolates) while its lowest isolate number (1 isolate) was obtained from seeds obtained from Fakos-Sharkya.

The same results indicate also that, both *M. phaseolina* (35 isolates) and *S. rolfsii* (22 isolates) showed the lowest across all surveyed localities comparing with the above mentioned three fungi. *M. phaseolina* was not isolated from peanut seeds collected from Akhmim-Sohage, Al Saff-Giza, Belbies-Sharkya and Kom-Hamada-Beheira while, *S. rolfsii* was not isolated from peanut seeds collected from Sohag and Shandawill (Sohag), Menia and Mallawy (Menia), Fakos and El-Husnia (Sharkya) and El-Nobariya (Beheira). Both fungi, however, were never isolated from peanut seeds collected from Belbies (Sharkya), Fayed, El-Kassasin and Abou-Souir (Ismaellia).

Another fungal group namely other fungi were also isolated fungi from peanut seeds. Its highest isolate numbers i.e. 7 & 6 isolates were recorded on seeds of peanut collected from Fayed and El-Kassasin (Ismaellia), respectively whereas, they were never recorded on peanut seeds obtained from Belbies-Sharkya and Abou-Souir-Ismaellia.

## c - Pathogenicity tests

Results in Table (3) indicate that all tested fungi were able to infect pods of peanut cv. Giza 5 with significant differences in between. *R. solani* caused the highest pod infection followed by *M. phaseolina*, *S. rolfsii*, *F. moniliformae* and *A. flavus*, respectively. Ismaellia fungal isolates, however, were more pathogenic while those from Sohag were the least pathogenic without significant differences in between.

Table 2b. Number of isolated fungi which associated with seeds of peanut pods collected from different localities

| Governorate Localities |              | <i>Fusarium</i> spp. | <i>Aspergillus</i> spp. | <i>R. solani</i> | <i>M. phaseolina</i> | <i>S. rolfesii</i> | Others | Total |
|------------------------|--------------|----------------------|-------------------------|------------------|----------------------|--------------------|--------|-------|
| Sohag                  | Sohag        | 36                   | 20                      | 17               | 2                    | 0                  | 3      | 78    |
|                        | Shandawill   | 28                   | 17                      | 18               | 3                    | 0                  | 2      | 68    |
|                        | Akhmim       | 33                   | 21                      | 22               | 0                    | 2                  | 3      | 81    |
|                        | Average      | 32.3                 | 19.3                    | 19.0             | 1.7                  | 0.7                | 2.7    | 75.7  |
| Menia                  | Menia        | 26                   | 12                      | 13               | 4                    | 0                  | 3      | 58    |
|                        | Samallot     | 30                   | 11                      | 28               | 1                    | 4                  | 4      | 78    |
|                        | Mallawy      | 27                   | 10                      | 9                | 2                    | 0                  | 5      | 53    |
|                        | Average      | 27.7                 | 11.0                    | 16.7             | 2.3                  | 1.3                | 4.0    | 75.7  |
| Giza                   | Al Saff      | 17                   | 21                      | 7                | 0                    | 1                  | 2      | 48    |
|                        | Embaba       | 17                   | 23                      | 16               | 1                    | 4                  | 4      | 65    |
|                        | Average      | 17.0                 | 22.0                    | 11.5             | 0.5                  | 2.5                | 3.0    | 56.5  |
| Sharkyia               | Belbies      | 33                   | 6                       | 11               | 0                    | 0                  | 0      | 50    |
|                        | Abou-Hammad  | 23                   | 12                      | 26               | 1                    | 2                  | 2      | 66    |
|                        | Fakos        | 36                   | 1                       | 6                | 2                    | 0                  | 3      | 48    |
|                        | El-Husnia    | 14                   | 19                      | 3                | 8                    | 0                  | 3      | 47    |
|                        | Average      | 26.5                 | 9.5                     | 11.5             | 2.8                  | 0.5                | 2.0    | 52.8  |
| Ismaellia              | Fayed        | 9                    | 20                      | 18               | 0                    | 0                  | 7      | 54    |
|                        | Abou-Soltan  | 18                   | 17                      | 8                | 2                    | 4                  | 5      | 54    |
|                        | El-Kassasin  | 17                   | 20                      | 18               | 0                    | 0                  | 6      | 61    |
|                        | Abou-Souir   | 26                   | 24                      | 4                | 0                    | 0                  | 0      | 54    |
|                        | Sarabium     | 18                   | 21                      | 17               | 6                    | 1                  | 4      | 67    |
|                        | Average      | 17.6                 | 20.4                    | 13.0             | 1.6                  | 1.0                | 4.4    | 58.0  |
| Beheira                | South-Tahrir | 17                   | 17                      | 17               | 2                    | 2                  | 1      | 56    |
|                        | Kom-Hamada   | 29                   | 25                      | 10               | 0                    | 2                  | 2      | 68    |
|                        | El-Nobariya  | 18                   | 15                      | 14               | 1                    | 0                  | 2      | 50    |
|                        | Average      | 21.3                 | 19.0                    | 13.7             | 1.0                  | 1.3                | 1.7    | 58.0  |
| Grand Total            |              | 472                  | 332                     | 282              | 35                   | 22                 | 61     | 1204  |

Table 3. Pathogenicity tests of some isolated fungi infecting peanut (Giza-5) pods

| Isolate source | <i>R. solani</i> | <i>S. rolfesii</i> | <i>M. phaseolina</i> | <i>F. moniliformae</i> | <i>A. flavus</i> | Mean  |
|----------------|------------------|--------------------|----------------------|------------------------|------------------|-------|
| Sohag          | 30.0             | 25.0               | 25.0                 | 10.0                   | 10.00            | 22.50 |
| El-Menia       | 40.0             | 10.0               | 30.0                 | 15.0                   | 20.00            | 23.75 |
| Giza           | 20.0             | 30.0               | 45.0                 | 35.0                   | 10.00            | 32.50 |
| Sharkyia       | 25.0             | 35.0               | 25.0                 | 25.0                   | 15.00            | 27.50 |
| Ismaellia      | 55.0             | 25.0               | 35.0                 | 25.0                   | 20.00            | 35.00 |
| Beheira        | 30.0             | 25.0               | 30.0                 | 30.0                   | 15.00            | 28.75 |
| Mean           | 33.33            | 25.00              | 31.67                | 23.33                  | 15.00            |       |

LSD at 5%

Fungi  
1.667Isolates  
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Infection of peanut pods caused by different isolates ranged between 10-55%. The highest pod rot infections i.e. 55.0, 45.0 and 4.0% were recorded by *R. solani* (Ismaelia isolate) followed by *M. phaseolina* (Giza isolate) and *R. solani* (El-Menia isolate), respectively. However, the lowest pod rot infection (10.0%) was recorded with each of *A. flavus* (Sohag and Giza isolates), *F. moniliforme* (Sohag isolate) and *S. rolfsii* (El-Menia isolate).

## Discussion

Peanut is considered one of the most important export crops in Egypt, however this export amount has decreased 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 (Marei, 2000).

Surveying studies of peanut pod rot diseases 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 and Sarabium) and Behira (South-Tahrir, Kom-Hamada and El-Nubariya) during season 2001 revealed that 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. On the other hand, the highest infection of pods with dry brown rot (caused by *Rhizoctonia solani*) was recorded in Fakos-Sharkya followed by Fayed-Ismaellia and Belbies-Sharkya while, the lowest one was recorded in Menia, Abou-Souir and El-Nubariya localities which lied in El-Menia, Ismaellia and Beheira governorates respectively. Meanwhile, the highest percentage of pods having pink discoloration (caused by *Fusarium moniliforme*) was recorded in Fakos, Belbies and Mallawy, meanwhile, the least one was recorded in El-Kassasin-Ismaellia followed by Shandawill-Sohag, Fayed-Ismaellia and South-Tahrir-Beheira. Also, the highest infection % of pods with general break-down (caused by several pathogens like *Aspergillus* spp and others of associated fungi) was recorded in Abou-Hammad-Sharkya followed by Al-Saff-Giza and Akhmim-Sohag meanwhile, the lowest readings were recorded in Fayed-Ismaellia. These results are in harmony with the similar obtained results of Zayed *et al.* (1986), Marei (2000) and Abdel-Ghany (2001) where all of them isolated the same fungi with different frequencies from the different parts of peanut pods in various localities and cvs.

Fungi isolated from shells and seeds of diseased peanut pods collected from different localities were identified as *Fusarium* 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 *Thichoderma* spp.). 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 followed by *Rhizoctonia solani*, *Aspergillus* spp., *Macrophomina phaseolina* and *Sclerotium rolfsii* respectively, in addition to 110 isolates of other fungi. As for the isolated fungi from seeds, *Fusarium* spp. were the most dominant on the peanut seeds followed by *Aspergillus* spp., *R. solani*, *M. phaseolina* and *S. rolfsii* in addition to 61 isolates of the above mentioned other fungi.

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 Sharkya 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-Sharkya 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-Sharkya. On the other hand, *Fusarium* spp. was more dominated on peanut seeds obtained from Sohag governorate than those obtained from Menia, Sharkya, Behira, Ismaellia and Giza, respectively. Peanut seeds from Sohag locality (Sohag) and Fakos (Sharkya) 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 Sharkya, 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-Sharkya. 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-Sohag, Al Saff-Giza, Belbies-Sharkya and Kom-Hamada-Behira while, *S. rolfsii* was not isolated from peanut seeds collected from Sohag and Shandawill (Sohag), Menia and Mallawy (Menia), Fakos and El-Husnia (Sharkya) and El-Nobariya (Behira). Both fungi, however, were never isolated from peanut seeds collected from Belbies (Sharkya), Fayed, El-Kassasin and Abou-Souir (Ismaellia). All of the above mentioned isolated fungi from the different localities and governorates in Egypt were previously recorded onto peanut seeds and shells in many places in Egypt and all over the world. Thus, the obtained results about peanut pod rot and their frequency could be interpret in light the findings of El-Maghraby and El-Maraghy (1987) and El-Nagar (1987) who isolated different species of *Aspergillus* from peanut seed samples collected from different places in Egypt. As well as, Adiver and Anahosur (2002) and Brown *et al.* (2005) found

similar results of *Aspergillus* on peanut samples. Also, all of El-Sherif (1983), Subrahmanyam *et al.* (1987) and Abdel-Ghany (2001) confirmed the obtained results *Fusarium* spp., where all of them verified that *Fusarium* was one of the most frequently isolated genera from diseased peanut pods. Meanwhile, all of Ibrahim *et al.* (1977), Filonow *et al.* (1988), Filonow and Russell (1991), Marei (2000) Abdel-Ghany (2001) and Adiver and Anahosur (2002) verified that *Rhizoctonia solani* was the most dominant fungi isolated from infected peanut pods collected from different localities in Egypt and other countries. On the other hand, the results of Zayed *et al.* (1986), Gopal *et al.* (1994), Hollowell *et al.* (1998), El-Wakil and Ghonim (2000) and Adiver and Anahosur, (2002) emphasized the obtained results on *Sclerotium rolfsii* and *Macrophomina phaseolina*.

Pathogenicity tests of the isolated fungi from infected pods revealed that all tested isolates caused pod rot infection of peanut ranged between 10-55% when they 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). These results are in harmony with the obtained results of El-Sherif (1983), Marei (2000) Abdel-Ghany (2001), and Adiver and Anahosur (2002) where all of them verified the ability of these fungi to cause peanut pod rots on different peanut cvs. cultivated in various localities.

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## حصص الفطريات المصاحبة لقرون الفول السوداني

### المجموعة من المحافظات المختلفة في مصر

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أظهر حصص أمراض عفن القرون للفول السوداني في ستة محافظات في مصر خلال موسم ٢٠٠١ أن أعلى نسبة إصابة بالعفن كانت مسجلة في كل مناطق محافظة الشرقية (بليبيس- فاقوس- أبو حماد- الحسينية علي التوالي) متبوعة بأخميم (سوهاج) والصف (محافظة الجيزة). وقد سجلت أعلى إصابة بالعفن البني على القرون الناتج عن الفطر ريزوكتونيا سولاني في فاقوس (شرقية) متبوعة بمنطقة فايد (اسماعيلية) وبليبيس (شرقية). في الوقت نفسه سجلت أعلى إصابة للقرون بالعفن الوردي في فاقوس وبليبيس (شرقية) وملوي (المنيا). وقد سجلت أيضا أعلى نسبة إصابة للعفن العام على القرون مثل أنواع من الأسبرجلس وبعض الفطريات في أبو حماد متبوعة بالصف وأخميم. وقد عرفت الفطريات التي تم عزلها من أغلفة وبذور قرون الفول السوداني المصابة على أنها أنواع للفطر فيوزاريوم (فيوزاريوم أوكسيسبورم، فيوزاريوم سولاني، فيوزاريوم روم، فيوزاريوم ترايسنكتم، فيوزاريوم مونيليفورم و فيوزاريوم سيمكتم) و ريزوكتونيا سولاني، وأنواع تابعة لجنس الأسبرجلس (اسبرجلس نيجر، اسبرجلس فلافس، اسبرجلس باراميتكس، اسبرجلس تيسرس، اسبرجلس أوكراسيس و اسبرجلس فيومجاس) وماكروفيومينا فاسيولينا وسكليروشيوم رولفسياي وبعض الأنواع الأخرى التابعة لأجناس فطريات الألترناريا و الديبلوديا و البنيسليوم والبتيوم والريزويس و الترايكوديرما. وقد أنتجت تجارب العزل ١٨٢٨ عزلة فطرية من أغلفة القرون بالإضافة إلى ١٢٠٤ عزلة من البذور. ومن بين تلك العزلات المعزولة من الأغلفة والبذور كانت أنواع الفيوزاريوم هي الأكثر تواجدا متبوعة بفطريات الريزوكتونيا وأنواع الأسبرجلس و الماكروفيومينا فاسيولينا والأسكليروشيوم رولفسياي علي التوالي. وقد أحدثت كل الفطريات المختبرة العدوى بعفن القرون علي الفول السوداني وتراوحت نسبة الإصابة ما بين ١٠-٥٥%.