

Full Length Research Paper

Survey of root rot of groundnut in rainfed areas of Punjab, Pakistan

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To monitor root rot disease of groundnut, a survey was carried in the groundnut growing areas of Attock, Chakwal, Khushab, Mianwali and Rawalpindi districts of Punjab during September and October, 2008. To assess prevalence, incidence and severity of root rot, soil and plant samples were collected from 52 locations of the earlier-mentioned districts of Punjab. The highest mean root rot incidence (63%) was observed in Attock, whereas the lowest (0%) was observed in Khushab. The highest mean severity was 2.5 in Attock, while the lowest (1.3) was in Chakwal. *Aspergillus* spp., *Alternaria* sp., *Curvularia* sp., *Fusarium* spp., *Phoma* sp., *Rhizopus* spp. and *Penicillium* spp., were isolated from soil and root, stem and foliar samples of plants showing root rot symptoms. During this survey, it was concluded that root rot causes significant losses in the groundnut crop.

Key words: Ground nut, root rot, *Fusarium solani*.

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), is an important leguminous oilseed crop, belonging to the family Fabaceae (Nordern et al., 1982). Its current annual production is 26.4 million tones throughout the world (FAO, 2007). In Pakistan, annual production of groundnut is 85,000 tones (MINFAL, 2009). Being a leguminous crop, groundnut increases soil fertility by fixing nitrogen without disturbing the agro ecological balance (Reddy and Kaul, 1986).

In Pakistan, groundnut is cultivated mainly in rainfed areas. About 84% of the total groundnut area lies in Punjab, 13% in KPK and 3% in Sindh (MINFAL, 2009). The main reason for decline in productivity include both biotic and abiotic factors such as diseases, pests, weeds, moisture stress and poor soil fertility. Leaf spot diseases caused by fungus are the major destructive disease of groundnut and could cause a yield loss of up to 50% or more (Izge et al., 2007). Fungal diseases are prevalent and common in groundnut growing areas of Pakistan including root rot, tikka, crown rot and web blotch. Root rot is an important disease of many crops in the world (Wang et al., 2005). It is an alarming threat to groundnut crop in the Punjab province. The causal organism of the

disease is *Fusarium solani* (Mart) Sacc. This disease causes significant losses in groundnut growing areas of Attock, Chakwal, Mianwali and Rawalpindi. The objective of this study was to assess the prevalence, incidence and severity of root rot of groundnut in rain fed areas of Punjab, since there is lack of knowledge about the soil borne diseases (root rot) and their causal agent at farmer's level.

MATERIALS AND METHODS

Areas surveyed

A survey was conducted at maturity stage of groundnut crop during September, and October 2008. During this survey, 52 locations of district Attock, Chakwal, Khushab, Mianwali and Rawalpindi were surveyed (Figure 1). Information about seed source, sowing date, seed rate, previous crop, fertilizer, plough practices and yield were recorded from the farmers of the respective districts.

Diseases assessment

Ten groundnut fields were surveyed at each location randomly. The disease was assessed by an open quadrat (1.5 × 1.5 m) from each corner and mid point of field. To assess disease prevalence and disease severity, five plants were selected in each quadrat in an X or diagonal configuration depending on the geometry of the field. The following formula was used to calculate the percentage

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Table 1. Incidence and severity of groundnut root rot in main groundnut growing areas of Punjab.

Area	Incidence percentage of infected plant (%)	Severity (0 to 3) scale
Attock	63	2.5
Chakwal	45	1.3
Khushab	0	0
Mianwali	61	1.8
Rawalpindi	33	1.7

Incidence = Percentage of plants infected with root rot; severity = root rot symptoms assessed on visual rating scale (0 to 3) where: 0 = clean, 1 = slightly affected roots (<25%), 2 = moderately affected roots (<50%) and 3 = severely affected roots (>75%).

of disease prevalence:

$$\text{Prevalence (\%)} = \frac{\text{Locations with disease symptom}}{\text{Total locations}} \times 100$$

Incidence was recorded as percent of plants showing root rot, while disease severity was based on visual rating scales, that is, in the case of root rot: 0 to 3 rating scale was used; where: 0 = clean, 1 = slight, 2 = moderate and 3 = severe (Ledingham et al., 1973). Diseased plants were uprooted with soil adhering to roots. Plant and soil samples were preserved in cellulose bags (12 × 8 cm) and transported to the laboratory for further analyses.

Isolation of fungi from soil

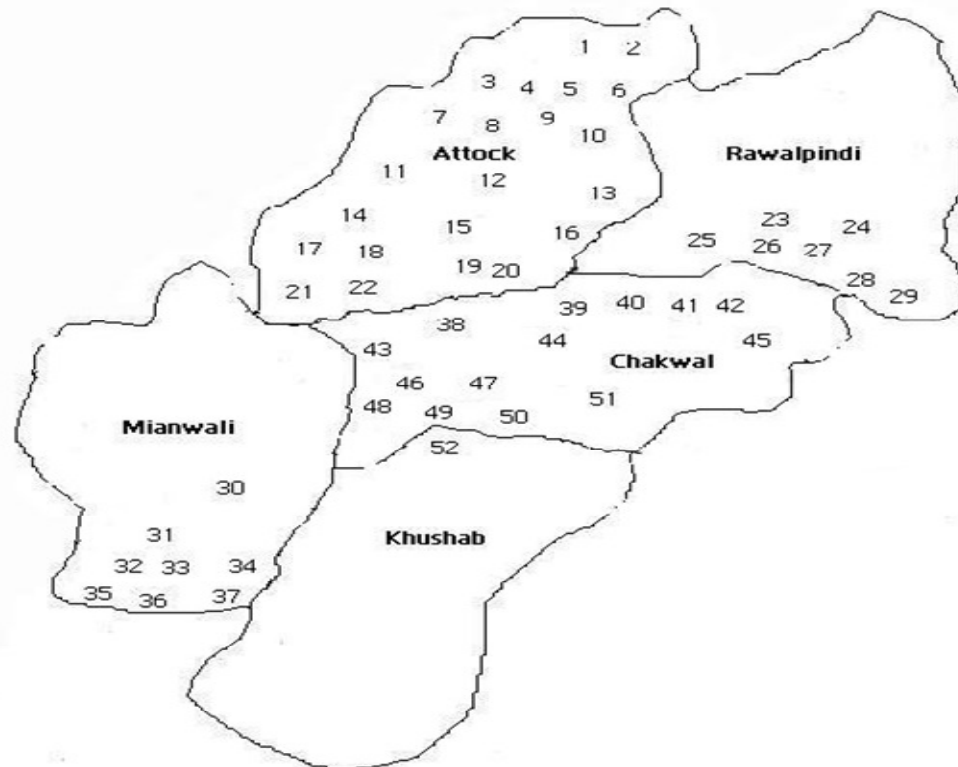
Soil dilution method (10^{-3} dilution) was used to isolate fungi from soil samples (Waskman and Fred, 1992). Different types of media viz. malt extract agar (general fungi), malt extract-benomyl-malic acid agar (basidiomycete fungi), dicholaran-rose bengal-chloramphenicol agar (food spoilage fungi), actidione-keratin bait-tap water agar (keratinophilic fungi) and tap water agar with hemp seed bait (zoosporic fungi) were used for the isolation of fungi. The cultures of fungi were purified and maintained on malt extract agar slants at 27°C. Identification of fungi was made on the basis of morphological and growth characteristics of colonies using different keys for identification of fungi (Gilman, 1945; Domsch et al., 1980; Barent and Hunter, 2003).

Isolation of fungi from infected parts (roots, stem and foliar) of groundnut plants

Root, stem and foliar parts were separated and washed under running tap water for 5 to 10 min. Washed roots, stem and foliar parts were cut into pieces, surface disinfected by immersing in 1% chlorox for 1 min, rinsed three times in sterilized distilled water, dried on sterile blotting paper and placed on malt extract agar (Usmani and Ghaffar, 1982). The plates were incubated at 27°C for 3 to 5 days.

RESULTS AND DISCUSSION

The prevalence of root rot was 90, 76, 0, 85 and 83% in Attock, Chakwal, Khushab, Mianwali and Rawalpindi, respectively, during 2008. The highest mean incidence of root rot was 63% in Attock and 0% in Khushab. The highest mean severity was 2.5 in Attock, while the lowest (1.3) was in Chakwal (Table 1). Isolation, purification and identification of fungi were carried out in the laboratories of Federal Seed Certification and Registration Department, Islamabad, Government of Pakistan. Fungi belonging to seven genera were isolated (*Alternaria*, *Curvularia*, *Fusarium*, *Phoma*, *Aspergillus*, *Penicillium* and *Rhizopus*). These findings are in accordance with those of Rashid et al. (2004). Fungi isolated from both soil and plant parts were *Alternaria* sp., *Curvularia* sp., *Fusarium* spp. and *Phoma* sp., while *Aspergillus* spp., *Penicillium* spp. and *Rhizopus* spp. were isolated only from soil. So, isolation of fungi from soil is better than from plants. Similarly, Javed et al. (2008) isolated *F. solani* from soil of infected fields with 100% frequency. *Penicillium* and *Rhizopus* were identified to generic level. *Alternaria*, *Aspergillus*, *Curvularia*, *Fusarium* and *Phoma* were identified to species level as *Alternaria alternata* (Fr.) Keissl, *Aspergillus flavous* Link ex Gray, *Aspergillus niger* van Tieghem, *Curvularia lunata* (Wakker) Boedijn, *Fusarium oxysporum* Schlecht, *Fusarium semitectum* Berk & Ravenel, *Fusarium solani* and *Phoma leveillei* Boerema & G.J. Boerema & G.J. Bollen. These findings are in accordance with those of Shah et al. (2010). Frequency of *Fusarium* spp. was the highest followed by *Aspergillus* spp. in soil, *Curvularia lunata* in roots, and *A. alternata* in both stem and foliar parts (Figure 2). In Punjab, five districts (Attock, Chakwal, Khushab, Mianwali and Rawalpindi) were chosen as these are the main groundnut producers under rain fed conditions (Figure 1). After disease assessment, fungi were isolated on a variety of media from soil and plant samples. Earlier,



1	Kamra	14	Jand	27	Mora Noori	40	Mangwal
2	Bahader Khan	15	Sughri	28	Susral	41	Dhudial
3	Haji Shah	16	Ghareebwal	29	Guliana	42	Chakral
4	Shakardara	17	Jaba	30	WanBhuchran	43	Tamman
5	Sanjwal	18	Lungar	31	Chak 7	44	Balkaser
6	Golra	19	Malal	32	Asranwala	45	Sadwal
7	Sarwala	20	Dhurnal	33	Harnoli	46	Bidre
8	Mirza	21	Mianwala	34	Chak 3 DB	47	Pira Fatehal
9	Akhori	22	Dandi	35	Chak 4	48	Dhurnal
10	Akhori	23	Sukho	36	Chak 26	49	Jhatla
11	Nara	24	Kaliam	37	Wattoo Wala	50	Bhilomar
12	Gali Jageer	25	Jatli	38	Tahi	51	Kallar Kahar
13	Dandi	26	Daultala	39	Minwal	52	Padrar

Figure 1. Locations surveyed in groundnut growing areas in the districts of Attock, Chakwal, Khushab, Rawalpindi and Mianwali at maturity stage of groundnut in September and October, 2008.

Mucor, *Aspergillus*, *Rhizopus*, *Curvularia*, *Penicillium* and *Fusarium* spp. were isolated from groundnut seeds (Aliyu and Kutama, 2007). Most *Fusarium* spp. are soil- and seed-borne plant pathogens. The occurrence of *Fusarium* spp. was more frequent as compared to other fungi, indicating that *Fusarium* is responsible for root rot disease (Marasas et al., 1988; Klassen et al., 1992). According to Elmer et al. (1997) *Fusarium* species are responsible for root rot in many parts of the world. Among

the isolated *Fusarium* spp., *F. solani* had the highest prevalence in diseased plants. Further pathogenicity tests confirmed *F. solani* as causal agent of root rot disease in groundnut which are in accordance with Semangun (1993) findings. Marasas et al. (1988) reported that *F. solani* is cosmopolitan in distribution. *Fusarium* spp. are more important and prevalent pathogens in the main groundnut growing areas of Punjab. They can attack underground parts leading to pre and post emergence

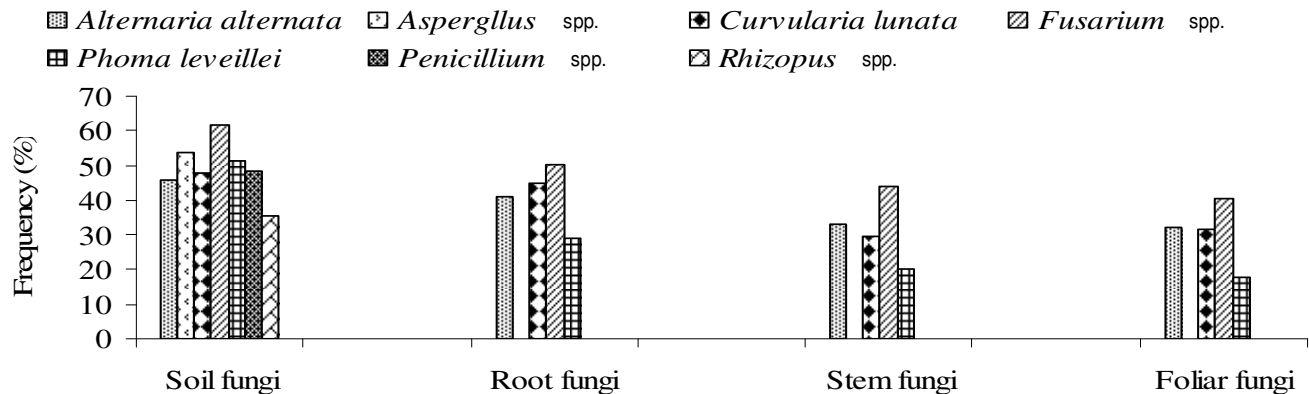


Figure 2. Frequency percentage of different fungi isolated from soil, root, stem and foliar of groundnut of rain fed growing areas of Punjab.

death, damping off, seedling blight and root rot. This is the first report on root rot of groundnut in rain fed areas of Punjab, Pakistan.

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