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*Full Length Research Paper*

# Evaluation of groundnut germplasm against root rot disease in agro-ecological conditions of district Chakwal, Punjab-Pakistan

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**In district Chakwal groundnut crop is under pressure due to root rot disease caused by *Fusarium solani* (Mart) Sacc. Evaluation of five groundnut genotypes against root rot namely 02KCG020, No. 334, BARI 2000, Golden and 02KCG05 was conducted in naturally disease infested field of district Chakwal during crop season 2009. Among the tested groundnut genotype, complete resistance to root rot was not observed in any genotype. Minimum disease incidence and mortality, 13 and 8% respectively with disease rating 0-1 was recorded in breeding line 02KCG020. The groundnut variety BARI 2000 was intermediate in resistance to root rot with disease incidence and mortality, 19 and 6% respectively with disease rating 0-1. Groundnut variety No. 334 was the most susceptible variety with disease incidence and mortality, 26 and 17% respectively. In agronomic performance, groundnut genotypes 02KCG020, BARI 2000, golden and 02KCG05 were superior to groundnut variety No. 334.**

**Key words:** Groundnut genotypes, root rot, agronomic characters, *Fusarium solani,* Chakwal, Pakistan.

## INTRODUCTION

District Chakwal is a part of Potohar Pleatue, situated in the foot of Salt Range Mountain. It is included in Rawalpindi division. In the east of Chakwal is Jehlum River, in the west is Indus River, in the north are Rawalpindi and Margalla Hills and in south Salt Range in semi circle form surrounds the district. The land area of the district is 8 hundred thousand hectares. District Chakwal comprises four tehsils namely tehsil Chakwal, Talagang, Choa Saiden Shah and Kallar Kahar. Chakwal district is an agricultural area. The main crops are wheat, ground nut, pulses, corn and millet. Groundnut is grown as a cash crop in the district. Major contribution in groundnut production is from Talagang followed by Chakwal and Kallar Kahar. The share of Choa Saiden Shah is negligible. Per hectare yield of the crop is very low in the district due to biotic and abiotic factors (Naeem et al., 2009). Among biotic factors diseases have prime importance caused by nematodes, fungi, bacteria and viruses (Smith, 1994; Subrahmanyam et al., 1980). Soil borne fungal diseases cause serious losses in crops (Mathur and Cunfer, 1993). *Aspergillus flavus, Aspergillus niger, Cercospora arachidicola*, *Curvularia* sp., *Fusarium solani, Fusarium oxysporum, Macrophomina phaseolina., Mucor, Rhizoctonia solani*, *Rhizopus* spp., *Penicillium* spp., *Puccinia arachidis*, *Pythium* spp, *Sclerotium rolfsii* (Gibson, 1953; Clinton, 1960; Reddy and Rao, 1980; Sadashivaiah et al., 1986; Parvathi et al., 1985; Aliyu and Kutama, 2007) are serious pathogens of groundnut round the globe and in Pakistan as well.

*F. solani* (Mart) Sacc., causing root rot of groundnut is the most devastating and economically important pathogen (Semangun, 1993). Root rot is a severe disease of groundnut round the globe. Exploiting host resistance is primary element in disease management. The agronomic performance of resistant cultivars is superior to cultivars with low disease resistance mostly in environmental conditions encouraging for disease development. Therefore in the present scenario of the disease experimental study was designed to explore

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**Table 1.** Spore per gram soil of experimental site Chakwal (Talagang) for groundnut germplasm screening against root rot during 2009.

| Field number | Inoculum level at two sampling depths (cm) | |
|---|---|---|
| | 0-15 | 15-30 |
| 1 | 7880 | 5000 |
| 2 | 7700 | 5400 |
| 3 | 7680 | 6000 |
| 4 | 7400 | 5500 |
| 5 | 7600 | 6000 |
| 6 | 7800 | 5400 |
| 7 | 7400 | 3400 |
| 8 | 7400 | 3200 |
| 9 | 7800 | 4500 |
| 10 | 7800 | 5100 |

resistance in groundnut genotypes against root rot.

## MATERIALS AND METHODS

### Site description

The experiments were conducted in the main groundnut growing area, Talagang (Chakwal) (32.5° N and 72.2° E), Punja b, Pakistan. The area is rain fed with annual rainfall of 300-500 mm and the climate is semiarid. The experimental site experienced heavy pressure of root rot disease during crop season 2008.

### Soil characteristics

The soil was sandy loam in nature. The soil organic matter was 0.51%, pH of the soil was 7.8. Phosphorous and Sulphur was 4.08 and 8.1 mg $kg^{-1}$ respectively. The concentrations of micronutrients potassium, zinc, copper, iron and manganese were 0.93, 1.8, 1.67, 5.19 and 2.7 mg $kg^{-1}$ respectively.

### Spore density

Sampling was made during crop season 2008. From each field 10 soil samples (50 g each) were taken randomly with 3 cm diameter soil sampler to the depth of 0 to 15 cm and 15 to 30 cm. The samples from each field and depth were mixed thoroughly. After air drying, one gram soil from each sample was suspended in 10 ml sterile distilled water in a sterilized test tube to make a dilution of $10^{-1}$. The test tube was capped tightly and shaken vigorously for 30 min. From this suspension 1 ml was added to fresh test tube containing 9 ml sterilized distilled water to prepare $10^{-2}$ dilution. Third dilution ($10^{-3}$) was prepared in the same manner. $10^{-2}$ and $10^{-3}$ dilution were used for inoculation. Inoculation was done by pouring 1 ml suspension on solidified PDA in a 9 cm Petri dish and spread with the help of sterilized L-shaped spreader. The dishes were incubated at 25℃ and observed continuously after 48 h. To calculate total number of propagules $g^{-1}$ of soil, average number of colonies per plate was multiplied by the dilution factor (Waskman and Fred, 1992).

### Experimental design

Five groundnut genotypes *viz.* 02KCG 020, No. 334, BARI 2000, Golden and 02KCG05 were evaluated against root rot in field experiments during 2009 (Table 1). The experiment was conducted using indigenous *F. solani* inoculum. Confirmation of disease pressure in the field was made by infector rows of susceptible groundnut variety (No. 334). It was sown 15 days prior to test genotypes and repeated after every three rows of the test genotypes according to a previously reported protocol (Twizeyimana et al., 2007). Plot size was 42.5 $m^2$ (6.5 × 6.5 m). Row to row and plant to plant distance was 35 and 15 cm respectively. Each treatment was replicated thrice and experimental design was randomized complete block. All the agronomic practices were applied regularly.

### Data collection

Evaluation of the germplasm against root rot was based on the following parameters: Disease incidence (%); mortality (%); disease severity; days to first flower; days to maturity; No. of branches $plant^{-1}$; Root length (cm); Plant height (cm); plant weight (g); No. of pegs $plant^{-1}$; pod $plant^{-1}$; 100 pod weight; yield (kg $hectare^{-1}$).

### Data analysis

Data was analyzed by analysis of variance following Duncan's Multiple Range Test (Steel and Torrie, 1980).

## RESULTS AND DISCUSSION

All the five tested groundnut genotypes were susceptible to root rot. The highest disease incidence (26%) and mortality (17%) was observed in groundnut variety No. 334. Disease incidence (13%) and mortality (8%) was lowest in groundnut breeding line 02KCG020. In the breeding line 02KCG05 disease incidence and mortality was 24 and 12% respectively. Disease incidence and mortality in BARI 2000 was 19 and 6% respectively. In golden variety disease incidence and mortality was 21 and 11% respectively (Table 2). Plants avoid, tolerate or recover from effects of insect pests attack due to

**Table 2.** Disease incidence and mortality in five groundnut genotypes in agro-climatic conditions of Chakwal (Talagang) during 2009.

| Treatment | Disease incidence (%) | Mortality (%) | Disease rating |
|---|---|---|---|
| 02KCG020 | 13$^{c}$ | 8$^{cd}$ | 0-1 |
| No. 334 | 26$^{a}$ | 17$^{a}$ | 0-3 |
| BARI 2000 | 19$^{bc}$ | 6$^{d}$ | 0-1 |
| Golden | 21$^{ab}$ | 11$^{bc}$ | 0-2 |
| 02KCG05 | 24$^{ab}$ | 12$^{b}$ | 0-2 |

In each column, values with different letters show significant difference (p≤0.05) as determined by Duncan's multiple range test.

**Table 3.** Growth characters of five groundnut genotypes in agro-climatic conditions of Chakwal (Talagang) during 2009.

| Treatment | Days to 1st flower | Days to maturity | No. of branches palnt$^{-1}$ | Root length (cm) | Plant height (cm) | Plant weight (g) |
|---|---|---|---|---|---|---|
| 02KCG020 | 36$^{b}$ | 133$^{d}$ | 15$^{a}$ | 38$^{ab}$ | 56$^{a}$ | 645$^{a}$ |
| No.334 | 34$^{b}$ | 134$^{d}$ | 11$^{bc}$ | 37$^{b}$ | 47$^{b}$ | 427$^{c}$ |
| BARI 2000 | 46$^{a}$ | 155$^{b}$ | 15$^{a}$ | 36$^{b}$ | 58$^{a}$ | 635$^{a}$ |
| Golden | 37$^{b}$ | 142$^{c}$ | 10$^{c}$ | 40$^{a}$ | 60$^{a}$ | 454$^{b}$ |
| 02KCG05 | 46$^{a}$ | 176$^{a}$ | 13$^{ab}$ | 37$^{ab}$ | 60$^{a}$ | 485$^{b}$ |

In each column, values with different letters show significant difference (p≤0.05) as determined by Duncan's multiple range test.

**Table 4.** Yield components of five groundnut genotypes in agro-climatic conditions of Chakwal (Talagang) during 2009.

| Treatment | No. of peg palnt$^{-1}$ | No. of pod palnt$^{-1}$ | 100 pod weight (g) | Yield (kg/ha) |
|---|---|---|---|---|
| 02KCG020 | 405$^{b}$ | 90$^{b}$ | 99$^{b}$ | 1463$^{b}$ |
| No. 334 | 197$^{d}$ | 54$^{c}$ | 78$^{c}$ | 677$^{c}$ |
| BARI 2000 | 500$^{a}$ | 110$^{a}$ | 103$^{ab}$ | 1530$^{b}$ |
| Golden | 339$^{c}$ | 121$^{a}$ | 115$^{a}$ | 2023$^{a}$ |
| 02KCG05 | 340$^{c}$ | 91$^{b}$ | 92$^{b}$ | 1613$^{b}$ |

In each column, values with different letters show significant difference (p≤0.05) as determined by Duncan's multiple range test.

possession of different phenotypic and biochemical properties that induce in them different mechanisms of resistance (Tingey, 1986; Eckey-Kaltenbach et al., 1994; Pedigo, 1996; Shaheen et al., 2006). The resistance mechanisms are highly effective against pest insects in many crops and vegetables (Eigenbrode and Trumble, 1994; Felkl et al., 2005). The presence of two independent recessive alleles of genes contributes groundnut cultivars resistance against both chlorotic and green rosette diseases (de Berchoux, 1960; Nigam and Bock, 1990; Olorunju et al., 1992). Groundnut genotypes have been found resistant against bacterial wilt (Yu et al., 2008).

Difference in flowering initiation among the groundnut genotypes was highly significant. Flowering initiation was prior in 02KCG020, golden and variety No. 334 than in BARI 2000 and 02KCG05. Following the same pattern, 02KCG020, golden and variety No. 334 matured first than BARI 2000 and 02KCG05 (Table 3). Tested genotypes showed highly significant difference in number of branches per plant. Highest number of branches plant$^{-1}$ (15) was observed in BARI 2000 and 02KCG020 where as lowest number (11) in variety No. 334 (Table 3). Root length was in range of 36 to 40 cm. The plant height was lowest (47 cm) in variety No. 334 where as in golden and 02KCG020 genotypes plants were 60cm exhibiting non significant difference with BARI 2000 and 02KCG020 (Table 3). The genotypes 02KCG020 and BARI 2000 exhibited highest plant weight and variety No. 334 was lowest in weight (Table 3). Tested groundnut genotypes exhibited a highly significant difference in yield and yield components. BARI 2000 produced highest number of pegs plant$^{-1}$ (500) where as lowest number (197) was observed in groundnut variety No. 334. The highest pod number plant$^{-1}$ (121 g) was recorded in golden and lowest (54 g) in variety No. 334 (Table 4). Golden variety dominated in yield with 2023 kg ha$^{-1}$ followed by 02KCG05 with 1613 kg ha$^{-1.}$ Cultivation of resistant cultivars is the most easy and practical approach to manage root rot in groundnut. Field screening is an

effective method to evaluate resistance in groundnut against soil borne pathogens (Brenneman et al., 1990; Shokes et al., 1992). In present studies, groundnut genotypes studied exhibited significant variations in their response to root rot. Similarly different genotypes exhibited different responses to stem rot (Branch and Csinos, 1987; Brenneman et al., 1990; Gorbet, 2004). Phonological, metabolic, structural, or possibly other factors may be responsible for resistance of groundnut to stem rot (Brenneman et al., 1990). Different groundnut genotypes have been developed with good level of resistance to rosette diseases and with acceptable agronomic performance. Quantitative traits have economic importance and are commonly used to improve crop (Amurrio et al., 1995).

## Conclusion

Five groundnut genotypes were screened against root rot in the present studies. Groundnut breeding line 02KCG020 exhibited high level of resistance under field conditions in natural disease infestation where as groundnut variety No. 334 was highly susceptible to the disease. The three groundnut genotypes BARI 2000, golden and 02KCG05 were intermediate in resistance against root rot. This study revealed that groundnut genotypes can be utilized in breeding program to develop resistant varieties against root rot for rain fed areas of Punjab and other groundnut growing areas.

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