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RESPONSE OF GROUNDNUT GENOTYPES AGAINST ROOT ROT DISEASE IN DISTRICT MIANWALI

SHAKIL AHMAD*, NOOR ZAMAN AND SALIK NAWAZ KHAN

Institute of Agricultural Sciences,
University of the Punjab, Quaid-e-Azam Campus Lahore, Pakistan
**Corresponding author email: drshakil.iags@gmail.com*

Abstract

Root rot caused by *Fusarium solani* (Mart) Sacc. in groundnut is a serious disease in district Mianwali. Five groundnut genotypes (02KCG 020, No.334, BARI 2000, Golden and 02KCG05) were evaluated against root rot in field under natural inoculum in farmer's field of Mianwali during crop season 2009. No groundnut genotype was completely resistant to root rot. In groundnut genotypes 02KCG020, disease incidence was minimum (10%) with 100% plant survival. The groundnut variety BARI 2000 and golden was intermediate in resistance to root rot with disease incidence 19% each and plant mortality 11% and 8% respectively with disease rating 0-2.Groundnut variety No.334 was the most susceptible variety with disease incidence and mortality 23% and 14% respectively.

Introduction

Groundnut (*Arachis hypogeae* L.) is an important oil seed crop. It is native to South America and now cultivated in more than 100 countries, covering an area of 26.4 million hectare with current annual production about 35.6 million tones round the world (Anon., 2007). In Pakistan groundnut is grown as cash crop mainly in rain fed conditions. The crop is cultivated on 93 thousand hectares with annual production 85 thousand tones (Anon., 2010). A variety of stresses affect groundnut production from planting to storage. Among these disease is the major stress. Different diseases hamper groundnut production (Mayee, 1987; Mayee & Datar, 1988; Ganesan & Sekar, 2004) .These include viral, bacterial, fungal and nematode diseases (Smith, 1994; Subrahmanyam *et al*., 1980). The majority of the diseases are caused by fungi and several of them cause reduction in yield varying in different regions and seasons (Mayee, 1995). Among these soil borne fungal pathogens causing serious losses have prime importance (Mathur & Cunfer, 1993). *Aspergillus flavus, A. niger, Cercospora arachidicola*, *Curvularia* sp., *Fusarium solani, F. oxysporum, Macrophomina phaseolina*, *Mucor, Rhizoctonia solani*, *Rhizophus* spp., *Penicillium* spp., *Puccinia arachidis*, *Pythium* spp., and *Sclerotium rolfsii* (Gibson, 1953; Clinton, 1960; Reddy & Rao, 1980; Sadashivaiah *et al*., 1986; Parvathi *et al*., 1985; Aliyu & Kutama, 2007) are serious pathogens of groundnut round the globe as well in Pakistan. Generally these pathogens infect underground parts of the plant and reduce yield (Wisniewska & Chelkowski, 1999). The most devastating and economically important is *F. solani* causing root rot in groundnut (Semangun, 1993).In groundnut growing areas of the world root rot is a sever disease with 95% disease incidence. Host resistance is the fundamental constituent for disease management in plants. Performance of resistance cultivars is better than cultivars with low disease resistance particularly in favorable environmental conditions for disease development. Therefore present study is designed to investigate resistance in groundnut genotypes against root rot.

Materials and Methods

Site description: Mianwali district is situated in Sargodha division of the Punjab province, Pakistan. It is continuation of Potohar platue and salt range. It shares boundaries with Chakwal, Khushab, Bhakkar, D.I Khan and Bannu districts. The experimental site lies between 32^0-13/ North latitudes and 71^0–33/ East longitudes. The experimental site was under heavy pressure of root rot disease during crop season 2008.

Soil characteristics: The soil used in the experiment was sand loamy in texture. The pH of the soil was 7.8 and the organic matter was 56%. Phosphorous and Sulphur was 3.8 and 7.8 mg kg-1 respectively. The micronutrients (potassium, zinc, copper, iron and manganese) concentrations were 105, 0.95, 1.41, 4.91 and 2.11 mg kg-1 respectively.

Spore density: During September October 2008 sampling was made from groundnut field of the district where incidence of the disease was sever. From each field 10 soil samples (50g each) were taken randomly with 3cm diameter soil sampler to the depth of 0-15cm and 15-30 cm. The samples from each field and depth were mixed thoroughly .The soil samples were air dried for 48 hours. One gram soil from each sample was suspended in 10ml distilled sterilized water in a sterilized test tube to make a dilution of 10^{-1}. The test tube was caped tightly and shaken vigorously for 30 minutes. To prepare 10^{-2} dilution 1ml suspension was added to fresh test tube containing 9 ml sterilized distilled water. Third dilution (10^{-3}) was prepared in the same manner. The 10^{-2} and 10^{-3} dilution were used for inoculation on PDA. Inoculation was done by pouring 1ml suspension on solidified PDA in a 9cm petri dishes and spread with the help of sterilized distilled L-shaped spreader. The dishes were incubated at 25^{o}C and observed continuously after 48 hours. To calculate total number of propagules g^{-1} of soil average number of colonies per plate multiplied by the dilution factor (Waskman & Fred, 1992).

Environmental conditions: The climate has extremely hot summer and cold winter season with average

maximum temperature per annum 47°C and minimum temperature 19°C. Mean annual rain fall of the Mianwali is 3.3mm and maximum rain fall occurs in the month of July i.e., 6.6cm.

Experimental design: In the field trial five groundnut genotypes viz., 02KCG 020, No.334, BARI 2000, Golden and 02KCG05 were evaluated against root rot during the crop season 2009.Each genotype served as a treatment. The field trial was conducted in natural *F. solani* inoculum pressure. To confirm high and consistent disease pressure in the field, infector rows of a highly susceptible groundnut variety (No.334) were sown 15 days earlier sowing the 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 42.5m^2 (6.5m× 6.5m). Row to row and plant to plant distance was 35cm and 15cm respectively. Each treatment was replicated thrice and randomized complete block design was followed in the experiment. 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/ plant canopy (cm)

Plant weight (g)

No of pegs plant^{-1}

Pod plant^{-1}

100 pod weight

Yield (kg/ ha)

Data analysis: Data analysis was accomplished by analysis of variance following Duncan's Multiple Range Test to separate the treatment means (Steel & Torrie 1980).

Results and Discussion

Among the tested groundnut genotype complete resistance to root rot was absent. The incidence of root rot was maximum (23%) in groundnut variety No. 334 with plant mortality 14%. The groundnut line 02KCG020 exhibited resistance to root rot with minimum disease incidence (10%) with 100% plant survival. Disease incidence and mortality in BARI 2000 was 19 % and 11% respectively. Golden exhibited disease incidence and mortality 19% and 8% respectively. Disease incidence and mortality in groundnut line 02KCG05 was 20% and 14% respectively (Tables 1 and 2). Groundnut cultivars have been found resistant against both chlorotic and green rosette diseases due to two independent recessive alleles of genes (de Berchoux 1960; Nigam & Bock 1990; Olorunju *et al*., 1992). Similarly Yu *et al*., (2006) reported resistance against bacterial wilt in groundnut genotypes.

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

Field number	Inoculum level at two sampling depths (cm)	
	0-15	15-30
1	5000	4000
2	5400	3000
3	5600	3150
4	5100	2750
5	5800	2500
6	5750	2300
7	5650	2100
8	5430	2300
9	5450	2600
10	6000	3150

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

Treatment	Disease incidence %	Mortality %	Disease rating
02KCG020	10b	0d	0
334	23a	14a	1-3
BARI 2000	19a	11b	0-2
Golden	19a	8c	0-2
02KCG05	20a	14a	1-3

In each column, values with different letters show significant difference ($p \leq 0.05$) as determined by Duncan's Multiple Range Test.

A significant difference was observed in flowering initiation. In 02KCG020, golden and variety No. 334 first flower appear earlier than BARI 2000 and 02KCG05.In the same manner maturity was delayed in both BARI 2000 and 02KCG05 (Table 3). Number of branches per plant was in range of 11-15 (Table 3). There was no significant difference in root length. A highly significant difference was observed in plant height (Table 3). A highly significant difference was observed in plant weight. The plants were heaviest (606g) in BARI 2000 and lightest (437g) in variety No. 334 (Table 3). A highly significant difference was observed in yield and yield components. Highest number of pegs (713) was observed in golden where as lowest number (309) was observed in variety No. 334.Number of pods per plant was highest (107) in BARI 2000 and lowest (52) in No.334. The pods were heaviest (119g) in golden variety and lightest (81g) in No. 334. In terms of yield golden (2697kg/ha) was dominant followed by BARI 2000 (2303kg/ha) (Table 4). Introduction of resistant cultivars still remains the most feasible approach to manage root rot in groundnut. To evaluate resistance in groundnut against soil borne pathogens field screening is an effective method (Brenneman *et al*., 1990, Shokes *et al*., 1992). Different

responses of groundnut genotypes to root rot have been observed in present studies. Similarly different genotypes exhibited different responses to stem rot (Branch & Csinos, 1987; Brenneman *et al*., 1990; Gorbet, 2004). The resistance in groundnut to stem rot may be attributed to phonological, metabolic, structural, or possibly other factors (Brenneman *et al*., 1990). Different groundnut genotypes have been developed with good level of resistance to rosette disease and acceptable agronomic performance. Quantitative traits have economic importance and are commonly used to improve crop (Amurrio *et al*., 1995). In the present studies five groundnut genotypes were screened against root rot .High level of resistance was exhibited by groundnut line 02KCG020 under field conditions. Groundnut variety No.334 was highly susceptible to the disease. The three genotypes BARI 2000, golden and 02KCG05 showed intermediate resistance. These germplasm lines and varieties can be utilized in breeding program to develop resistant varieties against root rot for rain fed areas of Punjab and other groundnut growing areas of Pakistan.

Table 3. Growth characters of five groundnut genotypes in agro-climatic conditions of Mianwali (Harnoli) during 2009.

Treatment	Days to 1st flower	Days to maturity	No. of branches	Root length (cm)	Plant height (cm)	Plant weight (g)
02KCG020	37b	137c	15bc	37b	61b	521b
334	33b	132c	11d	39ab	54c	437c
BARI 2000	43a	166b	17ab	41a	59b	606a
Golden	34b	137c	17a	39ab	66a	572ab
02KCG05	45a	177a	14c	40a	58b	537ab

In each column, values with different letters show significant difference ($p \leq 0.05$) as determined by Duncan's Multiple Range Test.

Table 4. Yield components of five groundnut genotypes in agro-climatic conditions of Mianwali (Harnoli) during 2009.

Treatment	No. of peg palnt^{-1}	No. of pod palnt^{-1}	100 pod weight (g)	Yield (kg/ha)
02KCG020	459c	89a	100b	2123bc
334	309d	52b	81c	1343d
BARI 2000	515b	107a	99b	2303b
Golden	713a	97a	119a	2697a
02KCG05	527b	91a	96b	1920c

In each column, values with different letters show significant difference ($p \leq 0.05$) as determined by Duncan's Multiple Range Test.

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