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## Research Article



### Genetic Resistance and Correlation between Black scurf and Powdery scab Disease of Potato

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#### Abstract

Multiple disease resistance is an aim of many plant breeding programs. In present studies twelve genotypes of potato were evaluated possessing resistance/tolerance against black scurf and powdery scab disease of potato. The trial was conducted in accordance with randomized complete block design (RCBD) with three replications and the results were statistically analyzed. In natural sick field the advanced line Fd-49-62 showed highly resistant reaction against black scurf and highly susceptible to powdery scab disease. The line Fd 44-42 was resistant to powdery scab but was highly susceptible to black scurf disease. Four lines/ varieties namely Fd-48-54, Diamant, Fsd-red and cardinal exhibited susceptible to highly susceptible reaction against both diseases. Remaining five entries possess an intermediate reaction in between moderately resistant to susceptible.

**Keywords:** Screening black scurf, powdery scab, multiple resistance, potato, pipelines/ advanced line

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#### Introduction

Potato (*Solanum tuberosum* L.) belonging to Solanaceae family, is starchy, tuberous food crop. Following rice, wheat, and maize, potato is the fourth largest food crop all over the world (IYP, 2008). In Pakistan it is the most prominent vegetable possessing 16-22% starch that is used in multiple combinations with meat, rice and mutton. Demand of potato consumption is increasing day by day, however average per acre yield is stagnant due to some biotic and abiotic stresses. Pathogenic diseases are among the most common and major yield hindering biotic stresses in Pakistan. For the last few years, soil and seed-borne diseases have become main threat to potato production in Pakistan (Ahmad et al., 1995). Black scurf (*Spongospora subterranea*) and powdery scab (*Streptomyces scabies*) are major diseases present in almost all production zones of Pakistan other than

Stem canker (*Rhizoctonia solani*) disease (Muhammad et al., (2013; Rauf et al., 2007, Ahmad et al., 1995; Khan et al., 1995).

Black scurf and powdery scab are fungal diseases of potato in Pakistan (Ahmad, 1998). Powdery scab is identified by the presence of superficial pimples on the skin of developing tubers these erupt to liberate powdery spores. Black scurf is identified by very small black sclerotia on the effected tuber surface. This disease also causes a russetting or checking on the tuber surface these symptoms are confused with those of common scab.

Keeping in view the damage caused by these diseases it was imperative to categories the advanced cultivars of potato possessing resistance or tolerance toward the black scurf and powdery scab disease

## Materials and Methods

Disease screening nursery comprising of 12 varieties/ advanced lines was established in the research area of Plant Regional Agricultural Research Institute, Bahawalpur, Pakistan, during 2010-2011. Seed tubers were obtained from Potato Research Institute, Sahiwal, Pakistan. The tubers were cultivated in sick plot with natural infested soil that was developed by continuous growing of potatoes lines / varieties. The sick soil provides a natural reservoir of commonly occurring soil borne tuber diseases.

The germplasm was sown on 09.10.2010, keeping a distance of plant to plant as 20 cm and row to row distances as 20 cm to 75 cm, respectively. The plot size was 7m x 0.75 m. The agronomic and plant protection measures in all 3 replications of all the entries were homogeneously treated. The trial was conducted according to the RCBD with three replications. During the design sampling probability sampling was chosen, the sample was considered as representative and the sampled units had probability of equal chance of selection in general data dissemination System (Boyko and Hill, 2009).

Tubers were harvested at plant senescence and washed and each tuber was scored for black scurf according to a visual tuber surface cover score ranging from 0 to 6.

0 = no visible disease on tuber surface, 0.5 = 1%,  
(Immune)

1 = 2–5%,

2 = 6–10%,

3 = 11–30%,

4 = 31–50%,

5 = 51–70%, and

6 = > 70% of tuber surface affected.

The percentage of tuber surface covered by lesions was recorded from all the tested cultivars. The proportion of healthy tubers with no visible lesions was also recorded. Powdery scab disease symptom severity was determined on the basis of percentage tuber surface area covered with powdery scab using the scale published by Merz (2000), which ranges from 1 (no symptoms) to 7 (> 75% covered with powdery scab). The results were analyzed statistically according to the formula given by Steel and Torrie (1980).

## Results and Discussion

The control of diseases through genetic resistance is considered to be more convenient and ensured method. Therefore varietal resistance was more emphasized than other aspects. Powdery scab is a wide-spread range pathogen of potato that can survive in all types of soil. According to Wale and de -Boer (2000) concluded that there was no significant difference in infection and disease levels between the three soil types tested. Nevertheless, powdery scab was generally more severe in the two lighter soils than in the clay soil. In some countries, powdery scab has been reported to be a particular problem in sandy and, to a lesser extent, loamy soils. It is known that acid soils can prevent disease by inducing the release of zinc and manganese, which are toxic to *S. subterranea* zoospores (Burnett, 1991), however, no significant differences in pH or heavy metal contamination (e.g. zinc) were present between the three soil types.

Analysis of variance regarding the Black scurf disease percentage indicates that all the tested varieties/ lines of potatoes differ statistically significant from each other with respect to disease incidence. Mean comparison by using Tuckey HSD is given in table 1. It is evident that potato genotypes differ appreciably in their level of susceptibility/ resistant to both diseases. The parameters for measuring the disease intensity are many and depend upon the test method used, the way in which the resistance is expressed. To obtain the more precision results 0 to 6 scale of Wilson et al. (1999) was used. The result exhibited that black scurf disease percentage amongst the tested entries ranged from 2.67 to 85.00. Minimum disease occurrence was found on FD-48-4 but maximum on advanced line 44-42, however, all the other tested cultivars showed intermediate response toward disease incidence. In case of powdery scab disease, incidence ranged from 6.67 to 91.1 percent. The minimum disease was found on advanced line 44-42, but maximum on FD-48-4. An assessment was obtained in the genetic resistance of the lines/ varieties. These clues will be followed up in future research during the incorporation of desired genes against the disease.

**Table: - 1** Mean Comparison regarding the Disease incidences of black scurf and powdery scab on tested potato cultivars/ lines.

Sr. No	Name of Variety/ Line	Disease incidence		Reaction of lines/ varieties	
		Black scurf	Powdery scab	Black scurf	Powdery scab
1	FD-49-62	11.363 BC	67.56 AB	MR	-S
2	Fd-48-4	2.667 C	91.10 A	HR	HS
+3	FD-White	58.333 AB	45.33 ABC	S	MS
4	FD-32-3	63.667 A	36.00 BC	S	MS
5	48-56	8.50 C	73.97 AB	R	HS
6	Cardinal	61.477 A	72.377 AB	S	HS
7	44-42	85.00 A	6.66 C	HS	R
8	FD-43-26	40.53 ABC	65.720 AB	MS	S
9	FSD-Red	81.310 A	64.600 AB	HS	S
10	393619-44	47.50 ABC	28.440 BC	MS	MR
11	Diamint	75.00 A	59.250 ABC	HS	S
12	FD-48-54	69.317 A	69.750 AB	S	S

**Table:- 2** Pearson Correlation

Black scurf disease

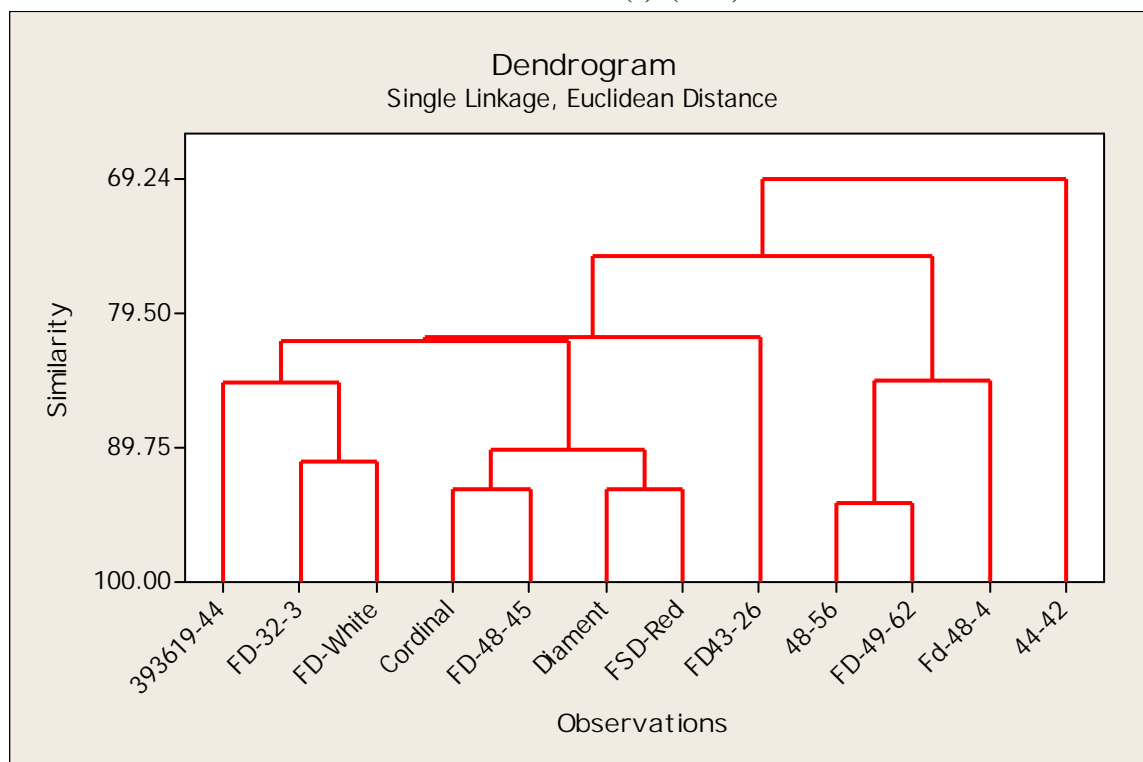
Powdery scab -0.4076  
P- Values 0.0136

From the results it is clear that both diseases have inverse relationship with each other on the susceptible and resistant cultivars. Cultivar FD-48-4 exhibited highly resistance toward black scrub but is highly susceptible to powdery scab disease. The advanced line 44-42 is resistant to powdery scab and highly susceptible to black scurf disease. Correlation coefficient values given in table 2 showed that both the diseases have exerted negative and significant effect with each other. While grading entries with respect to incidence of diseases were taken as parameter in the assessment of both the diseases.

### Dendrogram

Twelve genotypes of were grouped into 3 clusters based on the incidence of black scurf and powdery

scab diseases. Each cluster denotes a small scale representation of the total population. The advanced line 44-42 comprises of a single group. Cluster 2 comprises of 3 advanced lines i.e. 48-56, FD-49-62 and FD-48-4. Cluster 3 is included on 8 genotypes. (393619-44, FD-32-3, FD-white, Cordinal, FD-48-45, Diamint, Fsd-Red and FD-43-26). In cluster 3, the line 393619-44 and FD-43-26 have 80 % similarities, while remaining 6 entries i.e. (FD-32-3, FD-white, Cordinal, FD-48-45, Diamint and Fsd-Red) have more than 90 % similarities in disease incidences. In cluster 2 the lines 48-56 and FD-48-62 exhibited about 95 % resemblance with respect to diseases resistance/susceptibility. Figure below represents the overall detail of it.



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