

SCREENING OF POTATO (CULTIVAR) GERMPLASM AGAINST POTATO LEAF ROLL VIRUS (PLRV) UNDER NATURAL FIELD CONDITIONS



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ABSTRACT

Potato is attacked by many viral diseases and Potato leaf roll virus (PLRV) is an important progressive disease in Pakistan. Sixteen potato cultivars SS 70-4, FD-74-24, FSD white, FD 72-42, N 96-25, FD 74-30, Coroda, FD 71-1, FD 78-36, FD 78-15, FD 81, FD 74-21, FD 76-67, FD 74-47, FD 75-47 and FD 69-1 were screened under natural field conditions to identify resistance source against PLRV. Symptomatic appearance was the criteria to confirm the disease. Statistical analysis was performed to get the scientific results. Out of sixteen varieties five varieties FD 72-47, N96-25, FD-81, FD 74-21 and FD 75-47 were found highly resistant showing 0.00%, 0.00%, 0.13%, 0.40% and 0.00% disease incidence respectively, four varieties FSD White, FD 74-30, FD 74-47 and FD 69-1 were resistant exhibiting 13%, 18%, 14% and 18% disease incidence respectively, three varieties including Coroda, FD 78-15 and FD 76-67 were moderately resistant with 24%, 28% and 28% disease incidence, three varieties FD 74-24, FD 71-1 and FD 78-36 were moderately susceptible showing 30%, 34%, and 37% disease incidence and only one variety SS 70-4 exhibited highly susceptible results with 60% disease incidence. The most economic way is screening by identifying the resistant source in potato vegetable to control the losses caused by disease.

Keywords:

Potato,
 Cultivar,
 Potato leaf roll virus (PLRV),

I. INTRODUCTION

Potato (*Solanum tuberosum* L.) is an important vegetable crop carrying high nutritional value. In ranking it stand at number 4th with annual production of 309.9 million tons in the world after wheat, rice and maize, grown at area of 19.1 million ha (Oerke, 2006). In Pakistan the area under potato cultivation is 128 thousand hectares with the average production of 2542 tons per hectares (Bakhsh and Ahmad, 2006). Potato is suffering from many viral diseases but in Pakistan, it is subjected to serious infection and losses because of Potato leaf roll virus (PLRV).

It is transmitted by aphid *Myzus persicae* Sulz. Species in a non-propagative manner and is regarded as the most efficient vector (Harrison, 1984). The infection range of PLRV was found from 0-100 percent of plants (Gavran, 1997). Seeds infected by PLRV produce the plants with fewer and smaller tubers. In Pakistan, Potato leaf roll virus has been a rising and resurging disease because of high incidences encountered in the fields detected through ELISA tests (Mughal, 2003). PLRV has emerged as the most important disease and yield losses have been recorded up to 90% (Bhutta and Bhatti, 2002).

Plants suffering from potato leaf roll virus attack exhibits upward rolling of leaves and plants become stunted and off colored. Carbohydrate accumulation takes place in the leaves. The color of leaf may become purple or pink, leaflets become leathery in texture and phloem develops net necrotic symptoms which are visible on cutting a slice (Agrios, 2005).

Pathologists and breeders are making efforts to control PLRV by various approaches for secure production of virus free tubers. Efforts include specific growing strategies for production of seeds and its storage, potato seed certification programmes, control of vector by insecticides, mineral oils and bio pesticides, tissue culture technique and thermotherapy (Ooesterveld, 1987; Quak 1987). The principle objective of all these approaches is to obtain virus free cultivars. The available natural sources of resistance are not enough so new sources are sought. Less resistance and high severity of this disease in most of varieties/clones or lines is because of high inoculum level which may continue to increase this is because of aggressive

virulence of virus which may continue to introduce (Umar et al., 2011). There is the need to promote more resistant cultivar of potato because of complexity of other methods. Now a days it is immense important to introduce substituted advanced crop protection or control methods. Some of the most effective and persistent insecticides have been withdrawn from the market because of its residual effect, making it more difficult to control virus levels in seed and commercial potatoes. With the least usage of conventional synthetic chemicals and bio pesticide pathologist and breeders have to develop resistant cultivar of potato because it is also a cost limiting factor. In this way the screening of resistance source is encouraged in all valued crops.

II. MATERIALS AND METHODS

These research studies were carried out in Research area of Dptt. of Plant Pathology, University of Agriculture Faisalabad during the cropping season of 2013-2014. Sixteen potato cultivars (clones/lines/varieties) SS 70-4, FD-74-24, FSD white, FD-72-42, N 96-25, FD 74-30, Coroda, FD-71-1, FD 78-36, FD 78-15, FD 81, FD 74-21, FD 76-67, FD 74-47, FD 75-47 and FD 69-1 were collected from Ayub Agriculture research institute (AARI) vegetable section and Potato research center Sahiwal. To evaluate the potato (clones/lines/varieties) for their response of resistance against PLRV a virus free potato germplasm was grown in the field conditions by keeping 60 cm row to row distance and 30 cm plant to plant distance. RCBD (Randomized complete block design) was used to evaluate the resistant variety. Three replications were made randomly to screen the potato (clones/lines/varieties). Data was recorded from 20th December to till maturation with equal time intervals.

Data recording

The disease incidence was recorded on the basis of visual symptoms of every line and Incidence %age was calculated by following formula;

$$\% \text{ Incidence of virus} = \frac{\text{No. of infected samples}}{\text{Total no. of samples tested}} \times 100$$

The following modified scale was used:

Disease scale	Disease incidence	Symptoms	Reaction Group
0	0	No symptoms	HR
1	1-20	Rolling of upper leaves (Primary infection)	R
2	21-30	Rolling of upper and lower leaves (Secondary infection), erect growth.	MR
3	31-40	Rolling of leaves extending, leaves become stiff and leathery, stunting of plants and erect growth.	MS
4	41-50	Short internodes, papery sound of leathery leaves, rolling and stunting of whole plants. Young buds are slight yellowish and purplish.	S
5	51-100	Clear rolling of leaves, sever stunting, few tubers and tuber necrosis	HS

(Khan et al., 2006)

On the basis of symptoms, the infected plants then observed weekly.

Statistical analysis

Data was subjected to analyze by using Statistical Analysis System (SAS 9.3). The analysis of variance (ANOVA) was calculated at the 5% level of significance. Fisher's Least Significant Difference (LSD) test was used for statistical comparison among treatments of screening (Steel et al., 1997).

III. RESULTS AND DISCUSSION

In 2013-14 during the crop season sixteen potatoes (clones/lines/varieties) were screened against PLRV.

Potato germplasm field screening to PLRV during 2013-14

Variety	Disease Incidence %	Rating	Response
SS70-4	60 A	5	HS
FD74-24	30 CD	3	MS
FSD White	13 G	1	R
FD 72-47	0.000 G	0	HR
N96-25	0.000 G	0	HR
FD74-30	18 F	1	R
Coroda	24 E	2	MR
FD71-1	34 BC	3	MS
FD78-36	37 B	3	MS
FD78-15	28 DE	2	MR
FD81	0.133 G	0	HR
FD74-21	0.40 G	0	HR
FD76-67	28 DE	2	MR
FD74-47	14 F	1	R
FD75-47	0.000 G	0	MR
FD69-1	18 F	1	R

LSD: 0.2258

HR = Highly resistant, R = Resistant, Moderately resistant, MS = Moderately susceptible, HS = Highly susceptible.

Mild to progressive leaf rolling was observed after 40 days of sowing. Above mention varieties gave the mixed response. Out of sixteen varieties five varieties FD 72-47, N 96-25, FD 81, FD 74-21 and FD 75-47 were found highly resistant showing 0.00%, 0.00%, 0.13%, 0.40% and 0.00% disease incidence respectively, four varieties FSD White, FD 74-30, FD 74-47 and FD 69-1 were resistant and they exhibited 13%, 18%, 14% and 18% disease incidence, three varieties including Coroda, FD 78-15 and FD 76-67 were moderately resistant with 24%, 28% and 28% disease incidence, three varieties FD 74-24, FD71-1 and FD 78-36 were moderately susceptible showing 30%, 34%, and 37% disease incidence record and only one variety SS 70-4 exhibited highly susceptible results with 60% disease incidence.

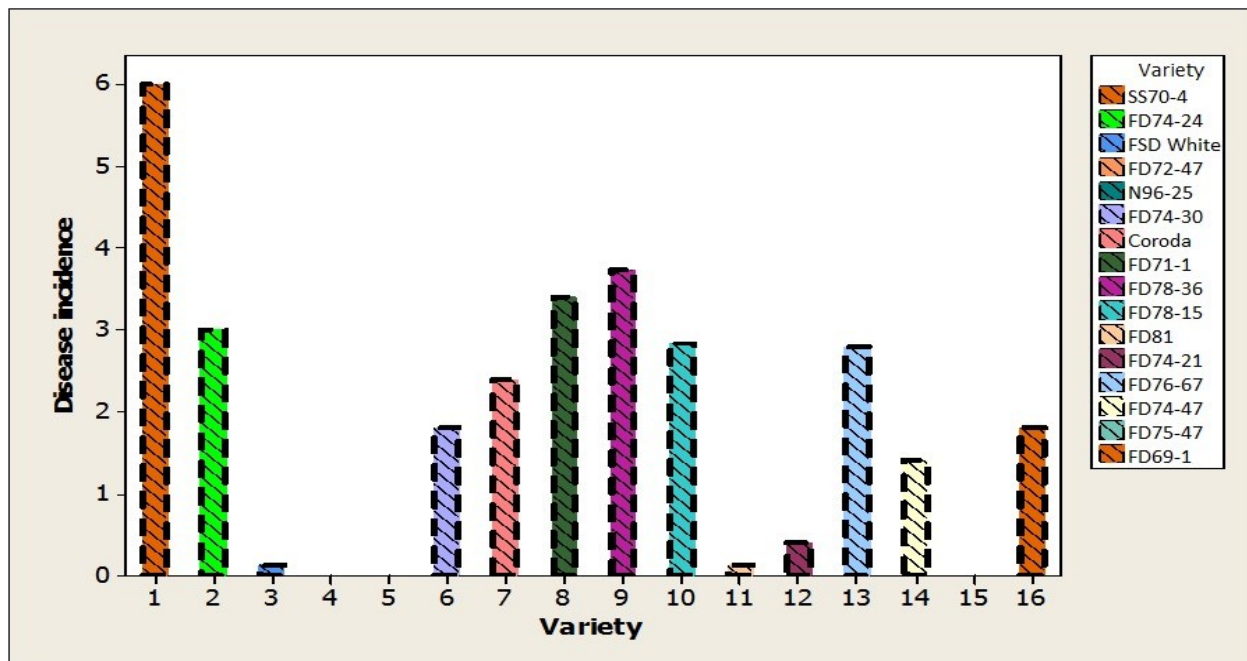


Figure 1 : Response of 16 screening potato cultivar against PLRV under field conditions

In fig. 1 the Y-axis shows the disease incidence in percentage where 1, 2, 3, 4, 5 and 6 on the scale are equal to 10, 20,30,40,50 and 60% incidence.

Potato is 4th important vegetable crop grown in plain and hilly areas of Pakistan. In 2005 the leaf curl disease was severely observed in potato fields of Punjab province of Pakistan. Plants showed the typical viral attack symptoms crinkled and curled apical leaves with stunted growth and reduced tuber production. This caused a notable loss in potato crop production. From all observation of fields it was clear that many viruses attacked the potato crop and the major threat was PLRV. This can be managed through alteration in sowing time causing disorder in spread through aphids of by using the resistant cultivars of potato (Mubeen *et al.*, 2009).

Same mixed response of potato cultivars was studied by Umer *et al.*, in 2011 in his experimentation while searching for source of resistance against PLRV. Forty potato cultivars were screened under the field conditions from which seven varieties/lines Astrix, Mirrao, Oceania, Orla, Hermes, Safreen and 396266-33 were found to be highly resistant against PLRV and four entries 394021-120, FD 7-2, FD 49-62 and FD 48-4 were found to be resistant (Umar *et al.*, 2011). In field the plant to plant spread in resistant cultivars of potato is less because of less virus titer (Thomas *et al.*, 1997).

Thirty six potato cultivars were tested for screening against PLRV under the field conditions (Bagnall and Tai., 1886). During a survey in Murree and Faisalabad among one hundred and forty eight potato cultivars or lines against PLRV 3.7% incidence was recorded in the local crossed material and 28.5% was in imported material. Most of them were found moderately resistant and moderately susceptible (Ahmad and Ahmad., 1995). Such varieties show the moderately resistant response and were high yielding and can be modified by the breeding or by tissue culture technique.

IV. CONCLUSION

Out of sixteen varieties, five FD 72-47, N96-25, FD-81, FD 74-21 and FD 75-47 were found highly resistant showing 0.00%, 0.00%, 0.13%, 0.40% and 0.00% disease incidence respectively. This resistant under natural field conditions is useful source to be utilized in breeding programmes for successful development of resistant varieties with high yield.

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