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Identification of PVY and Resistant Germplasm in Potato Through Protein Based Methods

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Abstract

Present study was conducted to evaluate the resistant germplasm against PVY and hypersensitive response of potato. PVY has caused great concern in potato production both in green house and field conditions. Six advanced varieties of potato were sown both in green house and field area of Plant Virology Section, PPI, Ayyub Agricultural Research Institute, Faisalabad to evaluate their response against PVY 2014-2015. The most reliable source, ELISA technique was used for the confirmation of virus. Detection of PVY was done through different methods such as symptoms, DAS ELISA and Strip ELISA method. Virus transmission was assessed through biologically and mechanically. Results revealed that biological mode of transmission have more impact on disease spread. SH-5 (12-17%) was found to be resistant, Simply Red (27-31%), FD 35-36 (43-45%) and FD 69-1 (34-37%) were moderately resistant while Cardinal (61-65%) and Karoda (67-71%) were moderately susceptible. So, virus impact is more pronounced on potato growth, as no variety was found to be immune.

INTRODUCTION

Potato (*Solanum tuberosum L.*) is the principal vegetable in Pakistan and chief source of carbohydrate in the whole world. In our country, it is grown on an area 1669.8 thousand ha. with annual production 3084.3 thousand tons (Pakistan bureau of statics, 2014). Average yield of potato in our country is comparatively low than advanced countries like Netherlands and China. Among constrains of low yield viral diseases occupy a prominent percentage. Viral diseases in some cases result in complete crop failure. Several viruses infect potato crop but those causing economic losses include Potato Virus Y (PVY), Potato Virus X (PVX) and Potato Leaf Roll Virus (PLRV) (Bantarri *et al.*, 1993). Potato viruses are very destructive especially when appear in mixed infection and become impossible to save the crop as it causes degeneration of variety, reduce vegetation and ultimately production declines (Silberschmidt, 1942; Sanger *et al.*, 1988).

But the average yield of potato crops in Asia remains low; in contrast, average yield of potato crop in Western Australia is 39.5 t ha. (Batt, 1994). The increasing need for high-quality virus-free seed potatoes remains one of the challenging and costly aspects of production (Khamassy, 1999). Currently, none of high yielding varities is showing durable resistance in Pakistan. This is mainly due to presence of virus mainly PVY. The PVY is among the most important diseases of potato since 1984. Losses in Pakistan are estimated from 40-70% (Mughal, 1988). PVY is the type species of the genus Potyvirus, in the family potyviridae. Symptoms induced by PVY vary from an almost mosaic up to severe necrosis and early death of plant, its depend upon on cultivar and viral strain (Silberschmidt, 1942; Souza Dias and Iamauti, 1997). For the eradication of virus three methods are commonly used thermotherapy, chemothrpy and tissue culture. Most effected method is tissue culture for the reduction of virus and most viable method for the detection of virus is ElISA (Enzyme Linked Immunosorbant Assey). There are several kinds of ElISA but in the field Rapid ELISA is commonly used as it is rapid.

MATERIALS AND METHODS

Six varieties/lines of potato were selected and sown in field area of plant virology section, PPRI, Ayyub Agricultural Research Institute, Faisalabad. Plant was done in RCBD. Fifteen tubers of each varieties/lines per row planted in three replicates with P x P 30 cm and R x R 60 cm, respectively. Following the recommended agronomic practices, the crop was sown in 15 October, 2014. Potato virus Y disease data was recorded following disease rating scale.

Disease rating	**Symptoms**	**Level of resistance/ susceptibility**
0	No visible symptoms	Highly resistance
1	Blackening and banding of vein on few leaves, mosaic starting on all leaves	Resistance
2	Blackening and banding of vein on all leaves. narrowing of leaves, venial necrosis, severe mosaic, leaf crinkling	Moderately resistance
3	Rugosity and leaf drop streak, dwarfing	Moderately susceptible
4	Lower leaves dead, drooping collapse of plants with very small tubers	Susceptible
5	All leaves dead, stem dead or dying	Highly susceptible

(Mughal and Khan, 2001)

Symptomatic leaves were collected for confirmation of PVY by ELISA method in serological lab of Plant Virology, PPRI, Ayyub Agricultural Research Institute, Faisalabad.

$$\text{Incidence of PVY (\%)} = \frac{\text{No.of infected plants}}{\text{Total No.of plants examined}} \times 100$$

RESULTS

Out of six varities/line; one of them (SH-5) found to be resistant, simply red, FD-35-36, FD-69-1 were moderately resistant whereas cardinal and caroda showed moderately susceptible responses to Potato Virus Y. So, virus impact is more pronounced on potato growth, as no variety was found to be immune.

Sr. no.	Variety/ lines	Disease severity index (%)	ODI value	Disease rating	Response
1	SH-5	24.3		1	R
2	FD-35-36	43.8		2	MR
3	FD-69-1	30.1		2	MR
4	Cardinal	71.0		3	MS
5	Simply red	38.7		2	MR
6	Karoda	64.8		3	MS

I – Immune (0%), R – Resistant (1-25%), MR – Moderately resistant (26-50%), MS – Moderately susceptible (51-75%), S – Susceptible (76-100%).

Many factors including diseases are responsible for low potato yield. Among these, prevalence of viral diseases like potato leaf roll virus (PLRV), potato virus Y (PVY) and potato virus X (PVX) are the most common, serious and widely distributed. Jarjees (2000) also used the ELISA for rapid detection of PVY in Iraq and obtained significant results. Abou- Jawdah (2001) studied potato fields in the 2 main production areas of Lebanon, the Bekaa and Akkar plains, for viruses and other pathogens of significance for a potato seed certification programme. Positive reaction was observed with PVY infected tissues. The color reaction was moderate yellow to dark yellow. All the varieties and lines were subjected to double antibody sandwich ELISA (DAS- ELISA), using monoclonal antibodies (Clark and Adams, 1977).

It provided rapid, reliable and accurate diagnosis of PVY. The severity of symptoms in naturally infected potato plants compared very well with color development in ELISA plate. Although symptom expression was indicating the incidence of PVY in the field samples but ELISA test also confirmed the virus in the samples. Genetic variability in potato germplasm for PVX and PVY seems to be narrow. It would

be desirable to broaden this base through breeding and biotechnology for which collection and use of local germplasm of potato can play a greater role. The change of genotype response against PVX and PVY during the both years might be attributed to various causes like genetic makeup of plant and several other biotic and abiotic factors. The screening results revealed that some environmental factors and most importantly genetic makeup must be involved in conditioning resistance.

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