http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 7 (7): 1140-1143, 2004
ISSN 1028-8880

Distribution of PLRV, PVS, PVX and PVY (PVY^N, PVY^o and PVY^c) in the Seed Potato Tubers in Turkey

[1] H. Bostan and [2]K. Haliloğlu
[1]Department of Plant Protection, [2]Department of Field Crops,
Faculty of Agriculture, Atatürk University, 25240, Erzurum, Turkey,

Abstract: This study was conducted in order to determine the distribution ratio of PLRV, PVS and PVY (PVY^N, PVY^o and PVY^c) in the seed potato tubers used for planting material in the important potato production regions of Turkey and observe the symptoms caused by single or mixed infection of these viruses under field condition. Firstly, over 880 leaf samples were tested by using virus-specific polyclonal antibodies. Secondly, 83 samples found to be infected with PVY in the result of first ELISA were retested by using PVY^o, PVY^N and PVY^c-specific monoclonal antibodies. The ELISA results showed that seed potato tubers used for planting material was infected with at the rate of PLRV (14.2%), PVX (11.8%), PVS (4.6%) and PVY (17.7%). On the other hand, the result of monoclonal antibody for PVY-strains showed that the frequency of PVY^N and PVY^o were (13.4%, 4.3%) but PVY^c was not found. Under field condition, plants infected with PLRV exhibited the rolling of young leaves, upright growth and pinky color but PVS did not cause any distinct symptoms. PVX alone or the combination of PVX with PLRV, PVS and PVY caused mild or severe mosaic symptoms on all cultivars. PVY induced yellowing of leaves, leaf drop streak, veinal necrosis on some plants from all cultivars, however, some plants did not develop any distinct symptoms in case of infected with PVY. The combination of PVY and PVX caused more severe mosaic, rugosity and reduced of leaf size. When plants infected with PVY and PLRV exhibited yellowing of leaves, leaf drop, dwarfing, rolling of leaves and rogositiy. However, some plants from Morfona and Granola cultivars died. On the other hand, the symptoms on plants infected with PVS and PLRV or PVS and PVY were similar to single infection of PLRV and PVY.

Key words: Seed potato, PLRV, PVS, PVX, PVY

INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important crops in Turkey. According to 2001 statistics, the total potato cultivated area of Turkey is 200 thousand ha and total potato tuber production is approximately 5 millions tons[1]. Turkey needs approximately 125.000-150.000 tons potato seed per year and there is no state company that produced diseases-free seed potato in Turkey. Therefore, to meet the demand of farmers, seed potatoes have been imported, multiplied and then have been distributed to the producers by some private companies[2]. Obtaining quantities of clean planting material has been a major barrier to increase potato production in Turkey. Seed tuber multiplication is slow and diseases tend to increase with each multiplication. Furthermore, under field conditions, potato often becomes infected with several viruses during a growing season[3,4]. Many plant viruses are carried within the propagation material[5]. Therefore, imported and multiplied seed-potato tubers can also be a source of viruses and become primary inoculum for virus vectors, if seed tubers are not routinely indexed[6,7]. Potatoes are subject to more than 30 virus diseases[8]. Depending upon the virus species, transmission can be mechanical through wounds, by a biological intermediary, or both[9]. The most common viruses affecting potato crops are potato virus Y (PVY, a *Potyvirus*), potato leafroll virus (PLRV, a *Polerovirus*), potato virus X (PVX, a *Potexvirus*), potato virus S (PVS, a *Carlavirus*) occur as single or mixed infections in potato cultivation and are responsible for major economic losses world-wide[10].

Economically, PVY is the most damaging plant virus due to the importance of its plant host species worldwide, including pepper, potato, tobacco and tomato [11-13] and is primarily spread in the non-persistent manner in fields by a variety of vectors[9,14-16]. PVY strains have been classified as common or ordinary (PVY^o), tobacco veinal necrosis strain (PVY^N) and striple streak strain (PVY^c), on the basis of symptoms in host plants[13,17].

Corresponding Author: Dr. Hidayet Bostan, Department of Plant Protection, Faculty of Agriculture, Ataturk University, 25240 Erzurum Turkey

PLRV is transmitted by aphids in a persistent-circulative manner and is not transmitted by sap inoculation. It occurs in the phloem of infected plants[18-21] facts other cultivated and non-cultivated Solanaceous species that can act as PLRV reservoirs[22]S is transmitted mechanically and by aphids[23] it has a narrow host range. It causes few or no symptoms in most of the common potato cultivars. However, expressions of PVS symptoms are slight deepening of veins and rugosity of leaves and possible standing and more open type of growth. Some strains may cause mottling or bronzing in certain cultivars[22]. PVX isolates cause widely different symptom severity ranging from mild to severe mosaic and may be latent, without foliage symptoms[4,22,24]. PVX is readily transmitted by contact of plant parts in the field and by the cutting knife before planting and by biting insects[22,25].

Minimizing the virus inoculum level of planting material is an important factor in management virus diseases in vegetatively propagated crops like potato[26,27]. Reliable and sensitive detection of these viruses is crucial factor for the clonal selection, seed production schemes and in certification programs for seed potato production[20]. Therefore, the absence or very low incidence of these viruses in potato cultivars has been tested mainly by ELISA screening on leaf extracts of sprouted tubers, since direct detection on dormant tubers is not reliable[6,28]. On the other hand, ELISA can be applied economically to detection of viruses and no need for well-equipped laboratories.

The purpose of this study was to determine the distribution of PLRV, PVS, PVX and PVY (PVY^N, PVY^0 PVY^c) in seed-potato tubers used by producers in some of the main potato-growing areas of Turkey with DAS-ELISA (Double Antibody Sandwich-Enzyme Linked Imminosorbent Assay) and observe the symptoms induced by single or mixed infection of these viruses under field condition.

MATERIALS AND METHODS

The study was conducted during 2001-2002 at Atatürk University, Faculty of Agriculture Department of Plant Protection Laboratories in Erzurum, Turkey. Seed-potato tubers were obtained from Bolu, Erzurum, İzmir, Niğde and Nevşehir (Agriculture Research Institutes, Agriculture Department of Provinces and Farmers).

Tubers were planted in the field based on cultivars and provinces in order to observe symptoms caused by single or mixed infection of PLRV, PVS, PVX and PVY on potato cultivars and the development of symptoms was observed during three months. In order to determine the distribution frequencies of viruses according to provinces; leaf samples collected from field were subjected to DAS-ELISA according to[29] by using virus-specific polyclonal antibodies (Boehringer GmbH, Mannheim, Germany). Firstly, over 880 leaf samples were tested by using polyclonal antibodies. Secondly, in order to determine the distribution rate of PVY strains, PVY-positive samples detected by polyclonal antibody in the result of first ELISA were retested by using PVY^o, PVY^N and PVY^c-specific monoclonal antibodies as described by company (Agdia Company, Elkhart, USA).

In all experiment, control samples on each plate included four wells of positive and negative lyophilized sap controls and the absorbance at 405 nm was measured with a Titertek Microplate ELISA reader (Elx800 Universal Microplate Reader Bio-Tec Instruments, Inc. B-2610 Wilrijk, Belgium).

RESULTS AND DISCUSSION

There were 1113 samples, of these, 881 were tested from plant leaves with DAS-ELISA. The ELISA results showed that seed potato tubers obtained from Bolu, Erzurum, İzmir, Niğde and Nevşehir were infected with at the rate of PLRV (15.8, 5.9, 16.2, 13.8 and 14.7%), PVS (6.5, 4.5, 7.7, 7.3 and 6.3%); PVX (4.6, 25.7, 3.8, 2.8 and 2.4 %); PVY (22.4, 12.0, 19.3, 15.8 and 14.7%), respectively. On the other hand, the result of monoclonal antibody for PVY strains showed that the frequency of PVY^N and PVY^o were for Bolu, (14, 8.4%) for Erzurum, (7.5, 4.5%) for İzmir, (15, 4.3%) for Nevşehir, (11.6,4.2%), (12.9,1.8%) for Niğde but PVY^c was not found (Table 1).

This finding showed that the distribution frequency of PVY and PLRV were higher than PVS and PVX in all provinces except from Erzurum. The reason of this might be the availability of vectors and alternative hosts for these viruses in these regions. PLRV, PVY and PVS-carrying aphids from another region could be transmitted during the growing season[10]. It was reported that *Myzus persicae* is the most efficient and commonly abundant vector of PLRV, PVY and PVS[14,15,22,30-32] throughout the world. On the other hand, PVY and PLRV infect many important food crops[12,22]. Although PVS is transmitted by *Myzus persicae*, the finding at the low level of PVS than PVY and PLRV might be explained by PVS having a narrow host range. The distribution ratio of PVX except from Erzurum was low. The reason of this may be that PVX is only transmitted mechanically and not transmitted by aphids. The high incidence of this virus in Erzurum contrary to the other provinces might be spread as the result of mechanical transmission following the cutting knife of infected tubers during seed multiplication and limited entry of certificated seed potato tubers. It was

Table 1: The distribution rate of PLRV, PVS, PVX and PVY on seed tubers in the important potato production regions in Turkey.

Provinces	Number of tested samples	Viruses (%) PLRV	PVS	PVX	PVY	PVY^N	PVY^O	PVY^C
Bolu	107	15.80	6.5	4.6	22.4	14.0	8.4	-
Erzurum	66	5.90	4.5	25.7	12.0	7.5	4.5	-
İzmir	129	16.20	7.7	3.8	19.3	15.0	4.3	-
Nevşehir	246	13.80	7.3	2.8	15.8	11.6	4.2	-
Niğde	333	14.70	6.3	2.4	14.7	12.9	1.8	-
AVERAGE	881	13.28	6.4	6.9	16.8	12.2	4.6	0.0

also reported that PVX is readily transmitted by contact of plant parts in the field and the cutting knife before planting and biting insects[22,25].

PVY caused yellowing of leaves, mosaic, leafdrop streak, veinal necrosis on some plants from all cultivars, however, some plants did not develop any distinct symptoms in case of infected with PVY. While PVX alone caused mild mosaic on all cultivars, the combination of PVY and PVX caused more severe mosaic, rugosity and reduced of leaf size. On the other hand, PVX, alone or in a combination of PVY, PLRV and PVS produced mosaic symptoms regardless of cultivars in all plants and symptom severity ranged from mild to severe mosaic. PLRV induced the rolling of young leaves, upright growth and pinky colour in all cultivars. When plants infected with PVY and PLRV exhibited yellowing of leaves, leafdrop, dwarfing, rolling of leaves and rogositiy. However, some plants from Morfona and Granola cultivars died. In the presence of PLRV and PVX at the same time, these plants developed mosaic beside symptoms caused by PLRV. While plants infected with only PVS din not exhibited any distinct symptoms, but the combination of PVY and PVS caused yellowing of leaves and reduced the leaf number. Furthermore, the symptoms on plants infected with PVS and PLRV or PVS and PVY were similar to single infection of PLRV and PVY.

In general, symptoms observed under field condition were similar to the symptoms previously reported by Hooker[22] for PLRV and PVS[13,17,22,33,34] for PVY [4,24,35] for PVX.

The results showed that tubers used for planting materials in Turkey were infected significantly with viruses. The reason of this might be applied agriculture system, the lack of necessary research on the vectors and host plants of these viruses and not to use of certified virus-free tuber for planting, indexing of propagation material and tissue culture techniques for seed potato production.

REFERENCES

1. Anonymous, 2001, Tarimsal Yapi (Üretim, Fiyat, Değer), Başbakanlık Devlet İstatistik Enst. Yay., pp: 591.
2. Arslan, N., M. Uyanik and A. Gümüşçü, 1999. Türkiye'nin patates tohumluğu ithalatı ve patateste tohumluk problemleri. II Ulusal Patates Kongresi, 28-30 Haziran, 1999, Erzurum, 1-9.
3. Uyen, N.V. and P.V. Zaag, 1983. Vietnamese farmers use tissue culture for commercial potato production. Am. Potato J., 60: 873-879.
4. McDonald, J. G., 1984. Viruses associated with mosaic symptoms in Russet Burbank potato. Can. J. of Plant Path., 6: 224-226.
5. Agrios, G.N., 1997, Plant Pathology. Academic Press Limited, London, pp: 635.
6. Spiegel, S. And R.A. Martin, 1993. Improved detection of potato leafroll virus in dormant tubers and microtubers by the polymerase chain reaction and ELISA. Ann. Appl. Biol., 122: 493-500.
7. Singh, R.P. and X. Nie, 2003. Multiplex virus and viroid detection and strain separation via multiplex reverse transcription-polymerase chain reaction. Can. J. Plant Path., 25: 127-134.
8. Salazar, L.F., 1996. Potato Viruses and Their Control. CIP, Lima, pp: 214.
9. Nault, L.R., 1997. Arthropod transmission of plant viruses: a new synthesis. Ann Entomol Soc. Am., 90: 521-541.
10. Singh, R.P., 1999. Development of the molecular methods for potato virus and viroid detection and prevention. Genome, 42: 592-604.
11. Holings, M. and A.A. Brunt, 1981. Potyviruses. In Handbook of Plant Virus Infections and Comparative Diagnosis. Edited by E. Kurtstak. Amsterdam: Elsevier, pp: 731-807.
12. Shukla, L.F., C.W. Ward and A.A. Brunt, 1994. The Potyviridae. Cambridge University Press, Campridge.
13. Kerlan, C., M. Tribodet, L. Glais and M. Guillet, 1999. Variability of potato virus Y in potato crops in France., J. Phytopathol., 147: 643-651.
14. Boiteau, G., R.P. Singh, R.H. Parry and Y. Pelletier, 1988. The spread of PVY^O in New Brunswick potato fields: timing and vectors. Am. Potato J., 65: 639-649.
15. Harrington, R., N. Katis and R.W. Gibson, 1989. Field assessment of the relative importance of different aphids species in the transmission of potato virus Y. Potato Res., 29: 67-76.

16. Boiteau, G., M. Singh, R.P. Singh, G.C.C., Tai and T. R. Turner, 1998. Rate of spread of PVY^N by alate *Myzus persicae* (Sulzer) from infected to healthy plants under laboratory conditions. Potato Res., 41: 335-344.
17. De Boks, J.A. and H. Huttinga, 1981. Potato virus Y. CMA/AAB, Description of Plant Viruses. No.242.
18. Peters, D. and R.A.C. Jones, 1981. Potato leafroll virus. In: Hooker, W.J. (Ed.), Compendium of Potato Diseases. The American Psychopathological Society, St. Paul, MN, pp: 68-70.
19. Harrison, B.D., 1984. Potato Leafroll Virus. Description of Plant Viruses, No. 291. Commonw. Mycol. Inst./Assc. Appl. Biol., Kew, England.
20. Loebenstein, G., F. Akad, V. Filatov, G. Sadvakasova, A. Manadilova, H. Bakelman, E. Teverovsky, O. Lachmann and A. David, 1997. Improved dedection of potato leafroll Luteovirus in leaves and tubers with digoxigenin-labelled cRNA probe. Plant Dis., 81: 489-491.
21. Radcliffe, E.B. and D.W. Ragsdale, 2002. Aphid-transmitted potato viruses: The importance of understanding vector Biology. Am. J. of Potato Res., 79: 353-386.
22. Hooker, W.J. 1986. Compendium of Potato Diseases. Am. Phytopathol. Soc. Press., St. Paul, Minnesota, pp: 125.
23. Wetter, C., 1971. Potato Virus S. CMI/AAB. Description of Plant Viruses, No: 60.
24. Bercks, R., 1970. Potato Virus X. CMI/AAB. Description of Plant Viruses, No: 4
25. McDonald, J.G., 1986. Viruses associated with mosaic symptoms in Russet Burbank potato. Can. J. Plant Pathol., 6: 224-226.
26. Nie, X and R.P., Singh, 2000. Detection of multiple potato viruses using an oligo (dT) as a common cDNA primer in multiplex RT-PCR. J. Virol. Methods, 86: 179-185.
27. Singh, R.P., X. Nie and M. Singh, 2000. Duplex RT_PCR: reagent concentrations at reverse transcription stage affect the PCR performance. J. Virol. Methods, 86: 121-129.
28. Hill, S.A., E.A. Jackson, 1984. An investigation on the reliability of ELISA as a practical test for detecting potato leafroll virus and potato virus Y in tubers. Plant Pathol., 33:21-26.
29 Clark, M.F. and A.N. Adams, 1977. Characteristics of the microplate method of enzyme linked imminosorbent assay for the deduction plant viruses. J. Gen. Virol., 340:475-483.
30. Harrington, R. and R.W. Gibson, 1989. Transmission of potato virus Y by aphids trapped in potato crops in southern England. Potato Res., 32: 167-174.
31. Piron, P.G.M., 1986. New aphid vectors of Potato virus Y^N. Nether. J. Plant Pathol., 92: 223-229.
32. Woodford, J.A.T., C.A. Jolly and C.S. Aveyard, 1985. Biological factors influencing the transmission of potato leafroll virus by different aphid species. Potato Res., 38: 133-141.
33. Singh, R.P., 1992. Incidence of the tobacco veinal necrotic strain of potato virus Y (PVY^N) in Canada in 1990 and 1991 and scientific basis for eradication of the disease. Can. Plant Dis. Surv., 77: 113-119.
34. Glais, L., C. Kerlan, M. Tribodet, V.M. Tordo, C. Robalia, S. Astier-Manifacier, 1996. Molecular characterization of potato virus PVY^N isolates by PCR-RFLP. European J. Plant Pathol., 102: 655-662.
35. Bostan, H. and E. Demirci, 2000. Patates X ve Y virüslerinin bazi patates çeşitlerinde neden olduğu simptomlar. Atatürk Üniv. Ziraat Fak. Derg., 32: 1-4.