J. King Saud Univ., Vol. 10, *Agric. Sci.* (1), pp. 45-53 (A.H. 1418/1998)

Potato Viruses in Central Saudi Arabia

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(Received 2/5/1417; accepted for publication 20/8/1417)

Abstract. Ouchterlony agar double diffusion test and ELISA were used to detect viruses infecting potato in Gassim and Riyadh, the two major regions for potato production in central Saudi Arabia. From these two regions, 259 diseased plant samples were collected. The agar double diffusion test was used to detect viruses in the samples collected in the first season (Autumn, 1989) while ELISA was used for samples collected in the last three seasons of survey (Autumn 1990, Spring 1990 and 1991). Twelve viruses were detected in each region. These were Alfalfa mosaic (AMV), cucumber mosaic (CMV), potato leafroll (PLRV), the potato viruses A, M, S, X and Y, potato yellow dwarf (PYDV), tobacco mosaic (TMV), tobacco ring spot (TRSV) and tomato spotted wilt (TSWV). AMV was the most frequently detected virus in each of the two regions but PLRV and TRSV were the least detected in Gassim and Riyadh regions, respectively.
Key words: Potato viruses, central area, Saudi Arabia, ELISA.

Introduction

Potato is cultivated in two seasons (Spring and Autumn) in six main regions of Saudi Arabia. These are Tabuk, Hail, Gassim, Riyadh, Hofuf and Najran [1].

Inspite of the worldwide effort for controlling virus diseases of potato, the incidence of the common potato viruses is still high [2,p. 84-113, 3-6] and new viruses are still reported [7]. Few reports were published on the effect of phytopathogenic agents on potato in the central region of Saudi Arabia and were mainly concerned with fungi and nematodes [8-13]. Virus diseases of potato in the central region of Saudi Arabia were mentioned in even fewer reports [12,14,p. 114-120]. These were caused by PLRV, PVY and AMV. The limited information on virus diseases of this important crop, which is now cultivated extensively in this country, encouraged us to carry out a survey to determine the different viruses that infect this crop and their relative importance in the different surveyed regions.Our findings in Tabuk and Hail, were reported earlier [1].Virus survey in Hofuf and Najran regions will be considered in a future report. In this paper we are reporting the findings obtained in Gassim and Riyadh regions.

Materials and Methods

259 samples were collected from potato plants suspected of viral infection in the 16 field trips made to Gassim and Riyadh regions in central Saudi Arabia in four consecutive potato growing seasons (two trips/location/season) starting Autumn 1989 and ending Spring 1991. Samples were tested serologically for the presence of any of the following viruses: alfalfa mosaic (AMV), cucumber mosaic (CMV), tobacco mosaic (TMV), potato leafroll (PLRV), the potato viruses A, M, S, X and Y, tomato spotted wilt (TSWV), tobacco ring spot (TRSV) and potato yellow dwarf (PYDV).

Double diffusion test as described by Hill in 1984 [15], was used for virus detection during the first season and sodium dodecyl sulphate was added to the sap before testing in a concentration of 1%. A modification of Clark and Adams' method [16] of the Enzyme- Linked Immunosorbent Assay (ELISA) was used during the remaining seasons. Antisera for the double diffusion test were purchased from the American Type Culture Collection (ATCC) at Rockville, Maryland, U.S.A. and ELISA kits were purchased from Agdia Inc. (ElKhart, Indiana, U.S.A). Due to the limited amount of antiserum for PVM, only four samples were tested for the occurrence of this virus during the first season of survey.

Results and Discussion

In Gassim, six viruses were detected by the double diffusion test in 38 potato samples collected from different fields during the Autumn season of 1989. These were AMV, PVA, PVX, PVY, PYDV and TMV (Table 1). PVA was the most frequently detected virus accounting for 65.8% and PYDV was the least, accounting for 6% of the samples tested. AMV, TMV and PVX were also prevalent during this season. The test was also performed for detection of CMV, PLRV and PVS but none was detected.

In 30 samples from the same region collected during Autumn 1990 from plants showing symptoms suggestive of virus infection, 11 viruses were detected by ELISA. These were AMV, CMV, PVA, PVM, PVS, PVY, PVX, PLRV, TMV, TSWV and TRSV (Table 1). AMV was the most frequently detected virus followed by TSWV, PVY and CMV, while PVX was the least. In the total number of samples collected during the two Autumn seasons in Gassim region, AMV, PVA, TMV and PVY were the most prevalent viruses, respectively and PLRV and PVS were the least detected.

In Spring 1990 and Spring 1991, 11 viruses were detected in Gassim region (Table 2). AMV was the most frequently detected in both seasons while CMV and PVX were the least detected viruses in the two seasons, respectively. Inspite of detection of the same viruses during both seasons, the frequency of detection for all of them was lower in Spring 1991, than in Spring 1990.

Table 1. Viruses detected in potato fields in Gassim during the autumn seasons of survey

Year	No. of* samples	Frequency of virus detection in samples											
		AMV	CMV	TMV	PLRV	PVM	PVY	PVX	PVA	PVS	TSWV	TRSV	PYDV
1989	38	17	00	15	00	-	07	14	25	00	-	-	06
1990	30	30	14	09	06	07	16	05	11	06	17	11	-
Total	68	47	14	24	06	07	23	19	36	06	17	11	06

* Samples were tested by double diffusion test during autumn 1989 and by ELISA during the autumn 1990.
- Not tested.

Table 2. Viruses detected in potato fields in Gassim during the spring seasons of survey

Year	No. of * samples	Frequency of virus detection in samples											
		AMV	CMV	TMV	PLRV	PVM	PVY	PVX	PVA	PVS	TSWV	TRSV	PYDV
1990	43	43	11	20	14	19	23	22	19	25	29	22	-
1991	49	35	10	09	04	13	12	01	19	17	17	06	-
Total	92	78	21	29	18	32	35	23	38	42	46	28	-

* Samples were tested by ELISA.
- Not tested.

Table 3. Viruses detected in potato fields in Riyadh during the autumn seasons of survey

Year	No. of * Samples	Frequency of virus detection in samples											
		AMV	CMV	TMV	PLRV	PVM	PVY	PVX	PVA	PVS	TSWV	TRSV	PYDV
1989	31	11	07	14	04	04+	13	10	24	04	-	-	11
1990	29	23	09	05	03	03	13	03	14	01	10	06	-
Total	60	34	16	19	07	07	26	13	38	05	10	06	11

*Samples were tested by double diffusion test during autumn 1989 and by ELISA during the autumn 1990.
- Not tested.
+ Only 4 out of 31 samples were tested.

able 4. Viruses detected in potato fields in Riyadh during the spring seasons of survey

Year	No. of * samples	Frequency of virus detection in samples											
		AMV	CMV	TMV	PLRV	PVM	PVY	PVX	PVA	PVS	TSWV	TRSV	PYDV
1990	18	18	09	10	12	12	15	12	12	13	14	11	-
1991	21	17	08	07	06	07	08	09	05	17	07	04	-
Total	39	35	17	17	18	19	23	21	17	30	21	15	-

* Samples were tested by ELISA.
- Not tested.

In Riyadh, the second region for potato production in central Saudi Arabia, 31 samples were collected during Autumn 1989. Ten different viruses were detected in the samples collected in Autumn 1989 (Table 3). PVA had the highest frequency of detection and PLRV and PVS had the lowest. The double diffusion test was also positive to all four samples tested against PVM antiserum.

In Autumn 1990, 29 samples collected from Riyadh region were tested by ELISA. Of the eleven viruses detected, AMV and PVS were the most and the least frequently detected, respectively(Table 3).

In the Spring seasons of 1990 and 1991, eleven viruses were detected in Riyadh region (Table 4) with AMV being the most frequently encountered. CMV and PVA were the least detected in Spring 1990 and Spring 1991, respectively.

Of the viruses detected during the Autumn seasons in the total number of samples collected from both locations, six viruses (AMV, PVA,TMV,PVY,PVX and TSWV), had higher frequency of detection in Gassim and four (PVA,AMV,PVY and TMV) had higher frequency of detection in Riyadh where as the frequency of PVS detection was more or less the same in the two locations (Tables 1 and 3). However, during the Spring seasons, the frequency of detection of all these eleven viruses was higher in Riyadh than in Gassim (Tables 2 and 4).

Virus detection in the total number of samples collected during the two Spring seasons was generally high compared to that in the total number of samples collected in the two Autumn seasons in each of the two locations. Mixed virus infections were observed in most samples . A clear example of this is the detection of AMV in all samples collected during Spring and Autumn seasons of 1990 in Gassim (Tables 1 and 2) and in the samples collected during Spring season of 1990 in Riyadh region (Table 4).

One could observe a considerable degree of seasonal variation between the percent of detection of these viruses in the different regions. An example of this, is the percent of detection of PVS which was very low during the Autumn seasons in Riyadh and Gassim and appreciably high during the Spring seasons in the two regions. These variations may be attributed to the cultivar grown and the location as suggested, in a similar study, by Singh *et al* [6], or to the source of potato seed tubers.

The results of this study show that potato production in central Saudi Arabia suffers from the common potato viruses such as PVY, PVS and PLRV that affect this crop in other parts of the world [2,4,5,6,17). The data further show that this crop in central Saudi Arabia also suffers from AMV, the most prevalent virus in the two regions similar to what was reported in the northern regions [1].

Acknowledgment. This article is part of KACST project # AR-10-81 which was kindly supported by King Abdulaziz City for Science and Technology in Saudi Arabia.

References

[1] Al-Shahwan, I. M., Abdalla, O. A. and Al-Saleh, M. A. "Viruses in the Northern Potato Producing Regions of Saudi Arabia." *Plant Pathol.*, 46 (1996), 91-94.

[2] De Bokx, J.A., Van der Want, J.P.H. *Viruses of Potatoes and Seed-potato Production*. Wageningen: Center for Agricultural publishing and documentation (Pudoc), 1987.

[3] Dhawan, P. and Rish, N. "Strain of Potato Leaf Roll Virus iIn Northern India." *Indian J. Virol.*, 8 (1992), 30-36.

[4] Hooker, W.J. *Compendium of Potato Diseases*. St. Paul, Minnesota, USA: The American Phytopathological Society, 1983.

[5] Singh, R. P. "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.*, 72 (1992), 113-120.

[6] Singh, S., Kumar, S. and Khurana, S.M.P. "Incidence and Relative Concentration of Common Potato Viruses in Five Cultivars." *Indian J. Virol.*, 10 (1994), 44-50.

[7] Fuentes, S. and Jayasinghe, U. "Potato Yellowing Caused by a New Bacilliform Virus.". *Fitopatologia*, 28 (1993), 22-36.

[8] Abou-Heilah, A.N., Kassim, M.Y., Sheir, H.M. and Shamsher Khan. "Survey of Fungal Plant Diseases in Saudi Arabia. I. Diseases of Vegetables." *Comm. Agric. Dev. Res., Coll. Agric. Univ. Alexandria.* Egypt, 4 (1983), 16-28.

[9] Abul-Hayja, Z.M., Al-Hazmi, A.S. and Trabulsi, I.Y. "A. Preliminary Survey of Plant Diseases in Al-Karj Region, Saudi Arabia." *Phtopath. Medit.*, 2 (1983), 65-70.

[10] Abu-Yaman, I.K. and Abu-Blan, H. A. "Major Diseases of Cultivated Crops in the Central Province of Saudi Arabia 3. Diseases of Filed Crops." *Z. Pflan. Z. Kh. Pflan. Z. Sch.*, 80 (1972), 65-67.

[11] Al-Hazmi, A.S.;, Abul-Hayja, Z.M. and Trabulsi, I.Y. "Plant Parasitic Nematodes in Al-Kharj Region of Saudi Arabia." *Nematol. Medit.*, II (1983), 207-212.

[12] Cook, A.A.; Sharif, M. and Abdeen, F. "Virus and Virus-Like Diseases of Pepper, Potato and Tomato Found in Saudi Arabia." *Symp. Biol. Asp.* Saudi Arabia, 8 (1985), 93-94.

[13] El-Meleigi, M.A., Khairi, S.M. and Ibrahim, G.H. "Tuber Diseases Associated with Locally Propagated and Imported Potato (*Solanum tuberosum* L.) Seeds." Proc. *Saudi Biol. Soc.*, 7 (1984), 9-18.

[14] Van der Zaag, D.E. The Potato Crop in Saudi Arabia. *Saudi Potato Development Programme*, Ministry of Agriculture and Waters, Riyadh, 1991.

[15] Hill, S.A. *Methods in Plant Virology*. London: Blackwell Scientific Publications., 1984.

[16] Clark, M.F. and Adams, A.N. "Characteristics of the Microplate Method of Enzyme Linked Immunosorbent Assay (ELISA) for the Detection of Plant Viruses." *J. of Gen. Virol.*, 34 (1977), 475-483.

[17] Webby,. G.N. and Close, R.C. "Aetiology of the Leafroll Diseases of Potatoes in New Zealand" *N.Z.J. Crop. Hort. Sci.*, 19 (1991), 167-175.

فيروسات البطاطس في وسط المملكة العربية السعودية

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المملكة العربية السعودية

(قدم للنشر في ١٤١٧/٥/٢هـ؛ وقبل للنشر في ١٤١٧/٨/٢٠هـ)

ملخص البحث. تم استخدام طريقة الإنتشار المزدوج في أطباق بتري لأوشترلوني أو إختبار الإليزا(ELISA) للكشف عن الفيروسات التي تصيب البطاطس في القصيم والرياض واللتين تشكلان المنطقتين الرئيسيتين في إنتاج البطاطس في وسط المملكة العربية السعودية

لقد تم جمع ٢٥٩ عينة نباتية من البطاطس المصابة من هاتين المنطقتين خلال أربعة مواسم زراعية متتالية (خريف ١٩٨٩و ١٩٩٠وربيع ١٩٩٠و١٩٩١م). تم التعرف على ١٢ فيروساً في كل منطقة وهذه الفيروسات شملت: تبرقش البرسيم (AMV) ، وتبرقش الخيار (CMV) والتفاف أوراق البطاطس (PLRV) وفيروسات البطاطس:PVY ، PVX، PVS، PVM وPVA وتقزم واصفرار البطاطس (PYDV) وتبرقش التبغ(TMV) والتبقع الحلقي في التبغ (TRSV) وذبول وتبقع الطماطم (TSWV). لقد كان فيروس تبرقش البرسيم(AMV) هو أكثر الفيروسات تكراراً بينما كان فيروسا التفاف أوراق البطاطس (PLRV) والتبقع الحلقي في التبغ (TRSV)أقل الفيروسات وجوداً في العينات المجموعة من منطقتي القصيم والرياض على التوالي.