

PLANT PROTECTION

Viruses Associated with Potato Diseases in the East and South of the Kingdom of Saudi Arabia

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Abstract. Samples from potato plants showing symptoms suggestive of viral etiology were collected at eight intervals starting Autumn 1989 and ending Spring 1991 from the eastern (Hofuf) and southern (Najran) regions of Saudi Arabia. Double diffusion test (DDT) in agar plates and ELISA were used to detect viruses in these samples. In each region, alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), potato virus A (PVA), potato leaf roll virus (PLRV), potato virus M (PVM), potato virus S (PVS), potato virus X (PVX), potato virus Y (PVY), potato yellow dwarf virus (PYDV), tobacco mosaic virus (TMV), tobacco ring spot virus (TRSV), and tomato spotted wilt virus (TSWV) were detected. The percentage of virus detection varied within the region and between the two regions with Najran sustaining higher incidence than Hofuf. In this survey, PYDV was detected for the first time outside north America in a single sample from each region by DDT during Autumn 1989, the only season in which the occurrence of this virus in Saudi Arabia was investigated.

Key words: Potato diseases, viruses, Saudi Arabia.

Introduction

Potato is becoming one of the most important cash crops and grown twice every year in Saudi Arabia. The area under cultivation is expanding since 1976 and production has dramatically increased from 20 tons to 60000 tons between 1976 and 1990 [1]. Potato is known worldwide to suffer from many serious viral diseases [2-7]. Earlier reports indicated the occurrence of viral diseases on potato grown in four regions of Saudi Arabia [8,9]. Few reports on potato diseases have been published from the eastern and southern regions of the kingdom. Three of these reports were from Hofuf (eastern region) and were only concerned with fungal diseases [10-12] and a single report from Najran where one of the diseases infecting potato in the southern region, was considered of viral nature based on symptoms expression only [13]. This investigation is intended to extend information about occurrence of viral diseases in potatoes in the eastern and southern regions of the country.

Materials and Methods

Eight visits were made to each of Hofuf (eastern region) and Najran (southern region) during four successive potato growing seasons, with each region visited twice per season, starting Autumn 1989. Leaf samples from single potato plants showing virus symptoms were collected in separate plastic bags and shipped in cooled containers to the laboratory. Samples were tested for presence of viruses by agar double diffusion test during the first season (Autumn 1989), and by ELISA during the following seasons. Antisera for agar double diffusion test were obtained from ATCC (12301 Parklawn Drive, Rockville, Maryland 20852, USA) or Boehringer Mannheim Biochemicals (P.O. Box 50816, Indianapolis, IN 46250, USA) and ELISA kits were obtained from Agdia Inc. (30380 County Road 6, Elkhart, IN 46514 USA). Antisera or ELISA kits were obtained for alfalfa mosaic virus (AMV), cucumber mosaic virus (CMV), potato virus A (PVA), potato leaf roll virus (PLRV), potato virus M (PVM), potato virus S (PVS), potato virus X (PVX), potato virus Y (PVY), potato yellow dwarf virus (PYDV), tobacco mosaic virus (TMV), tobacco ring spot virus (TRSV), and tomato spotted wilt virus (TSWV). Serological tests were conducted as described earlier [8,9,14,15,16].

Results and Discussion

Variable virus symptoms were observed on potato plants from which samples were collected. These symptoms were similar to those observed in the previously surveyed regions [8] and included mosaic, yellowing, leaf rolling (Fig. 1), mottle, chlorosis, vein clearing, calico, stunting and necrosis.

The frequency of virus detection in the tested samples generally varied for the different viruses as reported earlier in the other regions [8,9]. Eight viruses were detected in the samples collected during Autumn 1989 in each of Hofuf and Najran (table 1). These were AMV, CMV, PLRV, PVA, PVX, PVY, PYDV and TMV. The most frequently detected viruses in Hofuf and Najran were PVA and PVX respectively. PYDV which was the least detected in both regions was also detected in all other previously surveyed regions except Tabuk. PVS was not detected in any of the two regions while it was detected in the corresponding season in all other regions except Gassim.

Table 1. Identification of viruses in symptomatic potato samples collected from potato fields in Hofuf and Najran during the Autumn seasons of 1989 and 1990

Region	Year	No. of Samples*	Frequency of virus detection in samples											
			AMV	CMV	TMV	PLRV	PVM	PVY	PVX	PVA	PVS	TSWV	TRSV	PYDV
Hofuf	1989	53	26	10	18	04	-	25	30	38	00	-	-	1
Hofuf	1990	29	25	17	15	02	14	17	09	22	14	24	17	-
Najran	1989	38	10	03	14	06	-	18	21	15	00	-	-	1
Najran	1990	28	26	04	09	08	09	15	07	09	04	19	13	-

* Samples were tested by double diffusion test during Autumn 1989 and by ELISA during the Autumn 1990.

- Not tested.

Eleven viruses were detected by ELISA in each of the eastern and southern regions during Autumn 1990 (table 1). These were PVM, PVS, TRSV, and TSWV in addition to

the viruses detected in the previous Autumn season. An exception of this is PYDV which was not included in the survey during Autumn 1990 because the commercial ELISA kit was not available. AMV had the highest frequency of detection in both regions but CMV and PVS were the least detected in the southern region and PLRV frequency was the lowest in the eastern region. The data obtained during the two Autumn seasons suggest no particular pattern of virus spread in these two regions as some viruses seem to be spreading more in the eastern region, others seem to be spreading more in the southern and some are more or less evenly spreading in the two regions. The data in table 1 show an example of this, where PVA, AMV and CMV were spreading more in Hofuf, PLRV was spreading more in Najran and PVY was found more or less of similar incidence in the two regions.



Fig. 1. A- Leaf roll symptoms (left) and no symptoms (right) on potato plants.
B - Mosaic and yellowing symptoms on potato foliage.

In Spring seasons, 11 viruses were detected in the potato samples collected from each region (table 2). The prevalent viruses in the eastern region during 1990 and 1991 were PVA and PVS and the least detected were PVM and PVA during the two seasons, respectively. In the southern region, PVA and AMV were the most frequently detected viruses while PVX and PVA were the least detected in the same seasons. It is interesting to note that PVA was the most frequently detected during the Spring of 1990 in Hofuf and Najran and was the least detected during Spring of 1991 in both locations. One of the reasons for the fluctuation between the high and low PVA incidences in these regions during Spring 1991 could probably be interpreted by planting non-certified seed tubers as indicated by the growers for whom certified seed tubers have not been made available during that season.

Table 2. Identification of viruses in symptomatic potato samples collected from potato fields in Hofuf and Najran during the Spring seasons of 1990 and 1991

Region	Year	No. of Samples*	Frequency of virus detection in samples											
			AMV	CMV	TMV	PLRV	PVM	PVY	PVX	PVA	PVS	TSWV	TRSV	PYDV
Hofuf	1990	31	17	06	06	08	02	11	17	18	11	17	07	-
Hofuf	1991	20	12	09	09	10	09	12	08	04	13	12	08	-
Najran	1990	24	20	15	15	13	16	20	11	22	16	16	18	-
Najran	1991	15	15	08	10	07	09	14	11	03	14	13	10	-

* Samples were tested by ELISA.

- Not tested.

Although the data in table 2, does not reflect the incidence of the detected viruses in the surveyed regions during the two Spring seasons, and only reflects the relative occurrence of these viruses compared to each other in the tested samples, it clearly shows that the average number of the detected viruses per sample, (as determined from the total number of the detected viruses in the total number of the tested samples), is much higher in the south than in the east, an indication of the serious virus disease situation in the south, which agrees with our field observations in these two regions (15). This could also be supported by the frequency of virus detection, which accounts for 51.3% for the least detected virus (PLRV) in the southern region and 56.9% for the most detected virus (TSWV) in the eastern region. Some of the interpretations for this data is that most of the potato growers in the south are not keen for planting certified potato seed tubers and so often plant non-certified potato tubers that they purchase from the stocks sold in the local market which are usually imported from some neighboring countries for the sake of human consumption only. Also viruses were detected in some reservoir plants (wild and cultivated) that harbor potato viruses adjacent to potato fields in the southern region [16] without any efforts being made to eradicate these plants.

For comparison and discussion of the status of these viruses in the country as a whole, Table 3 was made which contains summary of the data obtained in this study (Tables 1 and 2) as well as those previously obtained and reported in two recent publications [8,9]. Table 3 shows that at least 12 viruses are associated with potato in

Saudi Arabia but their prevalence vary from one region to another. Therefore, whereas AMV had the highest percentage of detection in Gassim, Riyadh, and Tabuk, TSWV had the highest percent of detection in Hofuf and Najran, and PVA had the highest percent of detection in Hail. The frequency of detection of AMV in the last three regions was still high in any of them. Hence AMV was the prevalent virus in the overall number of samples collected from the whole country during the survey accounting for 64 %, followed by TSWV, PVA, and PVY (table 3). PLRV which is known to be one of the important viruses infecting potatoes elsewhere in the world [3 - 6, 17,18] turned out to have the lowest percentage of detection in this country accounting for only 20 %. PYDV which was not previously reported outside USA and Canada [3,19], was reported herein, for the first time in five potato-producing regions. A probable source of infection could be the potato seed tubers that were imported from the USA. Further research is needed to reveal the actual source of infection and the importance of this virus in Saudi Arabia. It is also note worthy that mixed virus infection was observed in all the surveyed regions [15] and most of the tested samples were found to have multiple rather than single infections.

Table 3. Relative frequency of the identified viruses in symptomatic potato plants collected from potato fields in the major six producing regions in Saudi Arabia during the survey (1989-1991)

Regions	Number of Samples	Viruses											
		AMV	CMV	TMV	PLRV	PVM*	PVY	PVX	PVA	PVS	TSWV*	TRSV*	PYDV*
Gassim ⁺	160	78	22	33	15	32	36	26	53	30	52	32	16
Hail ⁺	142	44	25	32	20	41	46	27	52	39	47	38	45
Hofuf	133	60	32	36	18	25	49	48	62	29	67	40	02
Najran	105	66	30	45	32	51	63	48	47	32	71	61	03
Riyadh ⁺	99	70	33	36	25	36	49	34	55	35	46	31	29
Tabuk ⁺	103	68	03	11	11	15	28	12	18	27	30	12	00
All regions	742	64	24	32	20	32	45	32	49	32	51	34	18

* The number of samples tested for detection of PVM, TSWV, TRSV, and PYDV were 545, 519, 519, and 223 respectively.

+ Summary of detailed data published in previous reports [8,9].

Since this manuscript completes the data obtained for potato viruses in Saudi Arabia [8,9,15,16], the conclusions we are drawing here, apply both for this as well as for the previous studies with regard to the whole country:

1. More than 12 viruses infect potato in the Kingdom of Saudi Arabia as some of the diseased potato samples tested negative to the 12 Antisera used in this study [15].
2. The presence of alternate hosts of these viruses (reservoir weeds and cultivated plants) in close proximity to the crop [16] and the occasional use of non-certified potato tubers for propagation of the crop are probably among the main sources of infection by these viruses.
3. Single potato plants were generally found to be infected with more than one virus [15].
4. The occurrence of PYDV in Saudi Arabia was reported for the first time outside USA and Canada in this study.

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الفيروسات المصاحبة لأمراض البطاطس في شرق وجنوب المملكة العربية السعودية

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ملخص البحث: جمعت عينات من نباتات بطاطس تكشف عنها أعراض توحى بالإصابة بالأمراض الفيروسية في المنطقتين الشرقية (الهفوف) والجنوبية (نجران) من المملكة العربية السعودية خلال ثمانية زيارات حقلية لكل منهما ابتداءً من خريف عام ١٩٨٩م وإنتهاءً بربيع عام ١٩٩١م. تم إستخدام إختبار الإنتشار المزدوج في أطباق البتري أو إختبار الإلايزا للإستدلال على وجود الفيروسات المسببة لتلك الأمراض. وقد أمكن تعريف الفيروسات التالية في كل من المنطقتين: فيروس تبرقش البرسيم الحجازي (AMV)، فيروس تبرقش الخيار (CMV)، وفيروسات البطاطس (Y, X, S, M, A)، وفيروس إنتفاف أوراق البطاطس (PLRV)، وفيروس تقزم وإصفرار البطاطس (PYDV)، وفيروس تبرقش التبغ (TMV)، وفيروس التبغ الحلقي في التبغ (TRSV)، وفيروس ذبول وتبقع الطماطم (TSWV)، إلا أن نسبة الإصابة بالفيروسات المسببة لهذه الأمراض تباينت في كل منطقة على حدة وكذلك فيما بين المنطقتين. وقد كانت منطقة نجران هي الأكثر إصابةً بهذه الفيروسات. إن تعريف الفيروس المسبب لمرض تقزم وإصفرار البطاطس يعد أول تسجيل لهذا الفيروس خارج أمريكا الشمالية حيث تم تعريفه في عينة واحدة من كل منطقة بإستخدام إختبار الإنتشار المزدوج في أطباق البتري وذلك خلال خريف عام ١٩٨٩م وهو الموسم الوحيد الذي تم فيه تقصي وجود هذا الفيروس في المملكة العربية السعودية.