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Screening and Selection of Potatoes for Resistance to Virus Diseases in Taiwan

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ABSTRACT

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ELISA was used to detect viruses in potato leaves and buds of three selected clones (No.143, No.770 and 385095-15) and 2 commercial varieties (Cardinal and Kennebec). The formers were maintained in open field, while the latter were propagated under virus-free system every year. The three clones were commonly infected with PVS and PVX, while the two commercial varieties were infected mostly with PVY and rarely with PVS, PVX or PVA. Cardinal which had higher concentration of PVY than Kennebec, yielded in average 24 t/ha, while Kennebec yielded 34 t/ha, when planted at different locations. This suggested that Kennebec was more resistant to PVY than Cardinal. Clone No.143 usually yielded higher than No.770, although both were highly resistant to PVY. In the field test, there was no difference in yield between plants from PVY-infected seed tubers and those from PVY-free seed tubers for Kennebec, No.143, No.770 and 385095-15. The concentrations of PVY whether mosaic strain or necrosis strain in the planting materials were relatively low. However, when plants were inoculated with PVY at early stage, virus infection caused yield reduction in Kennebec but not in No.143 or 385095-15. Since in addition to resistance to PVY, No.143 also showed high and stable yield and produced potato with commercially acceptable shape, color and taste, it was registered and named Tainung No.1 on March 2, 1993.

Key words: potato clones, potato viruses, potato virus Y, resistance

INTRODUCTION

In Taiwan, potato is mainly grown in fall and winter as a specialized crop for certain areas. The yield varies not only with field management, but most significantly, with seed tuber sources. Many potato diseases can be carried through generations in tubers saved for seeds (3). Virus diseases are the major problem in potato production in Taiwan. Although certified seed production system has been implemented for almost 20 years (4,11) and potato viruses A, S, X and Y are subjected to routine disease indexing by means of enzyme-linked immunosorbent assay (ELISA) (4,7,11,14,15,27), only two major varieties, *i.e.* Kennebec and Cardinal, are included in this certification system. Private seed suppliers (dealers or farmers) still contribute a significant portion of required quantity of Kennebec and the total amount of other less important varieties such as Omega and Wu-Feng. These seeds are produced with only visual inspection and limited roguing. Even meristem-tip cultured and virus-assayed elite materials could be rapidly infected with viruses once grown in the field (7,11) due to year-round prevalence of aphids and intensive cultivation of other Solanaceae crops nearby, not to mention the seed tubers produced by indivdual farmers who conduct limited virus eradication, if any. Potato yields thus fluctuate in a wide range with an average of 18 t/ha (Yearbook, 1991).

It is therefore necessary to add disease resistance as a selection criterion, besides the agronomic traits, in breeding program for new potato varieties. Some clones have been selected at TARI for their low degeneration rate and reliable tuber yield (21,22). When tested in farmers' fields, they also performed well (23,24). The present study was undertaken during the years of 1990-1992 to assess the level of virus resistance in these new clones as compared to commercial varieties, and the

effect of PVY on tuber yield in field planting. Part of the screening and inoculation results which have appeared elsewhere (8) is not included here.

MATERIALS AND METHODS

Potato varieties

Three clones and two commercial varieties were used in this study. Of the three clones, No.143 and No.770 were obtained in 1979 from AVRDC and 385095-15 obtained in 1986 from International Potato Center (CIP). They had been propagated and maintained for years in TARI under open field conditions (21). Cardinal and Kennebec were obtained either from Tou-Nan or Feng-Yuan Farmers' Association.

ELISA procedures

A direct ELISA was used in all studies to detect potato viruses A, S, X and Y (both mosaic and necrosis strains). All needed immunodiagnostic reagents were prepared according to Clark and Adams (5,6), except the PVS diagnostic kit which was purchased from Boehringer Manneheim GmbH (8) and was used in some tests. Leaf samples, each consisting of 3 leaflets (one terminal and 2 adjacent), were collected from a fully developed leaf near the top of the plant because newly expanded terminal leaflets are a more reliable indicator than older ones (9). ELISA value for each sample was obtained from two duplicate wells in the microtitration plates (Linbro, Flow Laboratories Inc.). Absorbance was measured at 405 nm with a Titertek Multiskan (Flow Laboratories) automated plate reader. Samples with absorbance exceeding 0.1 were considered virus infected in this study.

Incidence of plant viruses in different varieties

Tubers of No.143, No.770 and 385095-15, selected from a TARI experimental field in February, 1991 were multiplied at Mei-Feng (2,100 m asl) Highland Farm of National Taiwan University on May 17, 1991. Kennebec was obtained PVY-free from National Chung-Hsing University and had been multiplied once in the greenhouse before it was planted for comparison. One month after planting, plants suspected to be virus infected in all 4 varieties were sampled and rogued if tested positively by ELISA. All those which remained were sampled again two weeks before harvest for detection of PVA, PVX, PVS, PVY-m, and PVY-n. Kennebec, an early variety, was harvested 10 days earlier than other clones. Each plant was individually weighed for yield.

To understand the prevalence of different viruses in seed production areas, eighty seed tubers from the 1990-1991 crop were sampled for each variety, namely, No.143, No.770, Kennebec and Cardinal, and assayed for potato virus A, S, X, Y-m and Y-n by ELISA. All seed tubers were stored in cold room (4–7° C) until October, 1991 when they were allowed to sprout at room temperature. Sprouts were collected from one eye of each tuber and extracted in PBS-Tween 20 containing 2% polyvinyl pyrohidon (PVP) for use as antigen in ELISA. The yield potential of these seed tubers was then determined from three plantings made in Hou-Li, Tou-Nan and Hsi-Kou during the period from October 1991 to March 1992. Each planting was of the size between 0.1 to 0.3 ha. Field management followed farmers' practices. At harvest, marketable tuber yields from 4 randomly selected 1.2 m × 10 m plots were recorded and converted to hectare basis for each variety in each location. Tuber number was counted to calculate the average tuber size.

Effect of PVY carried in seed tubers on potato yield

Seed tubers were ELISA assayed for PVY and subsequently classified into 3 groups, namely, carrier of PVY-m only (M), carrier of PVY-n only (N) and non PVY carrier (H). The effect of PVY strains on tuber yields was studied. All seed tubers were planted by a split plot design on November 26, 1991 with genotypes as main plot and seed classification as subplot. There were 4 replicates for each treatment and 20 plants comprised a plot. The overall plant growth was observed for each plot and leaf samples were taken from each plot 2 weeks before harvest (February 20, 1992) for PVY detection by ELISA. Tuber yields were recorded from each plot.

Effect of PVY inoculation on tuber yield

Two separate experiments were conducted at the same time to study the effect of inoculation with PVY-m or PVY-n on plant growth and yield. All plants were grown from PVY-free seed tubers, 20 plants were planted to each plot of the size of 1.2 m × 3.2 m. The field experiment was a complete random design (CRD) with 3 replicates for each variety. All plants were manually inoculated with PVY-m or PVY-n at 22 days after planting (PVY was maintained on *Nicotiana sylvestris* Speg. et comes in greenhouse). More than 10 plants were sampled from each plot two months after inoculation to determine the infection rate and PVY concentration by ELISA. Tuber yields from each plot were recorded. Data of infection rate and yield of each variety were analyzed.

RESULTS

Incidence of virus infection in different varieties

At early stage, plants infected with viruses as evidenced from ELISA results were rogued. These

included 13 plants of No.143, 5 plants of No.770, 9 plants of 385095-15 and 2 plants of Kennebec. All the remaining plants grew till harvest. The ELISA results indicated that all varieties were infected by one or more viruses at harvest (Table 1). Kennebec was infected mostly by PVY-m, followed by PVX, PVA, PVY-n, but infection with PVS was rare. Three clones, No.143, No.770 and 385095-15 were commonly infected with PVS but were not infected or only rarely infected with PVY or PVA. Clones No.143 and No.770 were also infected with PVX at a high level. The ELISA value for PVY-m infected plants of No.143 was much lower than that of Kennebec. Good resistance to PVY-m and PVA was expressed in 3 tested clones, with additional PVX resistance also expressed in No.770.

The results of virus detection by ELISA and average yield per plant are shown for each variety in Table 2. There is no clear relationship between virus infection and plant yield, however all 3 tested clones yielded higher than Kennebec in general. Most plants of Kennebec variety were virus free, with an average yield of 564 g/pl. Plants infected with PVY produced an average yield of 471 g/pl. Those infected with virus(es) other than PVY had a yield of 501 g/pl. Six plants of No.770 were virus free. The majority of the plants were found infected with PVS alone or in combination with other viruses. The 40 plants infected with PVY averaged 609 g/pl and 90 plants free from PVY infection had an average of 676 g/pl. In both No.143 and 385095-15, most plants were dually infected

TABLE 1. Results of ELISA test for viruses in different potato varieties/clones propagated at Mei-Feng (Summer, 1990)

Variety or clone	Total plants tested	No. of plants reacting positively to				
		PVA	PVS	PVX	PVY-m	PVY-n
Kennebec	153	24 (0.251)[1]	5 (0.470)	26 (2.352*)	62 (0.623)	20 (0.244)
No.143	119	0	118 (0.718)	106 (2.440*)	23 (0.157)	13 (0.160)
No.770	153	15 (0.152)	100 (0.411)	5 (0.138)	0	40 (0.178)
385095-15	71	0	67 (0.661)	70 (2.538*)	0	12 (0.204)

[1] Number in parenthesis indicates the average ELISA values (A_{405} nm) from plants that gave a positive reaction to virus of relevance.

TABLE 2. Tuber yield (g/pl) of potato varieties/clones affected by infection with different viruses

Plant infected with	Kennebec		No.143		No.770		385095-15	
	No. Plt.	Ave. Yield	No. Plt.	Ave. Yield	No. Plt.	Ave. Yield	No. Plt.	Ave. Yield
None	59	564			6	578		
PVS			9	394	69	686		
PVX	11	526					3	712
PVY-m	20	490						
PVS, PVX			80	609			55	1,189
PVS, PVY-n					34	608		
PVA, PVS					10	569		
PVA, PVY-m	11	428						
PVS, PVX, PVY-m			10	497				
PVS, PVX, PVY-n			8	374			11	1,172
other[1]	34	524	6	611	17	643		
Pl with PVY[2]	60	471	23	465	40	609	11	1,172
without PVY[2]	16	501	90	591	90	676	58	1,164

[1] Plants with different combinations of viruses other than those listed.
[2] Plants with or without PVY could be also infected by PVX, PVS or PVA.

with PVS and PVX, yielding in average 609 g/pl and 1,189 g/pl, respectively. There was no yield difference in 385095-15 between plants infected with PVY and not PVY-infected. Yield reduction was not observed in plants of No.143 infected with PVY.

Commercial potato varieties produced from a seed certification program were commonly found to carry both the M and N strains of PVY (Table 3) by ELISA test on tuber sprouts. With Cardinal variety, out of 80 seed tested only two were virus free, the other three varieties were all infected with one or more viruses. Clones No.143 and No.770 were found fully contaminated with PVS, and No.143 was additionally infected with PVX. When tested against PVY, No.770 often gave a higher ELISA value than did No.143. Both Cardinal and Kennebec were free from PVX and only rarely infected with PVA or PVS. The PVY concentration as judged by ELISA value (A_{405} nm) was highest in Cardinal, followed by Kennebec and No.770. No.143 was the lowest in PVY content. The results indicated that PVY was prevalent in commercial varieties whereas PVS and PVX were common in clones No.143 and No.770.

Seed tubers from the same sources as aforementioned were planted to compare their yield ability in three locations. The harvest was delayed in both Hsi-Kou and Tou-Nan locations because of rain. Through the growing season, Kennebec gave a fast and vigorous haulm growth reaching maturity at 99 DAP in Hou-Li. It gave an average marketable tuber yield of 34 t/ha over 3 locations (Table 4). On the other hand, Cardinal had about one third of the plants showing mosaic symptoms and reduced growth in both Hou-Li and Hsi-Kou, the average tuber yield was only 24.3 t/ha. No.143, though found to carry both PVS and PVX, yielded 35.5 t/ha in average over 3 locations. Large tubers (larger than 150 g) contributed 42.8 % of marketable yield (Table 4). Clone No.770 gave an average yield of 26.2 t/ha, it produced more tubers of the size between 75–150 g.

TABLE 3. Detection of potato viruses A, S, X and Y from tuber sprouts by ELISA

Variety or clone	Total tubers tested	No. of tubers reacting positively to					—[1]
		PVA	PVS	PVX	PVY-m	PVY-n	
No.143	80	1 (0.103)[2]	80 (0.251)	80 (2.351^{+})	48 (0.155)	43 (0.167)	0
No.770	80	21 (0.142)	79 (0.530)	0	53 (0.209)	80 (0.347)	0
Cardinal	80	9 (0.127)	7 (0.214)	0	78 (0.484)	78 (0.726)	2
Kennebec	80	3 (0.104)	6 (0.134)	0	79 (0.219)	78 (0.397)	0

[1] —: No. *of tubers without virus infection.*

[2] number in parenthesis indicates the average absorbance from positively reacting samples.

TABLE 4. Yield performance of potato varieties and clones at different locations[1]

Variety	Hou-Li	Tou-Nan	Hsi-Kou	Average	Large tuber[2] (%)
P0			Marketable yield (t/ha)		
No.143	39.68	36.75	30.10	35.51	
No.770	29.00	26.34	23.30	26.21	
Cardinal	26.41	31.00	15.40	24.27	
Kennebec	35.73	34.76	32.39	34.29	
			Average tuber weight (g)		
No.143	199	186	250	211	42.8
No.770	124	146	181	150	25.4
Cardinal	165	144	196	168	32.5
Kennebec	173	202	252	209	39.6

[1] Planting dates were October 14 in Hou-Li, November 5 in Hsi-Kou and November 11, 1991 in Tou-Nan.

[2] Weight of tuber heigher than 150 g each.

Effect of PVY infection of seed tubers on potato yield

Seed tubers classified into PVY-free (H), PVY-m only (M) or PVY-n only (N) were planted in the field to compare their growth and yields. However, the PVY concentration was not high to start with (Table 5). There were a few plants in each class showing symptoms of mosaic, mottle or leaf-roll. Both mosaic and leaf-roll were seen in Kennebec, leaf-roll only in No.770, mottling was seen in both No.143 and 385095-15. However, most of the plants grew vigorously except some small plants.

The low spread of PVY during the year was indicated by a rather high rate of ELISA-negative plants in different varieties, especially in No.143 and Kennebec at 85 DAP (Table 6). Most PVY-infected plants were infected with both mosaic and necrosis strains in clones No.143 and 385095-15. There was no significant difference in tuber yields among three seed classes of the tested varieties. The use of PVY contaminated seed tubers did not result in yield reduction. The yield ranged from 25 to 29 t/ha in No.143, 15 to 23 t/ha in No.770, and 23 to 31 t/ha in Kennebec. However, the lowest yield recorded for M class of No.770, 14.7 t/ha might be due to its high percentage of PVY infection. In 385095-15, higher yield was obtained in M class seed which had PVY infection rate similar to H class (Tables 5 & 6).

Effect of PVY inoculation on tuber yield

Two months after inoculation, plant samples were collected from each plot for ELISA test to detect the presence of either mosaic or necrosis strains of PVY.

TABLE 5. Comparison of varieties or clones by ELISA tests against PVY made before planting and harvest

Variety	Stage	H		M		N[2]	
		PVY-m	PVY-n	PVY-m	PVY-n	PVY-m	PVY-n
No.143	Before planting	0.020[1]	0.062	0.130	0.079	0.058	0.129
	Before harvest	0.397	0.253	0.260	0.426	0.514	0.308
No.770	Before planting	0.024	0.045	0.124	0.061	0	0.128
	Before harvest	0.232	0.168	0.228	0.155	0.155	0.148
385095-15	Before planting	0.016	0.050	0.191	0.082	0.036	0.121
	Before harvest	0.298	0.250	0.279	0.301	0.563	0.482
Kennebec	Before planting	0.032	0.044	0.195	0.044	0.058	0.122
	Before harvest	0.178	0.161	0.515	0.385	0.363	0.358

[1] Average absorbance of positively reacted plants.
[2] H: PVY free seed tuber; M: seed tuber with PVY-m; N: seed tuber with PVY-n.

TABLE 6. Effect of PVY on potato tuber yield

Variety or clone	Seed tuber class	ELISA samples	No. of plants with Positive reaction to			No. of plants with negative reaction (%)	Tuber yield (t/ha)
			Y-m	Y-n	m+n[1]		
No.143	PVY-Free	37	7	0	9	21 (57)	26.1 bc[2]
	PVY-m	38	4	2	10	22 (58)	24.9 bc
	PVY-n	40	4	2	11	23 (57)	29.0 abc
No.770	PVY-Free	38	9	2	15	12 (31)	20.7 cd
	PVY-m	35	12	4	14	5 (14)	14.7 d
	PVY-n	40	14	6	6	14 (35)	22.8 c
385095-15	PVY-Free	37	5	3	13	16 (42)	27.8 bc
	PVY-m	39	7	–	16	16 (41)	36.5 a
	PVY-n	35	4	1	21	9 (26)	22.1 cd
Kennebec	PVY-Free	40	1	6	2	31 (77)	23.4 bc
	PVY-m	40	1	5	6	28 (70)	24.9 bc
	PVY-n	40	2	11	1	26 (65)	31.6 ab

[1] Y-m: PVY mosaic strain; Y-n: PVY necrotic strain; m+n: mosaic and necrotic strain.
[2] Means with the same letter are not significantly different at 5% level by Duncan's New Multiple Range Test.

There was no significant difference in infection rate among four varieties, but Kennebec had higher ELISA values for plants, in other words, higher PVY concentration, inoculated either with PVY-m or PVY-n (Table 7). Kennebec had more plants dually infected with both mosaic and necrosis strains than other clones. The virus symptoms included leaf roll (in No.770 and Kennebec), mosaic (in 385095-15 and Kennebec) and mottle (in No.143). There were only a few severely diseased plants.

The highest yield was obtained with No.143, followed by 385095-15, No.770 and Kennebec in that order. The inoculation treatments resulted in significant yield reduction in Kennebec, but not in other 3 clones (Tables 6 & 7). No.143 yielded 28–31 t/ha, No.770 yielded 17–19 t/ha, 385095-15 yielded 25–27 t/ha and Kennebec yielded only 15–17 t/ha in these experiments.

DISCUSSION

Viral diseases are one of the major limiting factors in potato production (1,3,17). Among these, PVY is the most important to cause tuber yield reduction which may range from 30 to 80% depending on disease severity (2,3,10,12). Synergistic interaction usually results from mixed infection with different viruses (26). For example, severe symptoms may develop in plants infected with PVY in combination with PVX or PVA (16). Preinfection with PVX and PVY could reduce the level of resistance to PLRV infection (9,16). Infection with PVX or PVS singly causes no visual symptom, but dual infection could result in mild crinkle (27). Potato virus S, usually undetectable by visual symptoms, could maintain itself in field to serve as a continuous source of inoculum. It is transmitted not only mechanically but also by aphids in a fast spread (25).

In Taiwan commercial potato plantings give a low yield because of using virus-infected seed tubers or harvesting before maturity. Chipping processers thus import some foundation seeds to multiply seed tubers for their contract plantings in order to guarantee both quality and quantity of raw tubers. Some even set up a laboratory for tissue culture work (personal communication). In the past, government institutes also made efforts to select for new processing varieties from introductions since many virus resistant varieties are bred and available in some foreign countries (1,2,13,16,19,20). However, most introductions failed to persist after being infected by viruses (21). Screening work was also carried out by inoculating 1,875 genotypes from CIP with PVY-m for selection of resistant clones (22).

Several clones were selected for their reliable yield and negligible degeneration through years of observation. They performed well in regional trials from 1989 to 1991 (23,24) in terms of yield, however, these clones are suitable for fresh-market use exclusively. This study demonstrated that they possess a higher level of resistance to PVY infection than two commercial varieties, namely, Cardinal and Kennebec. Cardinal was susceptible to PVY (Table 3), extension seed tubers produced from certified system could only be used for ware potato crop but not for further seed purpose. The plants developed mosaic and mottling symptoms when PVY-infected seed tubers were used, resulting in a drastic yield reduction (Table 4). Even greater yield loss resulted from mixed infection with PVA (8).

TABLE 7. Effect of PVY inoculation[1] on potato yields

Variety or clone	No. plant sampled for ELISA[2]	No. of plants with Positive reaction to			ELISA value		PVY infection rate %	Yield (t/ha)
		PVY-m	PVY-n	m+n	Y-m	Y-n		
		(inoculation with PVY-m)						
No.143	52	9	11	–	0.179	0.171	24.7 a	30.8 a[3]
No.770	38	8	9	2	0.192	0.194	33.4 a	19.2 c
385095-15	26	5	2	3	0.282	0.177	34.7 a	25.3 b
Kennebec	45	10	3	12	1.090	0.297	51.0 a	15.3 c
		(inoculation with PVY-n)						
No.143	50	11	–	1	0.284	0.145	25.3 a	28.3 a
No.770	44	18	1	2	0.198	0.117	44.0 a	16.6 c
385095-15	40	11	–	–	0.169	–	20.0 a	27.2 b
Kennebec	46	6	1	11	1.243	0.765	33.0 a	17.3 c

[1] All plants were grown from PVY-free seed tubers on November 26 and inoculated on December 18, 1991.
[2] ELISA tests for PVY-m and PVY-n were carried out on plant samples collected on February 19, 1992.
[3] Means with the same letter in a same column are not significantly different at 5% level by Duncan's New Multiple Range Test.

Kennebec was classified as highly resistant to PVY by Bagnall and Tai (2). However, it was so only for the first year of infection according to Singh and Somerville (20). It was infected under heavy infection pressure. Our results also indicated that Kennebec was resistant to PVY to a certain degree. Only 40% of plants in Kennebec were infected with PVY when planted at Mei-Feng from PVY-free source (Table 1) and it still yielded well under favorable climate and good cultural practices when seed tubers carried PVY only and not in high concentration (Tables 3 & 4). However, more Kennebec plants became dually infected with M and N strains of PVY upon inoculation at early stage (30DAP). Virus concentration also increased (Table 7), the yield loss was ca. 30–40%. This indicated that the PVY resistance level was reduced when plants were exposed to high PVY concentration at ealy stage of growth.

By contrast, the 3 tested clones proved to be highly resistant to PVY, although they were commonly infected with PVX and/or PVS. They had a lower rate of PVY incidence (Table 1) than Kennebec, No.143 was resistant to PVA in addition (Tables 1 & 3). Inoculation of the clones with PVY at early growth stage resulted in 20–44% of infected plants. PVY-positive leaf samples from such plants gave ELISA absorbance values of 0.12–0.28. The corresponding values for Kennebec were 33–51% and 0.30–1.24. No yield reduction was observed from virus inoculation in these clones (Tables 6 & 7). PVY resistance may be attributed to resistance to infection, and even if plants were occassionally infected, the concention of the virus maintained at a low level. The virus may be self-climinating in plant or multiply at a slow rate (2,20).

Clone No.143 usually produces large uniform tubers with yellow skin and yellow flesh. It is ideal for curry cuisine and mash potato with possible local market and in Hong-Kong for fresh use. Although having been maintainted under natural field conditions for many years, its yield appeared to be stable and comparable to commercial varieties from certified seeds (23,24). Its resistance to PVY (and also PVA) was demonstrated (8) and confirmed in this study. This asset made it possible for farmers to produce No.143 ware potatoes with minimum spray of insecticides or to produce seeds without certification program. No.143 was approved for registration as a new variety on March 2, 1993. It should be included in current certification system prior to extension, since the stocks held by farmers might carry PVX and PVS and serve as an inoculum source for other commercial plantings. In addition, the presence of PVX and PVS in No.143 might affect the resistance level to PVY (9,20). It is also time for renovating No.143 after being continuously multiplied in farmers' fields for 3 years. But the certified seed of No.143 can be used for further seed crops because of its resistance to PVY.

Both No.770 and 385095-15 possess resistance to PVY, No.770 is also resistant to PVX. No.770 produces red skinned, medium sized tubers and is a substitute for Cardinal only for export market. It yields moderately because of its low proportion of large tubers. On the other hand, 385095-15 has stable high yield of large tubers. However the long oval tubers do not meet the market requirement and the tuber specific gravity is generally low. They are not ready for farmers' acceptance.

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摘　　要

曹幸之．1993．臺灣馬鈴薯抗病毒病害品系之篩選．植病會刊2:232-240．(臺中縣霧峰鄉　臺灣省農業試驗所園藝系)

利用酵素結合抗體免疫分析(ELISA)檢測馬鈴薯品種(系)的葉片及芽體，以調查各品種(系)上病毒之發生，供試材料包括三個農試所選育的品系(No.143、No.770和385095-15)及兩個栽培品種(卡第那和克尼伯)，本所品系在田間歷經多年觀察，其種薯係自然留種，而栽培品種係由健康種薯體系生產，每年更新。結果顯示本所三個品系普遍感染有馬鈴薯S和X病毒，而栽培品種多感染Y病毒而少S、X或A病毒。夏季在高冷地繁殖時，各品種(系)均顯示植株感染有PVY時比植株未感染PVY的產量略低。栽培品種的供試採種薯多已感染PVY，且卡第那品種所含PVY濃度又較克尼伯品種爲高，產地田間試驗克尼伯平均產量達34 t/ha，卡第那只24 t/ha，顯示克尼伯對PVY具有抗性。No.143一般產量比No.770爲高，該兩品系比克尼伯對PVY有較高抗性。種薯帶PVY與否對No.143、No.770、385095-15與克尼伯四個品種(系)的產量沒有影響，但種薯PVY的濃度並不高。幼株接種PVY則對克尼伯造成顯著的減產，而且病株多複合感染PVY的嵌紋與壞疽系統，本所供試品系則少複合感染PVY的兩個系統，而且所含病毒濃度也較克尼伯所含爲低，No.143與385095-15的產量不因接種處理而減少。各

試驗均顯示卡第那對 PVY 呈感病，其採種薯不能再供留種用，克尼伯對 PVY 具有抗性，當只感染有 PVY 及 PVY 濃度不高時，並不明顯減產。本所選育的三個品系均較克尼伯對 PVY 更具抗性，其中 No.770因薯球中等大小，產量中等，而且薯皮紅色，雖對 PVX 也具抗性，推廣性不大，385095-15一般豐產，但長形薯不易被市場接受，No.143的產量表現穩定，其薯球外形與克尼伯相似，而色澤與鮮食品質均佳，因此於民國 82 年 3 月 2 日通過命名爲“台農一號”。

關鍵詞：馬鈴薯品系、馬鈴薯病毒、馬鈴薯 Y 病毒、抗病篩選。