Fruit Varieties Journal 42(3):109-115 1988

Virus Tested Pear Germplasm Available at the National Clonal Germplasm Repository in Corvallis, Oregon

JOSEPH POSTMAN,[1] AND KIM HUMMER[2]

Abstract

More than 1800 unique pear accessions are maintained at the National Clonal Germplasm Repository (NCGR) in Corvallis, Oregon. The 23 primary wild species of *Pyrus* and over 1400 unique cultivars, rootstocks, and selections are represented in this collection. Sixty-one percent of pear cultivars were found to be infected with common pear viruses. The repository has 575 pear clones that have tested virus-negative as received. Known viruses have been eliminated from 288 pear clones by subjecting them to thermotherapy and micropropagation. These clones are now available to researchers and plant breeders. Most have previously been unavailable in North America as virus-tested plants.

Introduction

The United States Department of Agriculture-Agriculture Research Service (USDA-ARS) operates the National Clonal Germplasm Repository (NCGR) for small fruits, hazelnuts, hops, mint and pears in Corvallis, Oregon. Since the 1950s, commercially important pome and stone fruit cultivars and rootstocks have been made available by the IR-2 Virus Free Repository at the Washington Agricultural Experiment Station in Prosser, Washington (5). In the mid 1970s, the need to preserve other valuable, but non-commercial, fruit and nut germplasm became evident and a series of clonal germplasm repositories were proposed (1). Eight such repositories have been established across the United States (11). The NCGR at Corvallis was the first of these to be built.

The NCGR *Pyrus* collection presently contains 1845 accessions representing about 1400 unique cultivars, rootstocks, and selections. All of the primary wild species of *Pyrus* are represented (Table 1). Studies have shown that these wild species carry genes for resistance to nearly all important insects and diseases of pear, and adaptation to a very wide range of environmental conditions (10). Additional variants, representing the natural genetic diversity of the genus are being sought for the collection throughout the world.

Cultivars at the repository are maintained as growing plants in screenhouses, field plantings, and *in vitro*. Species material is kept as seed, pollen, and growing plants. Detailed historical, descriptive, and inventory records for each accession are kept on a computer database, and this information is available to the public through the Germplasm Resources Information Network (GRIN).*

Viruses in pear trees can result in lowered fruit production (3, 12), unmarketable fruit (7), reduced vegetative growth (3, 8, 12), loss of graft compatibility with certain rootstocks and decreased cold hardiness (8). The commercial importance of virus-free fruit trees has long been appreciated, and is evidenced by the tremendous use that has been made of the cultivars available through the IR-2 program (5). Availability of virus-tested historical cultivars and unimproved germplasm is just as important for present and future use. Researchers and breeders should use virus-negative plants to accurately evaluate genetic characteristics. When plants are propa-

[1]Plant Pathologist.

[2]Curator, USDA-ARS National Clonal Germplasm Repository, 33447 Peoria Road, Corvallis, Oregon 97333.

*Further information about GRIN can be obtained by contacting the Database Manager, USDA-ARS, DBMU-GRIN, Rm 130 Bldg 001, BARC.West, Beltsville, MD 20705.

Table 1. Primary *Pyrus* species with natural origins and number of accessions at the National Clonal Germplasm Repository—Corvallis, December, 1987.

Species	Authority	Origins	Number of Accessions[a]
P. amygdaliformis	Villars	Greece, Sardinia, Turkey, Yugoslavia	39
P. betulifolia[b]	Bunge	Central, North China, South Manchuria	53
P. calleryana	Decne.	Central, South China	86
P. communis	L.	West, Southeast Europe, Turkey	81
P. c. var. caucasica[c]		Southeast Europe	6
P. c. var. pyraster[d]	L.	Southeast Europe	21
P. cordata	Desv.	France, Spain	24
P. cossonii[e]	Rehder	Algeria	5
P. dimorphophylla	Makino	Japan	38
P. elaeagrifolia	Pallas	Southeast Europe, Turkey, West USSR	33
P. fauriei	C. Schneider	Korea	31
P. gharbiana	Trabut	Morocco	8
P. glabra	Boiss.	Southeast Europe, Turkey	4
P. hondoensis	Kikuchi & Nakai	Japan	23
P. koehnei[f]	C. Schneider	South China, Taiwan	21
P. mamorensis	Trabut	Morocco	19
P. nivalis	Jacq.	West, Central, South Europe	23
P. pashia	Buch.-Ham Ex D.Don.	India, Nepal, Pakistan	32
P. pseudopashia	T.T.Yu	North, West China	1
P. pyrifolia	(Burm.f.) Nakai	China, Japan, Korea, Taiwan	32
P. regelii[g]	Rehder	Afghanistan	8
P. salicifolia	Pallas	North Iran, Southwest USSR	7
P. syriaca	Boiss.	Israel, Lebanon, Libya, Syria, Tunisia	17
P. ussuriensis	Maxim.	North China, Korea, Manchuria, Siberia	31
P. xerophylla	T.T.Yu	North, West China	1

[a]counts do not include named cultivars.
[b]synonym = P. betulaefolia Bunge. spelling incorrect; ICBN Article 73.8.
[c]synonym = P. caucasica Fed.
[d]synonym = P. pyraster L.
[e]synonym = P. longipes Coss. & Durr illegitimate later homonym; ICBN Article 64.1.
[f]synonym = P. kawakamii Hayata predated by P. koehnii.
[g]synonym = P. heterophylla Reg. & Schmalh. previous use refers to *Sorbus*.

gated clonally, every cutting, scion or runner that is taken from a virus infected plant may also carry the same viruses. Without appropriate precautions, distribution of plant germplasm is a very efficient method of distributing virus diseases around the world. To avoid this problem, all material stored at NCGR-Corvallis is being tested for important virus diseases.

Plants distributed by the Corvallis repository are accompanied by a virus status summary. Germplasm is available without charge to any researcher or plant breeder anywhere in the world. Since opening in 1980, NCGR-Corvallis has distributed plant germplasm to 39 states in the US and to 34 foreign countries.

Virus Testing

All pear accessions maintained as growing plants are tested for latent viruses by graft inoculation of virus sensitive indicator plants under the proper environmental conditions. Fridlund (4, 6) has selected indicator varieties that produce foliar symptoms in the greenhouse following inoculation with several important viruses. Other pear viruses produce symptoms in inoculated indicator plants only after several years in the field. Serological methods such as ELISA (2)

cannot be used to detect most pear viruses until antisera against these viruses become available.

Some recommended indicators for pear viruses are listed in Table 2, and those that are being used at NCGR-Corvallis are noted. Pear vein yellows virus (PVYV) and ringpattern mosaic (= apple chlorotic leafspot virus) are the most common virus diseases found in pears. They can be detected reliably in about 10 weeks using the greenhouse method (6). Apple stem grooving virus (ASGV) induces foliar symptoms when 'Virginia Crab' or *Pyronia veitchii* is inoculated in the greenhouse, however neither indicator is reliable.

Pear vein yellows and ringpattern mosaic will produce symptoms in many cultivars when trees are young (Figure 1), especially when the plants are grown in a shaded greenhouse or screenhouse. Stony pit virus and the bark deforming viruses take several years to detect in the field. Stony pit, which produces only fruit symptoms, may not show symptoms every year, or in all fruit. The variety 'Bosc' is being used as a field indicator to detect stony pit at the repository. Fortunately, the fruit and bark deforming viruses are uncommon.

Over 61 percent of pear cultivars and 14 percent of clones of wild species received at the repository were found to be infected with pear vein yellows or ringpattern mosaic viruses. Viruses in pear are only known to be spread by grafting, and are not passed through the seed. Plants that originated as seedlings and have not been grafted onto infected rootstocks should be virus-free. Thus many recently developed cultivars and material collected in the wild test virus-negative. The wild species in the repository collection that tested virus-positive were obtained from arboretum or experiment station collections and had

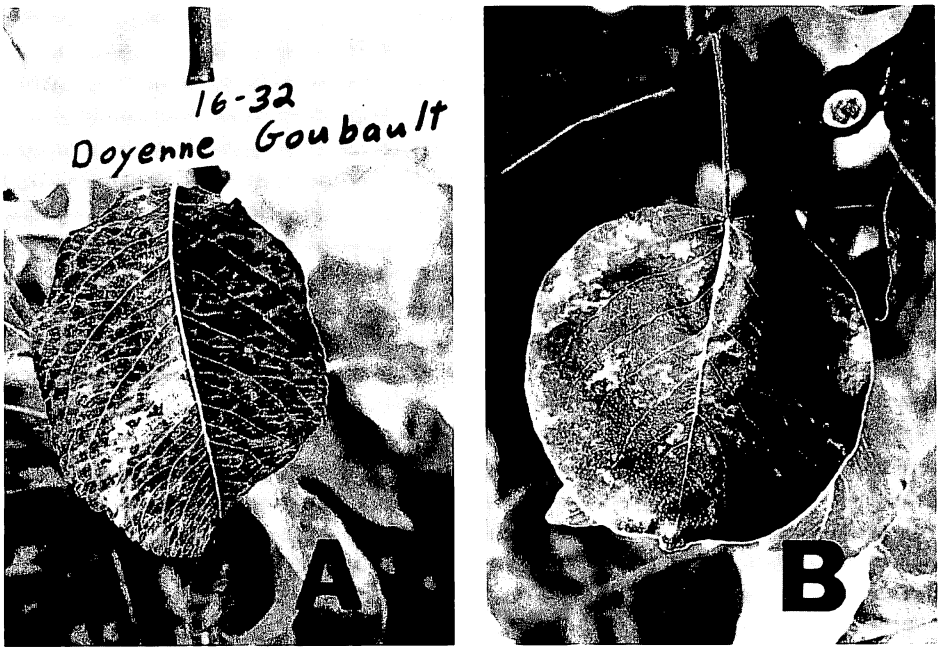

Figure 1. Symptoms of A) pear vein yellows virus in 'Doyenne Goubault' and B) pear ringpattern mosaic virus in 'Stuttgater-Geishirtle.'

Table 2. Sensitive indicator varieties recommended for detection of latent pear viruses by graft inoculation.

Virus Indicator	Time Required	Viruses Detected
	Greenhouse Indexing	
Pyrus communis		
Nouveau Poiteau[a, b]	10 weeks	apple stem pitting, quince sooty ringspot, pear vein yellows, rough bark[c], ringpattern mosaic (=apple chlorotic leafspot)
Malus pumila		
Virginia Crab[a]	8 weeks	apple stem grooving, apple stem pitting[c]
Pyronia veitchii[a]	8 weeks	apple stem grooving[c], latent quince viruses, pear vein yellows
	Field Indexing	
Pyrus communis		
Beurre Bosc[a]	3 crops	stony pit
Bartlett	2 years	bark split, blister canker, rough bark
Malus pumila		
Lord Lambourne	3 years	apple rubbery wood (MLO)

[a]Indicators presently being used at NCGR-Corvallis.
[b]Plants must be cut back and defoliated after 4 weeks, symptoms are expressed on second flush of growth.
[c]Reliability of indicator for these viruses is in question.

been clonally propagated, probably on virus infected rootstocks.

The repository presently has 575 pear accessions that have tested virus negative as received. A list of these can be obtained by contacting the curator.

Virus Elimination

All NCGR accessions discovered to be virus infected are subjected to thermotherapy and micropropagation. Infected plants are repropagated and grown in a heat chamber that alternates at 4 hour intervals between 30 and 38 degrees C. Alternating the temperature increases the percentage of plants surviving hot air thermotherapy (9) and still eliminates viruses from the new tips. This treatment has proven effective with pears at the repository. After about 3 weeks in the heat chamber, a 5 mm shoot tip is removed from each growing point and grafted onto a young seedling rootstock. (*Pyrus betulifolia* seedlings are used because their lobed juvenile leaves and their birch-like adult leaves are easily distinguished from most scions.) A bottle is inverted over the micrograft to maintain high humidity until the graft union forms. Trees produced in this way must be grown and tested for several years to verify virus elimination. Approximately 75 percent of these trees have subsequently tested negative for pear vein yellows and ringpattern mosaic viruses. This process, from the time an infected plant is identified, until a virus-negative replacement tree is available for distribution, may take 3-5 years. Testing for additional viruses is continuing and new methods will be added as they are available.

Listed in Table 3 are pear clones that have been freed of known viruses at NCGR-Corvallis. There are presently 210 additional pear clones at various stages in the virus elimination process. Most of these clones have not previously been available in North America as virus-tested plants. Efforts to verify all plant identities by fruit and vegetative characteristics are underway. Requests for plant material should be addressed to: Curator, National Clonal Germplasm Repository, 33447 Peoria Road, Corvallis, Oregon 97333.

Table 3. Pear accessions freed of viruses at the National Clonal Germplasm Repository—Corvallis[a].

Aarer Pfundbirne
Abate Fetel
Akce
Allexandrine Douillard
Ames
Anjou, 4n
Arganche
Bariker
Baronne Leroy
Bartlett, Bagley Russet
Bartlett 4n
Bartlett 4n, Max Red
Bella di Giugno [Bella di Diugno]
Belle Angevine (=Pound)
Belle Lucrative [Esperen, Herrenbirne]
Belle Picarde
Belle de Beugny
Bera Wysmienita
Bere-obtjabra
Bergamote d'Ete
Bergamotte Sageret
Berger
Besi d'Hery
Beurre Capiaumont
Beurre Clairgeau
Beurre Diel
Beurre Dilly [Bre Dilly]
Beurre Dubuisson
Beurre Dumont
Beurre Easter
Beurre Flon
Beurre Fouqueray
Beurre Giffard
Beurre Gris
Beurre Gris d'Hiver Nouveau
Beurre Henri Courcelle
Beurre Jean van Geert
Beurre Madame Henre Lamy
Beurre Millet
Beurre Phillippe Delfosse
Beurre Slucka
Beurre d'Amanlis
Beurre d'Angleterre
Beurre d'Arenberg
Beurre de Bollwiller
Beurre de Ghelin
Beurre de Jonghe
Beurre de Nantes
Beurre de Saint Nicolas
Blanquet Precoce
Bojka
Bon Chretien d'Hiver
Buffum
Butirra di Roma [Butirra Roma Pirovano]
Campas No. 1
Campas No. 2
Carigradsko Alice
Cayuga
Cebulka
Chasseurs
Chojuro
Citron D'Ete
Clapp Favorite, Red (=Kalle, =Starkrimson)
Claude Blanchet
Colonel Marchand
Coloree de Juillet
Comice, Spur
Comte de Chambord
Comte de Lambertye
Comte de Lamy
Comtesse Clara Frijs
Comtesse de Paris
Conseiller a La Cour
Consigliere d'Appelle
Delices d'Avril
Directeur Hardy
Dorset
Doyenne Boussock (=Double Philip)
Doyenne Goubault
Doyenne Gris
Doyenne Madame Levavasseur
Doyenne de Juillet (=Summer Doyenne)
Doyenne de la Grifferaye
Doyenne du Comice 4n
Duchesse Bronzee
Duchesse d'Angouleme Bronzee
Duchesse de Berry d'Ete
Duchesse de Bordeaux
Early Green Sugar
Early Harvest
Ecmianka
Emile d'Heyst [Emile Di Heyst]
Epargne (=Jargonelle)
Epine de Mai
Erabasma
Estella
Eureka
Eva Baltet
Ewart
F-25
Favorite Morel
Flemish Beauty
Fondante de Moulins Lille
Fragrante
Frederick Clapp
Gansel's Bergamot
Garber
Gelbmostler
General Galliene
General Le Clerc
Gieser Wildeman
Gliva Ukrainskaya

Table 3. Continued.

Graf Moltke [Grave Moltke]
Grand Champion
Graparon
Grata
Grosse Louise
Guar Li Sdlg No. 2
HW 601
Hardy, Red
Henri Desportes
Highland
Homony
Hortellet
Hosui
Huang Hsing Sui Li
Hung Li
Ilinka
Jakobowka Hanowerska
Jalovcovka
Jalowcowka
Jesinji Vodenac
Jubileer D'Ar
Kiparyjska
Krolewka
Kyles Sugar
Lady Clapp
Laioyang 50
Lange Graticol
Lawson
Laxtons Progress
Laxtons Satisfaction
Le Brun
Lehoux Grignon
Lezinova
Longue Verte
Longworth
Louis Vilmorin
Louise Bonne de Jersey
Mac
Madame Favre
Madame Gillekins
Madame Lye Baltet
Mag 1
Mag 6
Mandan 58-4
Marie Louise
Mariette de Millepieds
Mednik
Mellina
Mendel
Messire Jean
Mitchell
Mock's William (=Sensation Red Bartlett)
Moe
Monterrey
Muskatelka Prava
Muskatelka Seda
Mustabej
Nagy Szegfukorte
Namshi P't
Nan Li
Norhausen Forelle [Nordhauser]
Normannischen Ciderbirne
Novogodnaia (New Year)
OHxF 130
OPR-135 P. calleryana
OPR-157 P. calleryana
OPR-255
Orel No. 15
P. communis 5n
P. nivalis P-91
P-12
P-79
Passans du Portugal
Pautalia
Petit Muscat
Petite Rousselet
Ping Ding Li
Pitmaston Duchess
Porporata
Precoce Trevoux
President Drouard
President Hardy
President Heron
President Loubet
President Loutreul
President Osmonville 40
Professor Grosdemage
Progres
Pulteney
RX 226
RX 274
Red Pear
Reimer's Hybrid
Reliance
Rene Dunan
Rotkottig Frau Ostergotland
Royale Vendee
Saint Gilles
Sanguine
Sanguinole
Santa Clause
Santa Maria
Schweizer Wasserbirne
Scipiona
Senateur Belle
Shinseiho
Sierra
Sion Szu Mi
Snyder
Stout
Stuttgater-Geishirtle
Sucree Rosee
Sucree Verte
Sucree de Mountlucan

Table 3. Continued.

Sudduth	Tzu Ma Li
Sugar Top	Ulitchka [Upitchka]
Summer Muskatel Birne	Urbaniste [Des Urbanistes]
Surecrop	Uvedale St. Germain (=Pound)
Szumi	Variolosa (P. pashia hyb.)
Talasova Zimni	Verbula
Tedrow Beauty	Verte Longue d'Automne
Theilersbirne	W-1
Thornley	White Doyenne
Timpurii de Voinsati	White Star
Tioma	Wikler Early
Topka	Wilder Early
Toulouska pozdni	Wilenska Plenna
Triomphe de Touraine	Windorska
Triomphe de Vienne	Winkleman
Trubchanka Popularnaia (Common Trubchanka)	Winter Bartlett
Tsarigradka	Winter Cole
Tyford Monarch	Zuckerbirne

[a]Names in brackets are the names as received; names in parentheses are synonyms or translations; names following comma describe mutant clones.

Literature Cited

1. Brooks, H. J. and D. W. Barton. 1977. A plan for national fruit and nut germplasm repositories. HortScience 12:298-300.
2. Clark, M. F. and A. N. Adams. 1977. Characteristics of the microplate method of enzyme-linked immunosorbent assay for the detection of plant viruses. J. Gen. Vir. 34:475-83.
3. Cropley R. and A. F. Posnette. 1973. The effect of viruses on growth and cropping of pear trees. Ann. Appl. Biol. 73:39-43.
4. Fridlund, P. R. 1976. Pear vein yellows virus symptoms in greenhouse grown pear cultivars. Pl. Dis. Rep. 60:891-94.
5. Fridlund, P. R. 1980. The IR-2 program for obtaining virus free fruit trees. Plant Disease 64:826-30.
6. Fridlund P. R. 1980. Glasshouse indexing for fruit tree viruses. Acta Hort. 94:153-58.
7. Milbrath, J. 1966. Stony pit of pear in Oregon. Ore. Ag. Exp. Sta. Tech. Bull. 93, 23 pp.
8. Minoiu N., D. Vladianu, K. Pattantyus, P. Parnia, C. Cracium, V. Cracium, M. Stirban. 1986. Investigations on pear vein yellows in nursery Acta Hort. 193:89-94.
9. Nyland, G. and A. C. Goheen. 1969. Heat therapy of virus diseases of perennial plants. Ann. Rev. of Phytopath. 7:331-53.
10. Westwood, M. N. 1982. Pear germplasm of the new national clonal repository: It's evaluation and uses. Acta Hort 124:57-65.
11. Westwood, M. N. 1986. U.S. establishes national clonal repository system for fruit and nut crops. Diversity 9:19-21.
12. Westwood, M. N. and H. R. Cameron. 1974. Effects of vein yellows virus on growth, flowering and yield of Anjou pear. J. Amer. Soc. Hort. Sci. 99:425-26.