Proposals for a Reappraisal of the Status of the Names of Plant-Pathogenic *Pseudomonas* Species

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Two lists of phytopathogenic *Pseudomonas* species are presented. The first list comprises 80 names of species that have been validly published and for which cultures are available. It is proposed that these names be retained until a comprehensive rational classification is produced for this group. The second list contains more than 140 names which it is proposed should be rejected on grounds of illegitimacy, synonymy, lack of authentic cultures, or inappropriate classification.

A complete revision of the genus *Pseudomonas* Migula 1894 is presented in *Bergey's Manual* (27). In this revision there are only seven descriptions of plant-pathogenic species, namely, *P. fluorescens* Migula 1895 (some strains of biotype II), *P. syringae* van Hall 1902, *P. cichorii* (Swingle 1925) Stapp 1928, *P. caryophylli* (Burkholder 1942) Starr and Burkholder 1942, *P. cepacia* Burkholder 1950, *P. marginata* (McCulloch 1921) Stapp 1928, and *P. solanacearum* (Smith 1896) Smith 1914. While many plant bacteriologists would probably agree that on present evidence most plant-pathogenic *Pseudomonas* nomenspecies do not justify ranking as taxospecies and that their names can, if nomenclaturally valid, be regarded as synonyms of one or another of the seven taxospecies recognized by Doudoroff and Palleroni, they would also consider that the treatment of this genus by Doudoroff and Palleroni (27) is inadequate from a plant pathologist's viewpoint because it does not provide a nomenclature that expresses the phytopathogenic individuality of these bacteria (30). Whatever the taxonomic and other disadvantages of the existing nomenclature of the plant-pathogenic pseudomonads, it reflects the pathogenic properties of these organisms better than the nomenclature used in *Bergey's Manual*. It therefore seems to us important to retain those names that are nomenclaturally legitimate until a satisfactory rationalization can be made that combines a "general purpose" classification, such as that of Doudoroff and Palleroni (27), with a "special purpose" classification catering to pathologists; the position of the species in the related genus *Xanthomonas* is similar (31, 50).

The *International Code of Nomenclature of Bacteria* approved by the International Com-

mittee on Systematic Bacteriology at the First Congress of the Bacteriology Section of the International Association of Microbiological Societies in Jerusalem in 1973 (in press) provides that "names of bacteria in the various categories validly published up to 31 December 1977 will be assessed by the Judicial Commission with the assistance of taxonomic experts." "When approved by the ICSB these Approved Lists of Bacterial Names will be published in the IJSB before 1 January 1980. Names validly published under the Code between 1 January 1978 and 1 January 1980 will be added to the Approved Lists" but "those names validly published prior to 1 January 1980 and not included in the lists will have no further standing in nomenclature. They will not be added to the lists of *nomina rejicienda* and will thus be available for reuse for the naming of new taxa." Essential features of the names to be recorded in the approved lists are that they be validly published and that they refer to organisms for which authentic cultures are available in recognized culture collections. Although more than 220 names have been used for plant-pathogenic bacteria in the genus *Pseudomonas* Migula 1894, some are illegitimate because they are contrary to the rules of the revised Code, whereas others refer to species for which no representative cultures are known to exist. Many even lack adequate original descriptions by which cultures could be identified reliably if they are isolated again.

As a first step towards a more rational and useful classification of the plant-pathogenic pseudomonads, lists are presented here. They divide the existing nomenspecies into: (1) those that are legitimate according to the approved rules of the *Bacteriological Code* and which we propose should be retained in general use until a

nomenclature emerges with the degree of differentiation that is sought by plant bacteriologists and pathologists, and (2) those that should not be retained because they are nomenclaturally illegitimate, are later objective or generally accepted subjective synonyms of those in list 1, are without extant cultures in recognized collections, or have been inappropriately classified.

List 1. *Pseudomonas* nomenspecies proposed to be retained pending further research. It is acknowledged that some have received little attention and may well have been inappropriately classified. Therefore this list is likely to be modified before formal submissions are made for the Approved Lists of Bacterial Names. (Complete references are given for the authorities of these nomenspecies.)

- P. aceris* (Ark 1939) Starr and Burkholder 1942
P. agarici Young 1970
P. alboprecipitans Rosen 1922
P. alliicola (Burkholder 1942) Starr and Burkholder 1942
P. amygdali Psallidas and Panagopoulos 1974
P. andropogonis (Smith 1911) Stapp 1928
P. angulata (Fromme and Murray 1919) Stevens 1925
P. antirrhini Takimoto 1920
P. apii Jagger 1921
P. aptata (Brown and Jamieson 1913) Stevens 1925
P. asplenii (Ark and Tompkins 1946) Săvulescu 1947
P. atrofaciens (McCulloch 1920) Stevens 1925
P. azadirachtae Desai et al. 1966
P. barkeri (Berridge 1924) Dowson 1943
P. berberidis (Thornberry and Anderson 1931) Stapp 1935
P. betle (Ragunathan 1928) Săvulescu 1947
P. cannabina Šutić and Dowson 1959
P. caricapapayae Robbs 1956
P. caryophylli (Burkholder 1942) Starr and Burkholder 1942
P. cattleyae (Pavarino 1911) Săvulescu 1947
P. cepacia Burkholder 1950
P. ciccaronei Ercolani and Caldarella 1972
P. cichorii (Swingle 1925) Stapp 1928
P. coronafaciens (Elliott 1920) Stevens 1925
P. coronafaciens subsp. *atropurpurea* (Reddy and Godkin 1923) Stapp 1928
P. delphinii (Smith 1904) Stapp 1928
P. dysoxyl Hutchinson 1949
P. eriobotryae (Takimoto 1931) Dowson 1943
P. flectens Johnson 1956
P. floridana (Bourne 1970) Bourne 1970
P. garcae Amaral et al. 1956
P. glumae Kurita and Tabei 1967
P. glycinea Coerper 1919
P. helianthi (Kawamura 1934) Săvulescu 1947
P. hibiscicola Moniz 1963
P. lachrymans (Smith and Bryan 1915) Carsner 1918
P. lapsa (Ark 1940) Starr and Burkholder 1942
P. maculicola (McCulloch 1911) Stevens 1913
P. mangiferaeindicae Patel et al. 1948
P. marginalis (Brown 1918) Stevens 1925
P. marginata (McCulloch 1921) Stapp 1928
P. mellea Johnson 1923
P. melophthora Allen and Riker 1932
P. mori (Boyer and Lambert 1893) Stevens 1913
P. morsprunorum Wormald 1931
P. morsprunorum subsp. *persicae* Prunier et al. 1970
P. oryzicola Klement 1955
P. panici (Elliott 1923) Stapp 1928
P. papaveris Lelliott and Wallace 1955
P. papulans Rose 1917
P. passiflorae (Reid 1939) Burkholder 1948
P. pastinacae Burkholder 1960
P. phaseolicola (Burkholder 1926) Dowson 1943
P. pisi Sackett 1916
P. pomi Cole 1959
P. primulae (Ark and Gardner 1936) Starr and Burkholder 1942
P. ribicola Bohn and Maloit 1946
P. rubrilineans (Lee et al. 1925) Stapp 1928
P. rubrisubalbicans (Christopher and Edgerton 1930) Krasil'nikov 1949
P. savastanoi (Smith 1908) Stevens 1913
P. sesami Malkoff 1906
P. setariae (Okabe 1934) Săvulescu 1947
P. solanacearum (Smith 1896) Smith 1914
P. sorghicola Rangaswami et al. 1961
P. striafaciens (Elliott 1927) Starr and Burkholder 1942
P. syringae van Hall 1902
P. syringae subsp. *capsici* (Orsini 1942) Klement 1956
P. tabaci (Wolf and Foster 1917) Stevens 1925
P. tagetis Hellmers 1955
P. theae (Hori 1915) Okabe and Goto 1955
P. tolaasii Paine 1919
P. tomato (Okabe 1933) Alstatt 1944
P. ulmi Šutić and Tešić 1958
P. viburni (Thornberry and Anderson 1931) Stapp 1935
P. viridiflava (Burkholder 1930) Dowson 1939
P. viridilivida (Brown 1915) Stevens 1925
P. viticola Nayudu 1972
P. vitiswoodrowii Patel and Kulkarni 1951
P. washingtoniae (Pine 1943) Elliott 1951
P. woodsii (Smith 1911) Stevens 1925

List 2. Names of *Pseudomonas* species that it is proposed should not be retained because they are: (a) illegitimate; (b) objective synonyms or generally accepted subjective synonyms of names in list 1; (c) not represented by authentic cultures in recognized culture collections (most are also so inadequately described as to be unrecognizable again, i.e., they are hyponyms); (d) considered on the basis of cultures and/or descriptions not to be appropriately classified in the genus. (The literature citations are not given for authors of these nomenclatures.)

- P. acernea* Ogawa 1937 (c)
P. aleuritidis (McCulloch and Demaree 1932) Stapp 1935 (c)
P. allii (Griffiths 1887) Migula 1900 (c)
P. aloes (Passalacqua 1929) Krasil'nikov 1949 (c)
P. amaranti Smith 1901 (c)
P. ananas Serrano 1934 (c)
P. araliae Uyeda 1909 (c)
P. astragali (Takimoto 1930) Săvulescu 1947 (c)
P. aucubicola Trapp 1936 (c)
P. aurantiaca tingitana (Remlinger and Bailly 1935) Krasil'nikov 1949 (c)
P. avenae Manns 1909 (c)
P. batatae Cheng et al. 1962 (c)
P. betae (Wieringa 1927) Dowson 1943 (c)
P. bowlesiae (Lewis and Watson 1927) Dowson 1943 (c)
P. brassicae acidiae (Lehman and Conrad 1896) Gruber 1909 (c)
P. brassicae vora (Delacroix 1905) Krasil'nikov 1949 (c)
P. briosii (Pavarino 1915) Krasil'nikov 1949 (c)
P. burgeri (Potebnia 1915) Korobko and Niki-foruk 1972 (c)
P. bussei (Migula 1900) Krasil'nikov 1949 (c)
P. calendulae (Takimoto 1936) Dowson 1943 (c)
P. cannabina var. *italica* Goidanich and Ferri 1960 (a)
P. caryocaryanea Dupaix 1933 (a)
P. castaneae (Kawamura 1934) Săvulescu 1947 (c)
P. caucasicum Shneider 1954 (c)
P. caulivora (sic) (Prillieux and Delacroix 1890) Krasil'nikov 1949 (c)
P. cerasi Griffin 1911 (b)
P. cerasi var. *prunicola* Wilson 1933 (b)
P. cerasi var. *pyri* D'yakova 1961 (b)
P. derasi uraggi Sackett 1925 (a)
P. cerealia (Gentner 1920) Stapp 1928 (c)
P. cinnamona Miyake and Tsunodo 1938 (c)
P. cissicola (Takimoto 1939) Burkholder 1948 (c)
P. citrarefaciens (Lee 1917) Stapp 1928 (b)
P. citriputealis (Smith 1913) Stapp 1928 (b)
P. coli-capsici (Passalacqua 1932) Krasil'nikov 1949 (c)
P. columnae (Thornberry and Anderson 1937) Burkholder 1948 (c)
P. conjac Uyeda 1910 (d)
P. corylii (Brzezinski 1903) Krasil'nikov 1949 (c)
P. cuboniani (Macchiati 1892) Krasil'nikov 1949 (c)
P. cumini (Kovachevsky 1936) Dowson 1943 (c)
P. cyamopsicola Rangaswami and Gowda 1963 (d)
P. desaiana (Burkholder 1939) Săvulescu 1947 (c)
P. destructans Potter 1899 (c)
P. dianthi (Arthur and Bolley 1896) Smith 1901 (c)
P. eleusineae Billimoria and Hegde 1971 (c)
P. endiviae Kotte 1930 (b)
P. erodii Lewis 1914 (c)
P. exitiosa Gardner and Kendrick 1921 (c)
P. fabae (Yu 1936) Burkholder 1948 (c)
P. fici (Cavara 1905) Krasil'nikov 1949 (d)
P. fluorescens var. *antirrhinastrini* Moffett 1966 (b)
P. fluorescens var. *exitiosus* van Hall 1903 (c)
P. formosanum (Okabe 1935) Krasil'nikov 1949 (c)
P. fragariae I Gruber 1902 (a)
P. fraxini (Brown 1932) Škorić 1938 (c)
P. gardeniae (Burkholder and Pirone 1941) Dowson 1943 (c)
P. gardneri Šutić 1957 (d)
P. gardneri var. *capsici* Šutić 1957 (c)
P. gladioli Severini 1913 (c)
P. glycinea var. *japonica* (Takimoto 1927) Săvulescu 1947 (b)
P. helianthi var. *tuberosi* Thornberry and Anderson 1937 (b)
P. hemmianus (Yamamoto 1951) Okabe and Goto 1955 (c)
P. hibisci (Nakada and Takimoto 1923) Stapp 1928 (b)
P. hibiscicola Rangaswami and Gowda 1963 (a)
P. holci Kendrick 1926 (c)
P. hordei (Goto and Nakanishi 1951) Okabe and Goto 1955 (c)
P. hypertrophicans Stahel 1933 (d)
P. intybi (Swingle 1925) Stapp 1928 (b)
P. iridicola (Takimoto 1931) Stapp 1935 (c)
P. iridis van Hall 1902 (c)

- P. itoana* Tochinal 1932 (d)
P. jaggeri Stapp 1928 (b)
P. koroensis (sic) Uyeda 1908 (c)
P. lacerans (Migula 1900) Krasil'nikov 1949 (c)
P. lachrymans f. sp. *cucumis* Gorlenko 1961 (c)
P. lachrymans f. sp. *melonis* Yatsynina 1939 (c)
P. lauracearum Harvey 1952 (c)
P. leguminiperdus (sic) (von Oven 1906) Stevens 1913 (c)
P. levistici Osterwalder 1909 (c)
P. lignicola Westerdijk and Buisman 1929 (c)
P. ligustri (d'Oliveira 1936) Săvulescu 1947 (c)
P. lohnisii (sic) (Kalantarion 1925) Krasil'nikov 1949 (c)
P. lupini Bel'tyukova and Korol'ova 1968 (c)
P. lycopersici (Burgwitz 1924) Stapp 1928 (c)
P. lycopersicum (Groenewege 1912) Krasil'nikov 1949 (c)
P. madrasensis Rangaswami and Gowda 1963 (c)
P. maidis (Maiocchi 1881) Migula 1900 (c)
P. martyniae (Elliott 1925) Stapp 1928 (c)
P. matthiolae (Briosi and Pavarino 1912) Dowson 1943 (c)
P. maublancii (Foex and Lansade 1936) Săvulescu 1947 (c)
P. medicaginis Sackett 1910 (c)
P. medicaginis var. *phaseolicola* (Burkholder 1926) Stapp and Kotte 1929 (b)
P. mori var. *huszi* Klement et al. 1960 (b)
P. musae Gäumann 1921 (c)
P. necrosis (Kalinenko 1933) Krasil'nikov 1949 (c)
P. nectarophila (Doidge 1917) Burkholder 1939 (c)
P. pachyrrhizus Fang and Ren 1960 (c)
P. panacis (Nakata and Takimoto 1922) Dowson 1943 (c)
P. panicumiliacei (Ikata and Yamauchi 1931) Săvulescu 1947 (c)
P. papaveris (Takimoto 1935) Okabe and Goto 1955 (c)
P. petasitis (Takimoto 1927) Săvulescu 1947 (c)
P. phormicola (Takimoto 1933) Krasil'nikov 1949 (c)
P. pini (Chester 1897) Petri 1924 (c)
P. polycolor Clara 1930 (b)
P. polygona (Thornberry and Anderson 1937) Burkholder 1948 (c)
P. prunicola Wormald 1930 (b)
P. pseudozoogloeae (Honing 1914) Stapp 1928 (c)
P. punctulans (Bryan 1933) Săvulescu 1947 (b)
P. putrefaciens liquefaciens (Delacroix 1906) Krasil'nikov 1949 (a)
P. putrefaciens putridus (Delacroix 1906) Krasil'nikov 1949 (a)
P. pyri (D'yakova 1955) Gorlenko 1961 (c)
P. radiciperda (Zhavoronkova 1932) Săvulescu 1947 (c)
P. rhizoctonia (Thomas 1922) Stevens 1925 (c)
P. ricini (Archibald 1927) Robbs 1954 (b)
P. rimae faciens Koning 1938 (b)
P. rubi idaei Natal'ina et al. 1954 (d)
P. saliciperda Lindeijer 1932 (c)
P. sambuci Tešić and Todorović 1953 (c)
P. savastanoi var. *fraxini* (Brown 1932) Dowson 1943 (b)
P. savastanoi var. *nerii* Smith 1928 (b)
P. seminum Cayley 1917 (d)
P. siccata (Moniz and Patel 1958) Rangaswami 1962 (c)
P. sojae (Wolf 1920) Stapp 1928 (c)
P. sojae var. *japonica* (Takimoto 1927) Krasil'nikov 1949 (b)
P. solanacearum var. *asiatica* (Smith 1914) Stapp 1928 (b)
P. solaniolens Paine 1923 (c)
P. sorghi (Burrill 1887) Krasil'nikov 1949 (c)
P. spongiosa (Aderhold and Ruhland 1905) Braun 1927 (b)
P. stizolobii (Wolf 1920) Stapp 1935 (b)
P. straminea Komagata 1961 (c)
P. striafaciens var. *japonica* Mukoo 1955 (c)
P. suberfaciens (Burr 1928) Krasil'nikov 1949 (c)
P. syringae var. *papulans* (Rose 1917) Smith 1944 (c)
P. syringae f. sp. *populea* Sabet and Dowson 1952 (b)
P. tectonae Roldan and Andres 1954 (c)
P. tonelliana (Ferraris 1926) Burkholder 1948 (b)
P. trifolii Huss 1907 (d)
P. trifoliorum (Jones et al. 1923) Stapp 1928 (b)
P. utiformica Clara 1932 (b)
P. viciae Uyeda 1915 (c)
P. vignae Gardner and Kendrick 1923 (b)
P. vignae var. *leguminophila* (Burkholder 1930) Magrou and Prévot 1948 (c)
P. viridifaciens (Tisdale and Williamson 1923) Tisdale and Williamson 1923 (b)
P. viridiflava var. *concentrica* (Petersen 1932) Săvulescu 1947 (c)
P. wieringae (Elliott 1930) Săvulescu 1947 (c)
P. xanthochlora (Schuster 1913) Stapp 1928 (c)

P. zingiberi Uyeda 1909 (c)

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