

PROJECT FULL TITLE:
**DEVELOPMENT OF A NEW DIAGNOSTIC TOOL USING DNA BARCODING TO IDENTIFY
 QUARANTINE ORGANISMS IN SUPPORT OF PLANT HEALTH**

GRANT AGREEMENT NO.: (226482)

Date: 21 September 2009
 Partner responsible: University of Aarhus (UA), Denmark
 Coordination and contact: Dr. Mogens Nicolaisen, Mogens.Nicolaisen@agrsci.dk

Collection of all relevant phytoplasmas from about 30 taxonomic groups.

We already have a collection phytoplasmas of 30 taxonomic groups, see list, however this list will be extended with relevant strains during the project (with e.g. palm lethal yellowing). Also rare strains will be included to ensure that their barcode regions are not identical to barcodes of Q-phytoplasmas.

| | Description | Origin | From | Classification |
|-----|-----------------------------------|---|----------------------|--------------------------------|
| 1. | American aster yellows (AAY) | Aster, FL, USA | McCoy | 16SrI-B - Aster yellows |
| 2. | Aquilegia virescence (AKV) | <i>Aquilegia alpina</i> , Germany | Marwitz | 16SrI-B – Aster yellows |
| 3a. | Apple proliferation (AP-15) | Apple, Udine, Italy | Carraro | 16SrX-A – Apple proliferation |
| 3b. | Apple proliferation (AP) | Apple, France | Garnier | 16SrX-A – Apple proliferation |
| 4b. | Ash yellows (ASHY4) | <i>Fraxinus americana</i> , Verbank, NY, USA | Sinclair & Griffiths | 16SrVII-A – Ash yellows |
| 4c. | Ash yellows (ASHY7) | <i>F. americana</i> , Ann Harbor, MI, USA | Sinclair & Griffiths | 16SrVII-? – Ash yellows |
| 4d. | Ash yellows (ASHY12) | <i>F. americana</i> , Inman WV, USA | Sinclair & Griffiths | 16SrVII-A – Ash yellows |
| 4e. | Ash yellows (ASHY8) | <i>F. americana</i> , Ann Harbor, MI, USA | Sinclair & Griffiths | 16SrVII-A – Ash yellows |
| 4f. | Ash yellows (ASHY2) | <i>F. americana</i> , Enfield, NY, USA | Sinclair & Griffiths | 16SrVII-A – Ash yellows |
| 6. | Aster yellows (AY-24126) | <i>Callistephus chinensis</i> | Garnier | 16SrI-B – Aster yellows |
| 7. | Apricot chlorotic leafroll (AY-A) | Apricot, Valencia, Spain | Llacer | 16SrIF – Aster yellows apricot |
| 11. | American aster yellows (AYW) | Aster, NJ, USA | Withcomb | 16SrI-B - Aster yellows |
| 12. | Flower stunting (BVK) | <i>Psammotettix cephalotes</i> , Dossenheim, Germany | Heintz | 16SrXIC – Leafhopper born |
| 14. | Chrysanthemum yellows (CHRYM) | <i>C. frutescens</i> , Berlin, Germany | Marwitz | 16SrI-A – Tomato big bud |

| | Description | Origin | From | Classification |
|------|-----------------------------------|--|----------------------|--|
| 16. | Cuscuta odorata latent (COL) | Botanical Institute Kiel, Ukraine | Seemueller | 16SrI-A – Tomato big bud |
| 20. | Catharanthus virescence (CVA) | Unknown leafhopper, Dossenheim, Germany | Heintz | 16SrI-C – Clover phyllody |
| 21. | Vietnam Periwinkle 2000 (VP) | Periwinkle Vietnam | Garnier | To be identified |
| 23. | Catharanthus virescence (CVT) | Periwinkle, Thailand | Klinkong | 16SrI-B – Aster yellows |
| 25. | Western X disease (BF) | Unknown, CA, USA | Kirkpatrick | 16SrIII-A - X disease |
| 27a. | Elm yellows (EY-C) | <i>Ulmus americana</i> , NY, USA. | Chen | 16SrV-A – Elm yellows |
| 27b. | Elm yellows (EY1) | <i>U. americana</i> , NY, USA. | Sinclair & Griffiths | 16SrV-A – Elm yellows |
| 28. | Faba bean phyllody (FAP) | <i>Vicia faba</i> , Sudan | Defalla | 16SrII-C – Faba bean phyllody |
| 30. | Sweet potato little leaf (SPLL) | Sweet potato, Australia | Garnier | 16SrII-D – Sweet potato little leaf |
| 31. | Poinsettia branching factor (JR1) | Poinsettia, USA | Lee | 16SrIII-H – Poinsettia branch inducing |
| 33. | Potato witches' broom (PWB) | Potato, USA | Lee | 16SrVI?– Clover proliferation |
| 35. | Hydrangea phyllody 8 (HYDF) | Hydrangea, France | Cousin | 16SrI-B – Aster yellows |
| 36. | Hydrangea phyllody (HYDP) | Hydrangea, Gent Belgium | De Leew | 16SrI-A – Tomato big bud |
| 37. | Clover phyllody (KVE) | Clover, UK | Clark | 16SrI-C - Clover phyllody |
| 38. | Clover phyllody (KVF) | Clover, France | Cousin | 16SrI-C – Clover phyllody |
| 39. | Clover phyllody (KVG) | <i>Trifolium repens</i> , Berlin-Dahlem, Germany | Marwitz | 16SrI-C – Clover phyllody |
| 40a. | Clover phyllody (KVI) | Clover, Italy, Lombardy | Carraro | 16SrIII-B – Clover yellow edge |
| 40b. | Clover phyllody Italy (CP) | <i>Trifolium repens</i> BG, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 41. | Peach X disease (CX) | Peach, Canada | Lee | 16SrIII-A – Peach X disease |
| 42. | Lucerne virescence (LUM) | Lucerne, France | Morvan | 16SrVI – Clover proliferation |
| 44. | Pear decline (PD) | Pear 207/86t, Germany | Seemueller | 16SrX-C – Pear decline |
| 45. | Plum leptonecrosis (PLNV6) | <i>Prunus salicina</i> , Italy | Carraro | 16SrX-B – Clover yellow edge |
| 48. | Primula yellows (PRIVC) | Primula, Germany | Marwitz | 16SrI-B ?– Aster yellows |
| 49. | Plantago virescence (PVM) | <i>Plantago coronopus</i> , Berlin-Dahlem, Germany | Seemueller | 16SrI-A – Tomato big bud |
| 50. | Phyllody Argentina (PhA) | Unknown, Argentina | Garnier | 16SrX-B – European stone fruit yellows |
| 51. | Grapevine yellows Chile 275 | Grapevine, Chile | Fiore | To be identified |
| 53. | Sandal spike 9 (SAS) | Sandal tree, India | De Leeuw & Dijkstra | 16SrI-B – Aster yellows |

| | Description | Origin | From | Classification |
|------|-------------------------------------|---|---------|--|
| 54. | Severe western aster yellows (SAY) | Celery (Severin 1929) CA, USA | Freitag | 16SrI-B – Aster yellows |
| 55. | Solanum big bud (SBB) | <i>Solanum marginatum</i> , Ecuador | Marwitz | 16SrIII-F – Milkweed yellows |
| 56. | Sesame phyllody (SEPN) | Sesame, Thailand | Sarindu | 16SrII-A – Peanut witches' broom |
| 57a. | Soybean phyllody (SOYP) | Soybean Thailand | Sarindu | 16SrII-C – Faba bean phyllody |
| 57b. | Soybean phyllody (SOYP) | Soybean Thailand | Sarindu | 16SrII-C – Faba bean phyllody |
| 59. | Stolbur (STOL) | Pepper, Yugoslavia | Sutic | 16SrXII-A – Stolbur |
| 61. | Tomato big bud (TBB) | Tomato, Australia | Osmelak | 16SrII-D – Sweet potato little leaf |
| 62. | Elm witches' broom (ULW) | <i>U. carpiniifolia</i> , France | Morvan | 16SrV-A – Elm yellows |
| 63. | Vaccinium witches' broom (VAC) | <i>Vaccinium myrtillus</i> Germany | Marwitz | 16SrIII-F – Milkweed yellows |
| 64. | <i>Achillea</i> yellows (ACH) | <i>Achillea millefolium</i> , UD, Italy | Carraro | 16SrI-C – Clover phyllody |
| 65. | Euscelidius variegates (API) | <i>Euscelidius variegatus</i> : UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 66. | Aster yellows (ASLO) | Aster, Slovenia | Carraro | 16SrXII-A – Stolbur |
| 67. | Unknown insect (BA) | Insect, Povoletto, UD, Italy | Carraro | 16SrXII-A – Stolbur |
| 68. | Eggplant little leaf (EPLL) | Unknown, India | Garnier | 16SrV-? – Elm yellows |
| 69. | Carrot yellows (CA) | <i>Daucus carota</i> , UD, Italy | Carraro | 16SrI-C – Clover phyllody |
| 71. | <i>Crepis biennis</i> yellows (CR) | <i>Crepis biennis</i> , UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 72. | <i>Erigeron</i> yellows (ER) | <i>Erigeron annuus</i> , UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 73. | <i>Leontodon</i> yellows (LEO) | <i>Leontodon hispidus</i> UD, Italy | Carraro | 16SrI-C – Clover phyllody |
| 74a | Plum leptonecrosis (LNI) | Plum cv Orzark Premier, Gemona, UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 74b. | Plum leptonecrosis (LNII) | Plum cv Orzark Premier, Gemona, UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 75. | Plum leptonecrosis (LNIV) | Plum cv Orzark Premier, Gemona, UD, Italy | Carraro | 16SrXII-A – Stolbur |
| 76a | Plum leptonecrosis (LNp) | Plum cv Orzark Premier, Gemona, UD, Italy | Carraro | 16SrX-B – European stone fruit yellows |
| 76c | Plum leptonecrosis (LNS2) | Plum cv Orzark Premier, Gemona, UD, Italy | Carraro | 16SrX-B – European stone fruit yellows |
| 77. | Daisy yellows (MA) | Daisy Cavazzo, UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 78. | Periwinkle yellows (OS) | Naturally infected, PN, Italy | Carraro | 16SrI-B – Aster yellows |
| 79. | Tomato stolbur (P-TV) | Tomato, TV, Italy | Carraro | 16SrXII-A – Stolbur |

| | Description | Origin | From | Classification |
|------|-------------------------------------|--|------------|--|
| 80. | Ranunculus virecence (RA) | Ranunculus Cavazzo, UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 81. | Acetosella witches' broom (SA) | <i>Acetosella</i> sp., UD, Italy | Carraro | 16SrI-B – Aster yellows |
| 82. | Celery yellows (SE) | Celery, Lavariano, UD, Italy | Carraro | 16SrXII-A – Stolbur |
| 83. | Silene alba yellows (SI) | <i>Silene alba</i> , UD, Italy | Carraro | 16SrXII-A – Stolbur |
| 84. | Silene vulgaris yellows (SIL) | <i>Silene vulgaris</i> , UD, Italy | Carraro | 16SrI-B – Aster yellows |
| 85. | Taraxacum leaf reddening (TA) | <i>Taraxacum officinale</i> , UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 86a. | Clover phyllody (TRp) | <i>Trifolium pratense</i> , UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 86b. | Clover phyllody (TRr) | <i>Trifolium repens</i> , UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 88. | Veronica yellows (VE) | <i>Veronica arvensis</i> , UD, Italy | Carraro | 16SrI-B – Aster yellows |
| 92. | Grapevine yellows (CA-1) | <i>Vitis vinifera</i> cv Caveccia, BO, Italy | Credi | 16SrXII-A – Stolbur |
| 93. | Grapevine yellows (SA-1) | <i>V. vinifera</i> cv Sangiovese, BO, Italy | Credi | 16SrXII-A – Stolbur |
| 95. | CY-TO | <i>Chrysanthemum frutescens</i> , Liguria, Italy | Bianco | 16SrI-B – Aster yellows |
| 97. | Hydrangea phyllody (HY92) | Hydrangea, Italy | Bertaccini | 16SrI-B – Aster yellows |
| 99. | Grapevine yellows (CH-1) | Grapevine. Italy | Credi | 16SrXII-A – Stolbur |
| 101. | Aster yellows (AY-1) | Aster, USA | Garnier | 16SrI-B – Aster yellows |
| 102. | Clover proliferation (CP-1) | Clover, Canada | Hiruki | 16SrVI-A – Clover proliferation |
| 103. | Aster yellows 27 (AY27) | Unknown, NJ, USA | Hiruki | 16SrI-B - aster yellows |
| 104. | Naxos yellows (NaxY) | Periwinkle, Sicily, Italy | Bertaccini | 16SrIX-C – pigeon pea witches' broom |
| 107. | Aster yellows (AY) | Aster Germany | Seemueller | 16SrI-B - Aster yellows |
| 108. | Grapevine yellows (GYU) | <i>V. vinifera</i> Chardonnay, UD, Italy | Carraro | 16SrIII-B – Clover yellow edge |
| 111. | NA | <i>Unknown, Naples, Italy</i> | Marcone | 16SrI-B - Aster yellows |
| 112. | New Jersey aster yellows (NJ-AY) | <i>Aster, New Jersey, USA</i> | Chen | 16SrI-A – Tomato big bud |
| 113. | Primula blue (PrB) | <i>Bordeaux, France</i> | Davies | 16SrII-C – Faba bean phyllody |
| 117. | German stone fruit yellows (GSFY/1) | <i>Peach South Haven, Germany</i> | Seemueller | 16SrX-B – European stone fruit yellows |

| | Description | Origin | From | Classification |
|------|-------------------------------------|--|----------------------|---|
| 118. | German stone fruit yellows (GSFY/2) | <i>Apricot, Germany</i> | Seemueller | 16SrX-B – European stone fruit yellows |
| 120. | Milkweed yellows (MW1) | <i>Milkweed NY USA</i> | Sinclair & Griffiths | 16SrIII-F – Milkweed yellows |
| 121. | Pichris echioides phyllody (PEP) | <i>Pichris echioides phyllody, Italy</i> | Marcone | 16SrII-E - Italian alfalfa witches' broom |
| 123. | Peanut witches' broom(PnWB) | <i>Unknown, FL, USA</i> | Lee | 16SrII-A - Peanut witches' broom |
| 125. | Pichris echioides yellows (PEY) | <i>Pichris echioides, PZ,, Italy</i> | Marcone | 16SrIX-C – Pigeon pea witches' broom |
| 126. | Rubus stunt (RuS) | <i>Rubus sp. Italy</i> | Marcone | 16SrV-E – Rubus stunt |
| 134. | Cabbage chloranty (CCh) | Bordeaux, France | Giannotti | 16SrI-B – Aster yellows |
| 135. | Aster yellows Jarausch 24126 (AY-J) | Bordeaux, France | Jarausch | 16SrI-B – Aster yellows |
| 137. | Cactus proliferation (CaP) | BCM, Bordeaux, France unknown | Garnier | To be identified |
| 139. | Witches' broom disease lime (WBDL) | BCM, Bordeaux, France Oman | Bové & Garnier | 16SrII-B – Lime witches' broom |