Section 2

Strains for *P. vulgaris* and other grain legumes

Centro Internacional de Agricultura Tropical
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ABOUT THE COLLECTION

The Centro Internacional de Agricultura Tropical (CIAT) in Cali, Colombia was the fourth international research centre established, its mandate including three major commodity thrusts: pasture improvement for the acid infertile soils of tropical America; improved yield and quality in Phaseolus beans, and cassava improvement. The Rhizobium collection at CIAT reflects these interests, principally containing and emphasising rhizobia from forage legumes adapted to acidic soils and strains for Phaseolus vulgaris and related species. Many other strains including those recommended for agriculturally important legumes in Australia and the USA are, however, held in the collection and are available to interested scientists.

All strains are maintained in the freeze dried (lyophilised) form, and will normally be supplied in glass vials. Details for the regeneration of cultures are included in the appendix. Cultures can also be supplied as peat base inoculant for specific experimental purposes.

To ensure better service and greater familiarity with cultures, responsibility for the collection has been divided between the staff microbiologists in the forage legume and bean programs. For information relating to the grain legume section of the collection, enquiries should be addressed to:

P.H. GRAHAM
Soil Microbiologist
Bean Program
CIAT, Apartado Aereo 67-13
Cali, Colombia
ABOUT THE CATALOGUE

This catalogue emphasises rhizobia isolated from Phaseolus sp, but principally P. vulgaris. In addition it lists Rhizobium strains from other grain legumes. The collection of rhizobia for pasture legumes has been published separately.

In characterising the symbiotic performance of strains "infective" is used to describe isolates nodulating their appropriate host when tested by the pouch method (Weaver, R.W. & Frederick, L.R., Plant Soil (1972) 36, 219-222). Many, but not all isolates, have also been tested for nitrogen fixation in Leonard Jar assemblies (Vincent, J.M. (1970) IBP Handbook No 15, Blackwell London). Those strains described as "effective" showed excellent nodule development, high N₂ (C₂H₂) fixation and active plant growth relative to -N controls in these tests. As the glasshouse used in this study was not airconditioned, some strains listed here as "ineffective" could have been affected by the high ambient temperatures.
Strains of Rhizobium for grain legumes

Species: *R. japonicum*

CIAT 1  
Glycine max. Obtained from the Marondellas Research Station, 
Infective.

CIAT 2  
Glycine max. Obtained from the Marondellas Research Station, 
Infective.

CIAT 3  
Glycine max. Obtained from the Marendallas Research Station, 
Infective.

CIAT 4  
Glycine max. Obtained from the Marendallas Research Station, 
Rhodesia as isolate 492 in 1971, originally Beltsville isolate 3 lib 38. 
Last tested for infectivity, 1972. 
Recommended strain for soybean inoculation in Colombia, 1972-1979. 
See also:

Graham, P.H. (1973) in "Genes, Enzymes and Populations A.M. Sr


CIAT 5  
Glycine max. Obtained from the Marendallas Research Station, 
Rhodesia as isolate 493 in 1971, originally Beltsville isolate 3 lib 42.
R. japonicum cont.


See also:

Varela, R. (1978) Revista ICA 13, 249-255

CIAT 58 Glycine max. Obtained from J. Dobereiner, Brazil, as isolate SB 16 in 1973. Has not been plant tested at CIAT.

CIAT 90 Glycine max. Obtained from University of Sydney as SU 697 in 1971, originally CB 1809. Last tested for infectivity in 1972. Highly effective. Recommended Australian inoculant strain for soya

See also:


CIAT 201 Glycine max. Isolated as Z252, Balboa, Buga, Colombia in 1972. Presumptive Rhizobium only.


CIAT 204 Glycine max. Isolated as Z256 Buga, Colombia in 1972. Presumptive Rhizobium only.

CIAT 205 Glycine max. Isolated as Z257 Buga, Colombia in 1972.
R. japonicum cont.

Presumptive Rhizobium only.

CIAT 206 Glycine max. Isolated as Z258 Buga, Colombia in 1972

Presumptive Rhizobium only.

CIAT 207 Glycine max. Isolated as Z259 Buga, Colombia in 1972.

Presumptive Rhizobium only.


Presumptive Rhizobium only.

CIAT 209 Glycine max. Isolated as Z261 Buga, Colombia in 1972.

Presumptive Rhizobium only.

CIAT 210 Glycine max. Isolated as Z1 Pradera, Colombia in 1972.

Presumptive Rhizobium only.

CIAT 211 Glycine max. Isolated as Z2 Pradera, Colombia in 1972.

Presumptive Rhizobium only.

CIAT 212 Glycine max. Isolated as Z3 Pradera, Colombia in 1972.

Presumptive Rhizobium only.


Presumptive Rhizobium only.

CIAT 214 Glycine max. Isolated as Z6 Pradera, Colombia in 1972.

Presumptive Rhizobium only.

CIAT 215 Glycine max. Isolated as Z8 Pradera, Colombia in 1972.

Presumptive Rhizobium only.

CIAT 216 Glycine max. Isolated as Z10, Pradera, Colombia in 1972.

Presumptive Rhizobium only.

CIAT 217 Glycine max. Isolated as Z12, Pradera, Colombia in 1972.

Presumptive Rhizobium only.

CIAT 218 Glycine max. Isolated as Z13, Pradera, Colombia in 1972.
R. japonicum cont.

Presumptive Rhizobium only.

CIAT 219  *Glycine max.*  Isolated as Z14, Pradera, Colombia in 1972.

Presumptive Rhizobium only.


CIAT 403  *Glycine max.*  Isolated from nodules on plants inoculated with Nitragin soybean inoculant. Presumptive Rhizobium only.

CIAT 656  *Glycine max.*  Isolated as Z637, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.

CIAT 658  *Glycine max.*  Isolated as Z638, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.
Strains of *Rhizobium* for grain legumes.

Species: *R. leguminosarum*

<table>
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<tr>
<th>Strain Code</th>
<th>Strain Description</th>
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<tbody>
<tr>
<td>CIAT 333</td>
<td><em>Pisum sativum</em>. Isolated as Z131, Tenerife, Colombia in 1972. Presumptive <em>Rhizobium</em> only.</td>
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<tr>
<td>CIAT 345</td>
<td><em>Pisum sativum</em>. Isolated as Z156 near Buga, Colombia in 1972. Presumptive <em>Rhizobium</em> only.</td>
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<td>CIAT 448</td>
<td><em>Lathyrus odoratus</em>. Isolated as Z448, Chia, Colombia in 1974. Presumptive <em>Rhizobium</em> only.</td>
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<tr>
<td>CIAT 459</td>
<td><em>Vicia sp.</em> (silvestral). Isolated as Z657 Obonuco, Colombia in 1975. Presumptive <em>Rhizobium</em> only.</td>
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</tbody>
</table>
Strains of Rhizobium for grain legumes

Species: *R. phaseoli*


CIAT 40 *P. vulgaris*. Obtained from J.C. Burton, Milwaukee as strain 127 K 26 in 1971. Last tested for infectivity in 1978. Ineffective at the temperature prevailing.

CIAT 45 *P. vulgaris*. Obtained from J. Dobereiner, Brazil as strain F310 in 1971. Last tested for infectivity in 1972.

R. phaseoli cont.


CIAT 83 P. multiflorus. (Syn. P. coccineus). Obtained from B. Strijdom, South Africa as strain UD2. Not plant tested at CIAT.


R. phaseoli cont.


CIAT 118  _P. vulgaris._ Isolated as Z31, Pradera, Colombia in 1972. Presumptive _Rhizobium_ only.


Highly effective.


R. phaseoli cont.


R. phaseoli cont.

CIAT 139 P. aborigenues. Isolated from germplasm accessions at CIAT in 1977. Presumptive Rhizobium only.


R. phaseoli cont.

CIAT 155 P. vulgaris. Isolated as Z140, San José, Antioquia, Colombia in 1972. Presumptive Rhizobium only.

CIAT 156 P. vulgaris. Isolated as Z141, San José, Antioquia, Colombia in 1972. Presumptive Rhizobium only.


See also:


R. phaseoli cont.


CIAT 251  P. vulgaris. Isolated as Z726, Palmira, Colombia in 1976. Presumptive Rhizobium only.


CIAT 300  P. vulgaris. Obtained from A. Franco, Brazil as strain 3610 in 1975. Not plant tested at CIAT.
R. phaseoli cont.


CIAT 312 P. vulgaris. Isolated as Z720, Popayan, Colombia in 1975. Presumptive Rhizobium only.


CIAT 323 P. vulgaris. Obtained from E.B. Roslycky, Canada as strain 95/RIO. Not plant tested at CIAT.


R. phaseoli cont.


Last tested for infectivity in 1979. Moderately effective.

CIAT 364  *P. vulgaris*. Obtained from the Marandellas Research Institute, Rhodesia as strain 1279 in 1976. Not plant tested at CIAT.

CIAT 381  *P. vulgaris*. Obtained as mutant isolate from strain CIAT 57, on exposure to 500 ppm streptomycin. Last tested for infectivity in 1979.


CIAT 404  *P. vulgaris*. Isolated from CIAT fields, Cali, Colombia in 1974.


Last tested for infectivity in 1979. Highly effective. Included in the 1980 IBIT.

CIAT 460  *P. vulgaris*. Obtained from G. Bayment, Belgium as strain 9.59 B.

R. phaseoli cont.

CIAT 515 *P. vulgaris*. Obtained from G. Bayment, Belgium as strain 9.2.1. Last tested for infectivity in 1978. Effective.

CIAT 579 *P. vulgaris*. Isolated as Z717, Popayan, Colombia in 1975. Presumptive Rhizobium only.

CIAT 580 *P. vulgaris*. Isolated as Z715, Popayan, Colombia in 1975. Presumptive Rhizobium only.


CIAT 609 *P. vulgaris*. Isolated as Z617, Chinchiná, Colombia in 1974. Presumptive Rhizobium only.

CIAT 610 *P. vulgaris*. Isolated as Z618, Chinchiná, Colombia in 1974. Presumptive Rhizobium only.

CIAT 611 *P. vulgaris*. Isolated as Z619, Chinchiná, Colombia in 1974. Presumptive Rhizobium only.


R. phaseoli cont.


CIAT 624  *P. vulgaris*. Obtained from R. Aguilera, Guatemala, as strain 43 in 1974. Not plant tested at CIAT.

CIAT 625  *P. vulgaris*. Obtained from R. Aguilera, Guatemala, as strain 22 in 1974. Repeatedly tested for symbiotic response 1974-79. Highly effective in most trials, though suspect at higher temperatures. Included in some sets of the 1979 IBIT.


CIAT 628  *P. vulgaris*. Obtained from R. Aguilera, Guatemala, as strain 27 in 1974. Not plant tested at CIAT.
R. phaseoli cont.

CIAT 629  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 26 in 1974. Not plant tested at CIAT.

CIAT 630  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 28 in 1974. Not plant tested at CIAT.

CIAT 631  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 24 in 1974. Not plant tested at CIAT.

CIAT 632  


CIAT 633  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 41 in 1974. Not plant tested at CIAT.

CIAT 634  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 42 in 1974. Not plant tested at CIAT.

CIAT 635  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 33 in 1974. Not plant tested at CIAT.

CIAT 636  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 44 in 1974. Not plant tested at CIAT.

CIAT 637  

P. vulgaris. Obtained from R. Aguilera, Guatemala, as strain 40 in 1974. Not plant tested at CIAT.

CIAT 638  

P. vulgaris. Isolated as Z643, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.
R. phaseoli cont.

CIAT 639  *P. vulgaris*. Isolated as Z644, La Buitrera, Colombia in 1974.

Presumptive Rhizobium only.

CIAT 640  *P. vulgaris*. Isolated as Z632, La Buitrera, Colombia in 1974.

Repeatedly tested for symbiotic response 1974-79. Highly effective. Included in the 1979 IBIT.


CIAT 644  *P. vulgaris*. Isolated as Z641, La Buitrera, Colombia in 1974.

Presumptive Rhizobium only.

CIAT 645  *P. vulgaris*. Isolated as Z635, La Buitrera, Colombia in 1974.

Presumptive Rhizobium only.

CIAT 646  *P. vulgaris*. Isolated as Z630, Palmira, Colombia in 1974.

Presumptive Rhizobium only.

CIAT 647  *P. vulgaris*. Isolated as Z648, La Buitrera, Colombia in 1974.

Presumptive Rhizobium only.

CIAT 648  *P. vulgaris*. Isolated as Z642, La Buitrera, Colombia in 1974.

Presumptive Rhizobium only.

CIAT 649  *P. vulgaris*. Isolated as Z647, La Buitrera, Colombia in 1974.

Presumptive Rhizobium only.

CIAT 650  *P. vulgaris*. Isolated as Z639, La Buitrera, Colombia in 1974.

Presumptive Rhizobium only.
R. phaseoli cont.

CIAT 651 P. vulgaris. Isolated as Z634, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.

CIAT 652 P. vulgaris. Isolated as Z629, Palmira, Colombia in 1974. Presumptive Rhizobium only.

CIAT 653 P. vulgaris. Isolated as Z649, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.

CIAT 654 P. vulgaris. Isolated as Z650, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.

CIAT 655 P. vulgaris. Isolated as Z636, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.

CIAT 657 P. vulgaris. Isolated as Z633, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.

CIAT 659 P. vulgaris. Isolated as Z640, La Buitrera, Colombia in 1974. Presumptive Rhizobium only.


R. phaseoli cont.

CIAT 666 **P. vulgaris.** Obtained from P. E. Davis, England as strain 3605 = CC 511. See also CIAT 57. Last tested for infectivity in 1976. Effective.


CIAT 688 **P. vulgaris.** Isolated as strain Z651, Popayán, Colombia in 1974. Presumptive *Rhizobium* only.

CIAT 872 **P. vulgaris.** Isolated from nodules, San Vicente, Colombia in 1978. Presumptive *Rhizobium* only.
R. Phaseoli cont.

CIAT 873  *P. vulgaris*. Isolated from nodules, San Vicente, Colombia in 1978.

Presumptive Rhizobium only.


Presumptive Rhizobium only.


Presumptive Rhizobium only.

CIAT 876  *P. vulgaris*. Isolated from nodules, El Guarne, Colombia in 1978.

Presumptive Rhizobium only.

CIAT 877  *P. vulgaris*. Isolated from nodules, Marinilla, Colombia in 1978.

Presumptive Rhizobium only.

CIAT 878  *P. vulgaris*. Isolated from nodules, Marinilla, Colombia in 1978.

Presumptive Rhizobium only.

CIAT 893  *P. vulgaris*. Isolated as M-20, Carmen de Viboral, Colombia in 1978.


CIAT 894  *P. vulgaris*. Isolated as M-83, Carmen de Viboral, Colombia in 1978.

Last tested for infectivity in 1978. Effective.

CIAT 895  *P. vulgaris*. Isolated as M-46, Carmen de Viboral, Colombia in 1978.

Last tested for infectivity in 1978. Effective.

CIAT 896  *P. vulgaris*. Isolated as M-113, Carmen de Viboral, Colombia in 1978.

Last tested for infectivity in 1978. Effective.
R. phaseoli cont.

CIAT 897  *P. vulgaris*. Isolated as M-24, Carmen de Viboral, Colombia in 1978.
Last tested for infectivity in 1978. Effective.

CIAT 898  *P. vulgaris*. Isolated as M-73, Carmen de Viboral, Colombia in 1978.
Last tested for infectivity in 1978. Effective.

CIAT 899  *P. vulgaris*. Isolated as M-188, Carmen de Viboral, Colombia in 1978.
Last tested for infectivity in 1978. Effective.

CIAT 900  *P. coccineus*. Isolated as CB1, Popayan, Colombia in 1979.
Last tested for infectivity in 1979.

CIAT 901  *P. coccineus*. Isolated as CB4, Popayan, Colombia in 1979.
Last tested for infectivity in 1979.

CIAT 902  *P. coccineus*. Isolated as CRI, Popayan, Colombia in 1979.
Last tested for infectivity in 1979.

CIAT 903  *P. vulgaris*. Obtained from J. Halliday, USA as Tal 182 in 1979.
Last tested for infectivity in 1979. Effective. Included in 1979 IBIT.

CIAT 904  *P. vulgaris*. Obtained from S.M.T. Saito, Brazil as C88 in 1979.
Effective. Included in 1979 and 1980 IBITs.

CIAT 905  *P. vulgaris*. Obtained from S.M.T. Saito, Brazil as C29 in 1979.
Last tested for infectivity in 1979. Effective. Included in 1979. IBIT.

CIAT 906  *P. vulgaris*. Obtained from S.M.T. Saito, Brazil as C34 in 1979.
Strains of **Rhizobium** for grain legumes.

Species: **Rhizobium sp.** (strains in this group are divided according to host plant.)

<table>
<thead>
<tr>
<th>Strain</th>
<th>Host Plant</th>
<th>Source and Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIAT 6</td>
<td><em>Arachis hypogea</em></td>
<td>Isolated in 1976 near Bogotá, Colombia. Presumptive <strong>Rhizobium</strong> only.</td>
</tr>
<tr>
<td>CIAT 47</td>
<td><em>Arachis hypogea</em></td>
<td>Obtained from Sydney University as SU 649 = CB 746 in 1972. Not plant tested at CIAT.</td>
</tr>
<tr>
<td>CIAT 396</td>
<td><em>Cajanus cajan</em></td>
<td>Obtained from the Instituto Nacional de Ciencias Agrícolas in Colombia in 1973. Originally from Japan. Not plant tested at CIAT.</td>
</tr>
<tr>
<td>CIAT 397</td>
<td><em>Cajanus cajan</em></td>
<td>Obtained from University of West Indies as strain UW 10001 in 1973. Not plant tested at CIAT.</td>
</tr>
<tr>
<td>CIAT 398</td>
<td><em>Cajanus cajan</em></td>
<td>Obtained from the University of West Indies as UWI 0004 in 1973. Not plant tested at CIAT.</td>
</tr>
<tr>
<td>CIAT 399</td>
<td><em>Cajanus cajan</em></td>
<td>Obtained from the University of West Indies as UWI 0005 in 1973. Not plant tested at CIAT.</td>
</tr>
</tbody>
</table>
Cajanus cajan cont.

CIAT 400 Obtained from P. Dart as Voand Bam 1 and originally isolated in Nigeria. Not plant tested at CIAT.

Phaseolus sp.

CIAT 79 See Arachis hypogea.

CIAT 257 Phaseolus acutifolius. Obtained from E.B. Roslycky as strain 94/RIO in 1976. Not plant tested at CIAT.

CIAT 518 Phaseolus lunatus. Obtained from E.B. Roslycky as strain 96/RIO in 1976. Not plant tested at CIAT.

CIAT 718 Phaseolus lunatus. Isolated from nodules, Tunía, Colombia in 1977. Presumptive Rhizobium only.

CIAT 719 Phaseolus lunatus. Isolated from nodules Restrepo, Colombia in 1977. Presumptive Rhizobium only.

CIAT 720 Phaseolus lunatus. Isolated from nodules, CIAT Colombia in 1977. Presumptive Rhizobium only.

CIAT 721 Phaseolus lunatus. Isolated from nodules, Pradera, Colombia in 1977. Presumptive Rhizobium only.


CIAT 723 Phaseolus lunatus. Isolated from nodules, Dagua, Colombia in 1977. Presumptive Rhizobium only.
Phaseolus sp. cont.

CIAT 725 Phaseolus lunatus. Isolated from nodules, Carimagua, Colombia in 1977. Presumptive Rhizobium only.

CIAT 879 Phaseolus lunatus. Obtained from J.C. Burton as strain 127E 12 in 1978. Not plant tested at CIAT.


Vigna unguiculata

CIAT 79 See Arachis hypogea

CIAT 239 Isolated as Z243, Galapa, Colombia in 1972. Presumptive Rhizobium only.

CIAT 292 Isolated as Z337, Carimagua, Colombia in 1973. Presumptive Rhizobium only.
Characterisation of selected strains of *Rhizobium phaseoli*

Table 1: Lists some biochemical, serological and nutritional data for 52 strains of *R. phaseoli*. The methods used were derived from the following publications:

<table>
<thead>
<tr>
<th>Tests</th>
<th>1, 3, 10, 11:</th>
<th>Graham, P.H. Plant Soil (1964) 20, 383-396.</th>
</tr>
</thead>
</table>

* Work undertaken by Arturo Palacios (Fertimex, Mexico) during a postgraduate internship at CIAT.
Table 1: Characteristics of selected strains of *Rhizobium phaseoli* from the CIAT collection

<table>
<thead>
<tr>
<th>Characteristic studied</th>
<th>15</th>
<th>40</th>
<th>45</th>
<th>57</th>
<th>66</th>
<th>75</th>
<th>96</th>
<th>123</th>
<th>125</th>
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<th>161</th>
<th>167</th>
<th>168</th>
<th>226</th>
<th>276</th>
<th>290</th>
<th>293</th>
<th>294</th>
<th>299</th>
<th>515</th>
<th>512</th>
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<tbody>
<tr>
<td>1. Gram-reaction</td>
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<td>2. Hectolactose production</td>
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<td>3. Isolated colonies on BYMA in 2-3 days</td>
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<td>4. Reduction of Tetrazolium HCl</td>
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<td>5. Growth in keyser medium pH 4.5</td>
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<td>6. Growth in keyser medium, pH 5.0</td>
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<td>7. Growth in pH 8.0 medium with 50 μM Mn</td>
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<td>15. Tolerance of Terramycin (5 µg/disc)</td>
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<td>16. Tolerance of Ampicillin (10 µg/disc)</td>
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<td>17. Tolerance of Cleandomycin (15 µg/disc)</td>
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<td>18. Tolerance of chloromycetin (30 µg/disc)</td>
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<td>20. Growth on glucose medium</td>
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<td>21. Growth on sucrose medium</td>
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<td>22. Growth on lactose medium</td>
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<td>24. Growth on rhamnose medium</td>
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<td>25. Growth on glycerol medium</td>
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<td>26. Nodulation with P. vulgaris, P 566</td>
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<td>27. Efficient in N2 fixation</td>
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<td>28. Serological reaction with 57 antisera</td>
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<td>29. Serological reaction with 255 antisera</td>
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<td>30. Serological reaction with 532 antisera</td>
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Appendix 1

Reconstitution of strains from Ampoules

Requirements:

Sterile pasteur pipette, 3 cornered file, sterile yeast-mannitol broth or physiological saline, Plates of yeast mannitol medium.

Procedure:

1. Mark the base of two petri plates containing YM medium with an X close to their outer walls.

2. Score the ampoule deeply with a file so that it will break readily under pressure. Filing mark should traverse the ampoule and be located in the middle of the cotton wool plug. Crack ampoule.

3. Half-fill sterile pasteur pipette with broth or saline, then add several drops to the paper at bottom of ampoule. Suck up and expel liquid several times.

4. Place 1 drop on X position in each of the two petri plates and leave them 2-3 hours to absorb liquid.

5. Subculture normally on the remaining area of the plate.