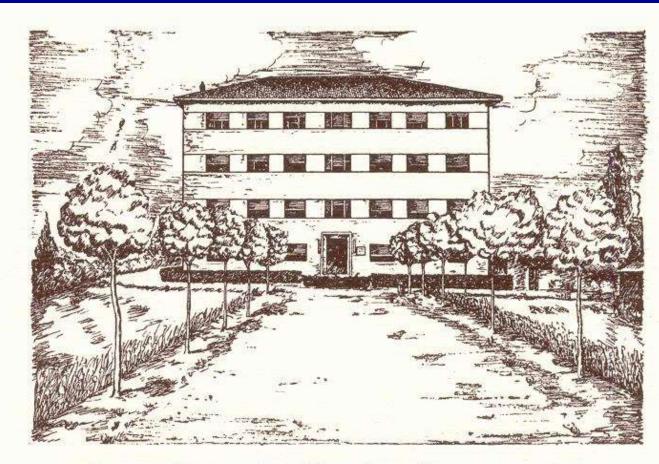
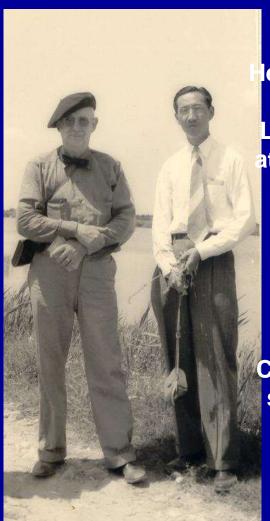
Stazione Sperimentale di Bieticoltura



Staxione Sperimentale di Bieticoltura - Rovigo - A.D. - MCMLIII

Resistance to CLS and to rhizomania (Alba, Rizor) was derived from Porto Levante sea beets





lerbert G. Coons (USDA) and Lee Ling (FAO) at Porto Levante July 20, 1951

Coons visited the same locality in 1925, 1935 and 1960

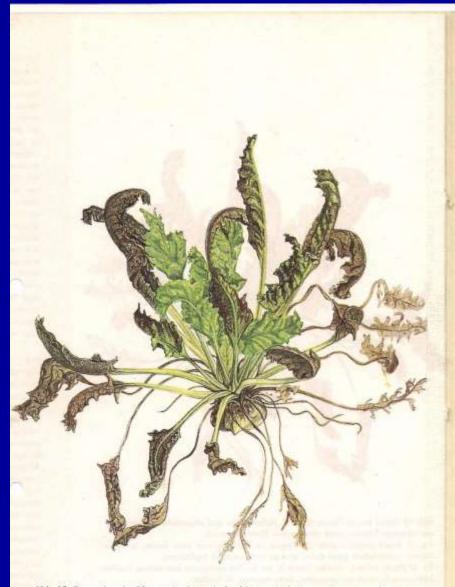


Abb. 12 Ganze kranke Pflanze (Stufe 5), Außenblätter sind abgestorben, Innenblätter mit schweren Schäden, stark einsetzender Blattneuaustrieb.

Fig. 12 Intera pianta malata (5° Stadio). Le faglie esterne sono morte; le faglie interne hanno subito gravi danni. Vi è un forte inizio di fagliazione.

Gr. 12 Plante entière, malade, (Stade 5). Les feuilles extérieures sont mortes, feuilles intérieures fortment endommagées, forte repousse de feuilles.

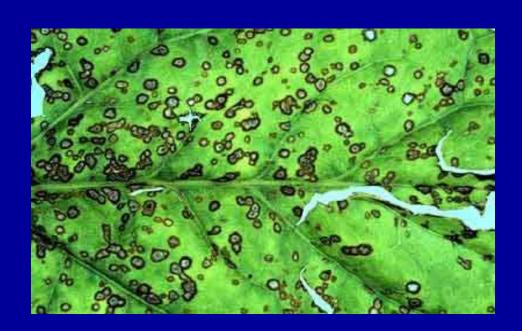
Picture 12 Whole plant diseased (step 5). Outher leaves are dead, inner leaves severely damaged, fresh foliage begins to grow.

Cercospora leaf spot

Resistance to cercospora leaf spot (CLS)

1909

First hybridation between sea beet and sugar beet



1925

First materials resistant to cercospora leaf spot



1935

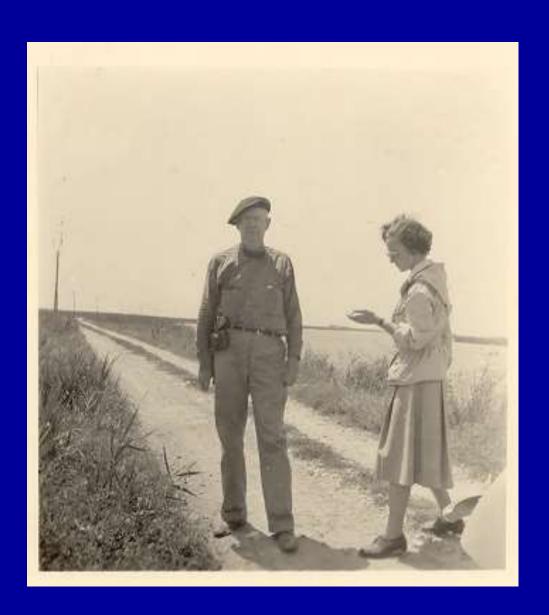
First varieties resistant to CLS (R 581 line)





This material derived from crossings with the sea beet that Munerati selected at Rovigo (1925)

1937 - release of cercospora leaf spot resistant varieties (SB) in Italy and USA



G.H. Coons in the Po Delta

Brougth the CLS resistance in USA

Rhizomania - spread to the main sugar beet cultivated areas

- dramatically lowers sugar yield
- damage can be reduced only with the use of resistant varieties
- diseased areas are expanding



Rhizomania

Chronology of rhizomania

- 1946 Abnormal expansion of "soil sickness" in Italy
- **1953** First written reference
- **1954** Beginning of systematic observations
- **1957** The unknown syndrome was called "rizomania"
 - Resistance in Italian varieties (Alba P)
- 1963 Demonstration of the biotic origin of the disease
- 1966 Discovery of the fungal-viral symbiosis
 - Breeding activity on diseased fields
- 1984 Release of Rizor (De Biaggi)
- 1986 Release of Holly CMS lines (Erichsen)
- 1993 New sources of resistance (Lewellen)

First reference on the unknown disorder

(from: Bollettino d'Informazioni dell'ANB, XIX, Oct. 10, 1953)

RADICI ECCEZIONALMENTE POVERE DI ZUCCHERO

Un'indagine sulle colture a Cavarzere, Ceggia e Pontelongo

I lavori della commissione e i risultati delle ricercha. Le cause sono da picercarst nelle anormali vicende meteoriche dell'annata e nella attività della cercospora.

dell'Sollo Seppendonale, da un ladadi finelli di prescioni appare

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Dopo Thomas dilli metic mahanespesibles de judano l'Assersore in quali appullante del voto mate ne Steticulturi a dure incuriro nel state fornito dal de Dal Negro, la corneledous rhenna espectuaro procolore all'ossessione di sepratambi fit rempiates discharges present quality solvado che accusosare i più hand indict productive.

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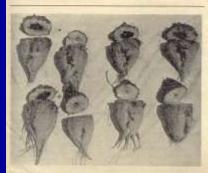
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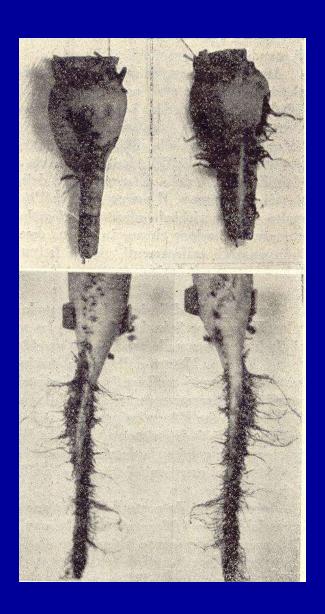




First illustrations of rhizomania symptoms

(from: Donà dalle Rose, 1957, 1958)





Diffusion of the unknown disease in soil

(from: Bongiovanni, 1964)

Inoculation of the plot Bologna Oct. 11, 1962



Diseased beets on the plot Bologna July 8, 1963



1957 variety trials in Italy on fields severely diseased the previous year

(from: Bongiovanni and Lanzoni, 1964)

Locality	Variety	Root yield (t / ha)	Sugar content (%)	Sugar yield (t / ha)
Cona (Venice)	Alba P	20.8	9.24	1.9
	Buszczynski CLR	16.8	9.98	1.7
Cavarzere (Venice)	Alba P	16.6	6.60	1.1
	Saros H 9 N (susc.)	7.4	5.06	0.4
Vighizzolo (Padua)	Alba P	17.0	8.12	1.4
	Mezzano NP	14.8	10.30	1.5

1983 yield evaluations in diseased fields

Locality	Rhizomania	Variety	Root yield (t / ha)	Sugar content (%)	Sugar yield (t / ha)	
Erstein, France	severe	Rizor	45.1 a	17.80 a	8.0 a	
		Monodoro	20.2 b	16.90 a	3.4 b	
		Mono 1167	19.5 b	16.83 ab	3.3 b	
		Mono 4086	22.7 b	17.42 a	4.0 b	
		Ritmo	21.4 b	17.35 a	3.7 b	
		Dora	14.7 d	15.52 bc	2.3 cd	
		Monosvoløf (susc.)	6.0 e	12.35 d	0.7 e	
S. Martino, Italy	severe	Rizor	49.7 a	15.93 a	7.9 a	
		Ritmo	37.7 b	14.94 a	5.6 b	
		Monodoro	41.1 b	13.46 b	5.5 b	
		Monofort (susc.)	22.9 c	13.43 b	3.1 c	
		Monova (susc.)	14.2 d	10.10 c	1.4 d	

1985 yield evaluations in diseased fields at Salinas, CA

Rhizomania	Variety	Root yield (t / ha)	Sugar content (%)	Sugar yield (t / ha)
Moderate /	84C39 - 031	60.8	12.90	7.8
severe	Rizor	40.1	13.80	5.5
	Ritmo	31.5	12.80	4.5
	Monodoro	37.5	11.90	4.5
	Monohikari	25.5		3.2
	HH37 (susc.)	24.1	9.90	2.4 1.8
	USH 11 (susc.)	20.1		
	LSD (P<0.05)	8.3	1.10	1.1

Performance of hybrids grown under moderate diseased pressure at Salinas, CA, in 2002 (Mean of two tests)

Variety	Rhizomania resistance	Root yield (t / ha)	Sugar content (%)	Sugar yield (t / ha)
Angelina	<i>Rz</i> , WB42	78.4	19.00	14.9
C 927 - 4H5	<i>Rz</i> , R22 *	80.2	18.10	14.5
Phoenix	Rz	81.1	17.60	14.4
Beta 4776 R	Rz	78.0	18.30	14.3
Rizor	Rz	70.8	18.70	13.3
USH 11 (susc.)	rz rz	53.3	15.60	8.4
LSD (P<0.05)		7.8	0.60	1.5

^{*} R22 resistance from *B. vulgaris* subsp. *maritima* through population C50. (Lewellen, 1995)

1986 field trial at Salinas, CA



Susceptible check

1989 field trial at Salinas, CA

R22



Susceptible check

1995 field trials at Imperial Valley, CA

C67 and C72 (R22)



US H11 Rhizosen Rizor

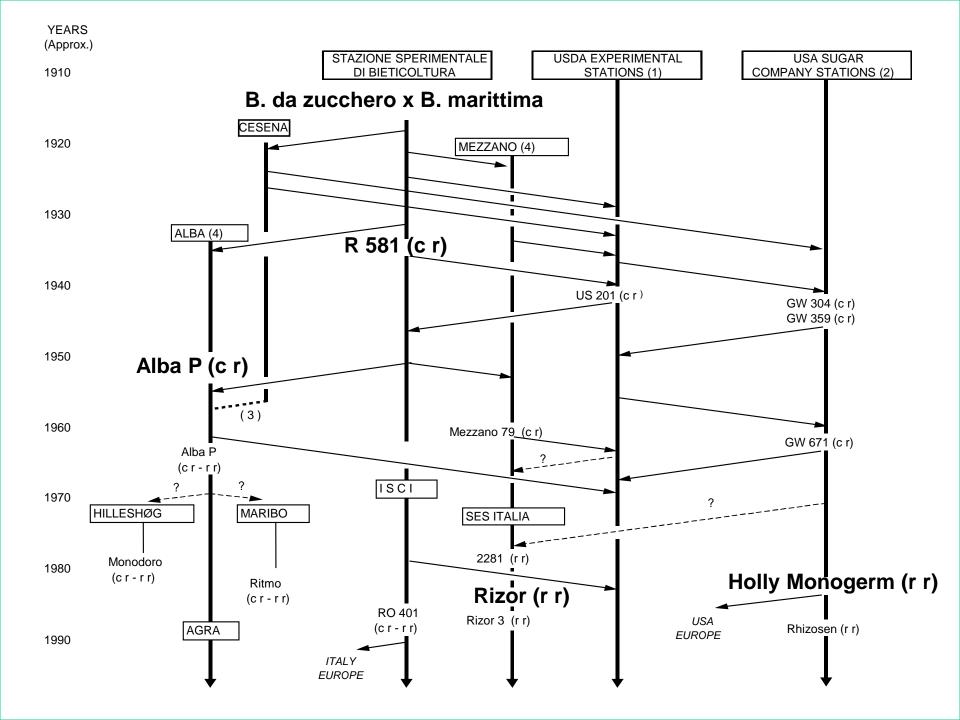
Origin of resistances to rhizomania

Alba → Munerati's CLS resistant germplasm →
Sea beet

Rizor → Derived from CLS resistant germplasm →
Sea beet

Holly — Unknown origin. Probably derived from sea beet

WB42 etc. — Sea beet



Conclusions

Resistance to CLS and to rhizomania (Alba, Rizor) was derived from Porto Levante sea beets

The origin of rhizomania resistances appear to have a close relationship with sea beet

- This hypothesis is confirmed by molecular analysis