G-1000, Marx's pea breeding line for multiviral resistance

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One of the major research objectives of the late Dr. Gerald A. Marx was the development of disease resistant pea germplasm. At the time of his death (13 Nov 1988), he left a large number of breeding lines, in some of which he had incorporated resistance to a number of viruses. He had accomplished this task, essentially, by using marker genes.

When it became apparent that genes for resistance to potyviruses affecting *Pisum sativum* might be clustered on two chromosomes (6, 7), we obtained from Dr. Marx five of his breeding lines possessing a number of markers, including *k* (wings keel-like) and *wlo* (waxless). In his memorandum, Dr. Marx noted that: a) his lines were initially developed in cooperation with R.O. Hampton (3) by crossing plants with *wlo* with those of PI 347485 carrying the *sbm-1* gene for resistance to the standard strain of pea seedborne mosaic virus (PSbMV-ST); b) F_2 resistant plants carrying *wlo* as a marker for *sbm* were then crossed with several lines possessing *k* linked to *mo* for resistance to bean yellow mosaic vims (BYMV); and c) plants with markers *k* and *wlo* were selected for 5 to 8 generations to determine whether they would retain resistance to BYMV and PSbMV-ST without viral testing. The two markers *k* and *wlo* are located on chromosomes 2 and 6, respectively (4); *mo* is linked to *k* (5) and *sbm* with *wlo* (1).

Twelve to 16 plants of each of Marx's lines were tested with each of the following viruses: BYMV, clover yellow vein virus (CYVV), pea mosaic virus (PMV), watermelon mosaic virus 2 (WMV-2), the NL-8 strain of bean common mosaic virus (BCMV-NL8), white lupin mosaic virus (WLMV) and the three pathotypes of PSbMV (PSbMV-ST, PSbMV-L, and PSbMV-P4). To minimize escapes, all plants were mechanically inoculated twice and then maintained in an insect free greenhouse at 28-30°C.

The results of our tests (Table 1) provided further evidence that most of the genes for resistance to potyviruses are closely linked and clustered on two chromosomes. The first cluster is located on chromosome 2 and includes: *mo* (BYMV and WMV-2), *cyv-1* (CYVV), *pmv* (PMV), *bcm* (BCMV-NL8), and *sbm-2* (PSbMV-L) (5, 6, 7, 8, 9, 13, 14). The second cluster is on chromosome 6 and comprises: *sbm-1* (PSbMV-ST), *sbm-3* (PSbMV-L), *sbm-4* (PSbMV-P4), *cyv-2* (CYVV), and *wlv* (WLMV) (1, 2, 6, 9, 10, 11, 12). Hence, Dr. Marx was able to show the value of markers in the development of multiresistant lines.

Table 1. Reaction of five Marx's pea breeding lines and three controls to bean yellow mosaic virus (BYMV), clover yellow vein virus (CYVV), pea mosaic virus (PMV), the NL8 strain of bean common mosaic virus (BCMV-NL8), pea seedborne mosaic virus (strain: PSbMV-ST, PSbMV-L, and PSbMV-P4), watermelon mosaic virus 2 (WMV-2), and white lupin mosaic virus (WLMV).

	Chromosome No. 2					Chromosome No. 6				
Virus	BYMV + WMV-2	CYW	PMV	PSbMV -L	BCMV -NL8	PSbMV -ST	PSbMV -L	PSbMV -P4	CYVV	WLMV
Gene	*mo*	*cyv-1*	*pmv*	*sbm-2*	*bcm*	*sbm-1*	*sbm-3*	*sbm-4*	*cyv-2*	*wlv*
B586-14-1(F_5)	+	+	+	+	+	+	+	+	+	nt
B586-37-3(F_5)	+	+	+	+	+	+	+	+	+	nt
B586-38-1(F_5)	+	+	+	+	+	+	+	+	+	nt
B686-320(F_6)	+	+	+	+	+	+	+	+	+	+
B886-956-1(F_8)	+	+	+	+	+	+	+	+	+	nt
Bonneville	+	+	+	+	+	–	–	–	–	–
PI 193835	–	–	–	–	–	+	+	+	+	+
Ranger	–	–	–	–	–	–	–	–	–	–

+ = gene for resistance; – = susceptible; nt = seeds were not available for this test.

One of Marx's breeding lines, **B636-320,** deserves particular attention, because in addition to viral resistance, it possesses some good horticultural characteristics. It blooms at the 9th or 10th node and has waxless leaves, white flowers, double pods, and wrinkled seeds with yellow cotyledons. According to the available records, it carries the following markers: *a, Bt, I, k, le, r*, and *wlo.* A seed increase was obtained in the fall of 1989 by growing plants in a greenhouse at Pullman, WA. Consequently, we are releasing **B636-320** under the name of **'G-1000, Marx's pea breeding line for multiviral resistance'**, to honor this outstanding researcher who dedicated his entire professional life to the enhancement of *P. sativum.*

Small seed samples of the 'Marx's pea breeding line' are available upon request from R. Provvidenti. Recipients of this line are requested to acknowledge its source when it is used in the development of new cultivars or other improved germplasm.

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