

UPDATE, PISUM GERmplasm AND PEA SEEDBORNE MOSAIC VIRUS IN
NORTHERN INDIA, 1987

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Northern India was previously reported (1,2) as a principal site from which pea seedborne mosaic virus (PSbMV) had been distributed into Pisum germplasm collections. At the same time (2), Northern India had been the world's richest resource of PSbMV-immune accessions (genotype sbm/sbm). We have since surveyed pea plantings over a 2500 km expanse of Northern India (Jammu and Kashmir, Hamachal Pradesh, Haryana, Rajasthan, Haryana, Delhi, and Uttar Pradesh) for both PSbMV occurrence and Pisum germplasm diversity during December 1985, February 1986, June 1986 (higher elevations), and 11-22 February 1987 (when second author visited India). We herein report the results of this survey.

Sweeping changes in diversity. There has been a drastic reduction in Pisum germplasm diversity in this extensive pea-growing area since the 1960's when the last collections of Northern India germplasm were made. The many hundreds of "local varieties" (landrace equivalents) grown in Northern India prior to 1970 have since been replaced by a few grain-type cultivars (principally 'Rachna' and 'T-163' developed at Agricultural University, Kanpur) and a few vegetable-type cultivars (principally 'Arkel' and 'Bonneville'). Simultaneously, whereas Northern India's 1,000,000 ha pea crop had previously consisted of grain-type "local varieties", as many as 487,000 ha are now planted to the above vegetable types, marketed as green pods by individual farmers.

In a single stroke, as it were, revolutionary changes in Northern India pea plantings have produced several remarkable results: (a) yields and farm profits have risen dramatically, (b) the field incidence of PSbMV has been reduced, and (c) a vast Pisum germplasm resource has been supplanted, probably in many cases irretrievably. Fortunately, Pisum collections (1957-61) by Walter Koelz, H. S. Gentry, and J. R. Harlan, USDA plant explorers (Table 1) had included many locations in India. Likewise, the Indian Agricultural Research Institute (IARI) had preserved a much larger collection of Pisum germplasm, principally from Uttar Pradesh, during the 1950's-60's. Some 472 accessions from the IARI collection were presented in 1970 to the USDA Plant Introduction Station, Geneva, New York, by Dr. H. B. Singh. Notwithstanding the presence of PSbMV in many of these accessions (2), much of this germplasm is being preserved in either IARI or USDA Pisum collections. An official USA/Canadian working group has now been authorized by USDA Agricultural Research Service and the Pisum Crop Advisory Committee to derive PSbMV-free sources from this valuable germplasm.

Field survey results. During rather painstaking field surveys in locations representative of the Northern India pea-producing region, we observed no plants of the above cultivars with obvious PSbM symptoms. Nevertheless, some 45 plants were sampled for sub-

sequent laboratory tests. None of these samples contained ELISA-detectable PSbMV. Of the districts surveyed, we observed plantings of only three old-time "local varieties" each harvested for grain use. Two in the Banaras District were tall, white-flowered types, and one in the Gorakhpur and Sultanpur Districts was a dwarf, purple-flowered type.

Experimental plot results. During 1986, samples were collected from 242 Northern India seedlots of Arkel, Bonneville, Rachna, 'T-163', 'RPG-3' and '44-21', and "nameless varieties". Seed sources consisted of small farmers and local, state, and national seed companies. Fifty to 300 seeds from each seedlot were space-planted 9 December 1986 in plots at Haryana Agricultural University. The resulting plants were observed in February 1987, and visual PSbM-symptom scores were ascribed to each plant. From these, plants representing three symptom-severity categories and several symptomless plants were sampled for preliminary tests by ELISA. A perfect correlation resulted between plants with conspicuous PSbM-like symptoms and positive tests for PSbMV by ELISA. Uniform PSbMV symptoms in the foliage of all plant nodes in experimental plots suggested that infected plants arose primarily from PSbMV-infected seeds.

Subsequently, plants from 132 seedlots were selected for PSbMV tests by ELISA. One or more plants from 52 seedlots were determined by ELISA to contain PSbMV (Table 2). Seedlots of most "nameless varieties" were kindly provided from private seed supplies of small farmers. Several significant points are apparent. Thirty-nine percent (52/132) of the Northern India pea seedlots tested by ELISA contained detectable PSbMV. The proportion of PSbMV-infected "nameless variety" seedlots (34/56=61%), however, was almost three times the proportion of infected named-cultivar seedlots (17/76=22%). Relatively healthy seed sources of major pea cultivars were readily available, providing definite potential for crop improvement through seed-stock assays and selection. On the basis of both visual observations and ELISA results, 12 sources of cv. Arkel, 12 sources of cv. Bonneville, and four sources each of cvs. 44-22 and RPG 3 were free of detectable PSbMV.

The confirmed occurrence of PSbMV in 52/132 Northern India seedlots suggest (a) that PSbMV had been readily aphid-transmitted in recent years from old-time "local varieties" to the supplanting named cultivars, and (b) that PSbMV-infected plants of both grain and vegetable cultivars may have lost competitive ability (PSbMV-induced plant stunting) against healthy plants in the field, thus escaping our survey observations at or beyond the bloom stage. Under February 1987 survey conditions, there was no evidence of PSbMV spread to healthy plants by aphid vectors, i.e. no plants with PSbM-like symptoms were observed in the upper plant canopy of the fields surveyed.

Observations. By decision of the All-India Coordinating Program, all pea lines henceforth released for commercial production in India must be powdery-mildew resistant. Superior powdery-mildew-resistant lines of both grain and vegetable types were observed at several trials/demonstrations in Uttar Pradesh, but particularly in the breeding plots of Dr. R. M. Singh, Banaras Hindu University, Varanasi. Dr. Singh and colleagues have made note-

worthy use of both novel and conventional Pisum germplasm. The near-future potential for superior, high yielding peas for Northern India appears to be very promising.

The concept of edible pods had not yet gained the interest of pea breeders in India. Increasingly eager acceptance of freshly harvested peas-in-the-pod by the Northern India metropolitan markets, however, suggests that zero-waste, powdery-mildew-resistant, edible-podded peas would be instantly successful there.

1. Hampton, R. O. and S. W. Braverman. 1979. Plant Dis. Reprtr. 63:95-99.
2. Hampton, R. O. 1986. PNL 18:22-26.

Table 1. 1937-70 Pisum collections from India repositied 1/
at the USDA Plant Introduction Station, NYS Agricultural
Experiment Station, Geneva, NY.

Year of collection	Plant explorer	Number of accessions	Description of area sampled
1937	W. Koelz	7	Whole subcontinent
1948	W. Koelz	21	Whole subcontinent
1949	W. Koelz	20	Whole subcontinent
1953	H. Gentry	2	Bombay (market)
1954	H. Gentry	3	IARI; Delhi (market)
1961	J. Harlan	2	Palanpur (market)
1970	H. B. Singh	2/ 472	Principally Northern India

1/- Accessions available in 1982.

2/- Presented to USDA Plant Inventory, in behalf of the Indian Agricultural Research Institute, by Dr. H. B. Singh.

Table 2. Incidence of PSbMV in selected Northern India pea seedlots, determined by ELISA serology.

Seedlot origin	Cultivar	No. seedlots PSbMV-infected, ELISA results	No. seedlots tested
Jaipur, Rajasthan	Bonneville	0	4
	Rachna	1	4
	44-21	0	4
	RPG 3	0	4
	T-163	2	4
	Nameless var. 1/	22	36
Ambala, Haryana	Arkel	3	4
	Bonneville	0	8
	Nameless var.	1	4
Hisar, Haryana	Bonneville	11	28
Jind, Haryana	Arkel	0	4
Karnal, Haryana	Nameless var.	2	4
Kurukshetra, Haryana	Arkel	0	8
	Nameless var.	9	12
Bareilly, Uttar Pradesh	T-163	1	4
Total		52	132

1/- Seed samples provided from farmers' private seed supplies.
