Importance of Seedborne Viruses in Crop Germplasm

As present or past members of the APS Virology Committee, we were recently asked to investigate the importance of seedborne viruses in U.S. crop germplasm resources. Our experience and the results of our study suggest that few individuals in the scientific and agricultural communities are appropriately heedful of this problem or the danger such viruses pose to crop productivity and indirectly to seed-sales losses in an increasingly sophisticated international marketing system.

In the same way recipients of blood plasma have a right to expect adequate provisions against transfusions contaminated with, for example, hepatitis B virus, we believe users of crop plant germplasm and the agricultural community at large deserve protection against germplasm-borne viruses. The time is right for adequate provisions to be made. Moreover, economical technologies exist for detecting and controlling germplasm-borne viruses. Concern and support within the scientific and agricultural communities, however, are prerequisites to meaningful germplasm improvement.

As the use of crop germplasm becomes more important, we believe that control of germplasm-borne viruses—and ultimately all germplasm-perpetuated pathogens—must become a fundamental part of national and international programs for germplasm stewardship. Scientific resources and knowledge are not limiting, and few supplementary support dollars would be required. Likewise, the need for several years of systematic effort to reach the goal of virus-free germplasm collections should be no deterrent; the distance between our present situation and a worthy goal should not impede the beginning steps toward that goal.

In 1978, Lister (7) predicted that "World-wide-collected [soybean] germ plasm is liable to carry seed-borne viruses . . . ." It has since been shown that soybean mosaic virus, particularly, occurs widely in *Glycine* germplasm collections. The impact of this seedborne virus on yield of selected germplasm accessions has been significant (3). Similarly, outbreaks of pea seedborne mosaic virus (6), retrospectively traced to pea (*Pisum sativum*) germplasm (5), have caused significant crop and seed-sales losses as well as virus contamination of institutional and commercial breeding programs. A strain of this virus was recently found (4) to be seedborne in lentil (*Lens culinaris*) germplasm.

Bean common mosaic virus has been known for many years to be endemic in bean (*Phaseolus vulgaris*) germplasm collections, and recently a seedborne strain of cucumber mosaic virus was found (2) in bean germplasm. The discovery in India that urdbean leaf crinkle virus is seedborne in mungbean (*Vigna radiata*) germplasm (1) illustrates a potential profusion of seedborne viruses in crop germplasm, yet to be revealed.

Some of the viruses that could be expected to occur in germplasm resources, on which future crop improvement depends, are listed in Table 1. Logically, the greater the economic value of the crop, the greater the advantage of germplasm-related research and the greater the opportunity for significant gain through control of germplasm-borne pathogens. Accordingly, the greatest initial benefits would be expected to accrue from controlling these pathogens in corn, soybeans, and wheat. Nevertheless, it would seem desirable to enlist the concern and efforts of scientists, crop advisory committees, crop improvement associations, and germplasm-improvement teams for all major crops, somewhat as suggested in reports of the National Plant Genetics Resources Board (8). As the concept of germplasm health and the value of fuller germplasm development and utilization are more widely recognized, we expect and encourage the creation of research positions specifically devoted to developing pathogen-free germplasm collections.

The initial step in controlling germplasm-borne viruses should be virus detection. We suggest that this effort begin with the germplasm resources and viruses listed in Table 1. Enzyme-linked immunosorbent assay (ELISA) is an excellent (sensitive, efficient, economical) technology for this task. Once germplasm-borne viruses are detected and the incidences known, the preferred course of action would be to generate virus-free genetic resources from assayed mother plants, with care to maintain the genetic base of the germplasm source. As an alternative, plant pathologists and breeder-geneticists could cooperatively ascertain the absence of viruses in selected F_2 breeding progenies in cases where virus-infected germplasm has been used as parents for crosses; this, however, inheres the danger of secondary virus spread once a viral contaminant has been introduced into the breeding program.

As a separate measure, we suggest that new accessions of germplasm be initially assayed for prioritized seedborne viruses and that the first-generation seed increase be accomplished in insect-free greenhouses, with additional tests for seedborne viruses. Because of the danger of cross-contamination among germplasm accessions by virus vectors, appropriate precautions against natural spread of viruses should be taken during periodic seed increases of germplasm collections.

We believe that crop germplasm will be increasingly strategic to future agricultural success in a food-needy world. If crop

Table 1. Seedborne viruses expected to occur in germplasm accessions of major U.S. crops

Crop[a]	Number of germplasm accessions	Viruses: Number reported seedborne	Viruses: Likely to occur in germplasm
Corn	3,060	5	Maize dwarf mosaic, sugarcane mosaic
Soybean	6,300	14	Soybean mosaic (known), tobacco ringspot, tobacco streak
Wheat	37,000	2	Barley stripe mosaic
Alfalfa (hay)	1,407	1	Alfalfa mosaic
Tobacco	1,112	10	Tobacco mosaic, tobacco ringspot, tobacco streak
Barley	23,800	1	Barley stripe mosaic
Peanut	4,809	6	Peanut mosaic, peanut mottle, peanut ringspot, peanut stunt, groundnut clump
Tomato	4,800	7	Tobacco mosaic
Oats	19,500	4	Barley stripe mosaic
Bean	7,771	4	Bean common mosaic (known), cucumber mosaic (known)
Lettuce	583	2	Lettuce mosaic
Onion	506	2	Onion yellow dwarf
Celery	85	3	Celery latent
Cantaloup	2,099	5	Cucumber mosaic, squash mosaic, tobacco ringspot
Pepper (green)	1,981	2	Tobacco mosaic, alfalfa mosaic
Pea	1,850	4	Pea seedborne mosaic (known)
Lentil	1,405	1	Pea seedborne mosaic (known)

[a] In descending order of 1981 market value in the United States.

germplasm potential is to be fully developed, plant scientists must be increasingly aware of factors limiting germplasm utilization and be active in resolving those limitations. We are convinced that germplasm-borne viruses warrant the concern of our Society and commitment to remedial action. Such viruses, when undetected and unrecognized, can accompany crop genes into breeding progenies. When this occurs, they constitute biological time bombs and threaten cultivar development, adjacent breeding materials, and surrounding crops. The problem need not be tolerated.

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Money-Makers, Money-Losers, and Balancing the Budget

The charge has been made that Council supports only those publications that make money. This is implied in a current editorial and has come to me also in letters and comments made to me at annual meetings. That some members perceive this to be true is due probably to inadequate communication by those of us on publication committees or who serve on Council. Council must always balance the budget.

To finance a publication that will either lose money or at best break even requires that another publication be approved that will make enough money to cover the deficit. The rejection or postponement of a publication proposal at a time when Society finances are at a low ebb gets publicized but the approval of a publication that will *not* make money at a time when Society finances are in the black is scarcely noted.

Currently the Society is recovering from the substantial expenditures involved in establishing PLANT DISEASE as a second journal of the Society. Because it has been a losing proposition, publication projects that would yield income greater than costs of production were favored to cover the deficits from publishing PLANT DISEASE. Until PLANT DISEASE is at least paying its own way (which now appears likely), the Society needs to give priority to projects that make money.

Even if it were true that APS is interested only in money-making projects, the money made supports services as well as projects of benefit to members. Such funds are used to keep dues from increasing or to hold page and reprint charges to a minimum. Job placement services are financed from Society funds. Society committees apply for and get services (that cost money) from APS headquarters. Publications such as *Phytopathology News*, annual reports, and the classics and monograph series need to be subsidized. Council has to give some priority to money-makers to finance publications that produce little or no income.

A compelling argument has been made that if no one is willing to buy a given publication, should APS publish it? Should Society resources be committed to an unwanted publication? If members do not buy a given publication, do they even encourage their libraries to buy it? Should APS publish materials that are wanted by only a few? These are serious questions that have to be resolved whenever proposals are made to Council.

APS members are sometimes more ingenious in thinking up projects that have limited appeal (and they want Society support when no commercial publisher would touch the projects) than in proposing projects that are in demand. Sometimes, projects are submitted first to commercial publishers, and only the rejected or borderline ones are submitted to the Society. APS also has standards for publication that are or should be just as rigorous as those applied to manuscripts for journal publication. The Society is interested in publishing both money-makers and money-losers, provided all are worthwhile for plant pathologists and agricultural scientists in general. However, Council has to use discretion in choosing some of each to satisfy the demand and to balance the budget.

These are my personal comments based on my observations of Council attitudes and activities in the 14 years I have served on Council and are not to be interpreted as the official response of Council. Remember, too, that Council attitudes and decisions change with changes wrought by appointment and election.

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An Aspect of Awards to Be Kept in Mind

J. P. Ross in his recent and thought-provoking letter on awards (PLANT DISEASE, Vol. 66, No. 9, page 761) neglects one aspect of the award business. The donor institution or group is usually more interested in promoting themselves than the recipient. Recipients of awards and their colleagues need to keep this in mind to prevent distortions in evaluating themselves and others.

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