

A Relational Database for Arizona Plant Disease Records

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Over the past decade there have been as many as three diagnostic clinics supported by the Department of Plant Pathology at the University of Arizona. Traditional diagnostic techniques and the disease index of Streets (1) have been the primary tools utilized by the clinic staff. The Arizona Plant Disease Database (APDD), which contains historical disease observations for the state, is an important resource now available to our diagnosticians. In the past, records of previous disease occurrence could not be utilized readily because of the time required to manually retrieve and examine records when a question arose. The computerized APDD and data sets described herein may be useful to persons diagnosing plant diseases associated with arid-lands agriculture or landscaping.

The APDD is composed of three databases that were constructed with a relational database management software package, R:BASE SYSTEM V (RB V) (Microrim, Inc., Redmond, WA), and reside on the hard disk of an IBM PC-XT microcomputer. The databases—"DISEASE," "LOSS," and "CLIMATE"—contain, respectively, all disease observations for individual plants that are currently in departmental archives, loss assessments for single host-pathogen combinations, and daily weather data from southern Arizona. Within a database, the RB V software package allows organization of data into TABLEs composed of one or more COLUMNs. (Throughout the text, terms specifically used by RB V are capitalized and names chosen for use in a specific database are capitalized and enclosed in quotation marks.) COLUMNs may contain TEXT data (one to 1,500 characters) or numerical data, either INTEGER or REAL. A database may contain more than one TABLE. COLUMNs are arranged in TABLEs so that those that will most frequently be retrieved together appear in the same TABLE. The definition of this initial structure is the step in database construction that requires the most consideration. All questions the database will potentially be required to answer must be identified before selection of the types of data for inclusion in the database. The APDD was designed to provide a variety of information, including annual summaries of clinic activity, lists of host-pathogen combinations grouped by month or county, reports of host-pathogen combinations new to the state, and complete problem records for individual homeowners or growers.

The database "DISEASE," which holds records of disease observations for single host plants, is composed of four TABLEs: "BASIC," "PATHOGEN," "DETAILS," and "CHEM." Each disease observation is given a unique accession number ("SEQNUM") that appears in each of the four TABLEs of the database. The TABLE "BASIC" holds the most frequently retrieved data for each record (diseased host), except the listing of pathogens, which is kept in the TABLE "PATHOGEN" (Table 1). Detailed field data contained in the TABLE "DETAILS" include field size and location,

planting date, irrigation method, crop stage, disease incidence, and disease distribution. Most entries in this TABLE appear in TEXT fields of eight to 30 characters. These entries are single words or short phrases, such as "drip" to describe irrigation method or "2 large patches" to describe disease distribution. The TABLE "CHEM" contains two TEXT COLUMNs of 30 characters each; the first lists the names of pesticides used by the grower and the second lists the names of pesticides recommended by the diagnostician. Thus, the data for each disease observation (record) are divided into four parts but are tied together with the accession number. Because more than one pathogen may be associated with a particular host, there may be multiple entries in the TABLE "PATHOGEN" with the same value of "SEQNUM" (accession number) but with sequential values of "PATHNUM" (Table 1). The Arizona databases currently store data in the original text or numeric form, which simplifies data entry and makes retrieved data understandable without translation. The more than 8,000 accessions in "DISEASE," which include the records of the three departmental diagnostic clinics in Phoenix, Tucson, and Yuma, as well as similar records that predate the clinics, cover most years since 1917.

The database "LOSS" was constructed to hold the results of annual crop loss assessment surveys made between 1919 and 1928 and to contain data collected from continuing crop loss assessment surveys. The COLUMNs included in this database were patterned largely on the original survey report form and include year, county, host genus and species, pathogen genus and species, crop acres in county, loss in acres, loss in dollars, percent loss, disease importance compared with

Table 1. Partial structure of the database DISEASE

TABLE	COLUMN characteristics			
	Name	Type	Width	Contents
BASIC	SEQNUM	INTEGER	8	Accession number
	SAMPMO	INTEGER	8	Sample month
	SAMPDAY	INTEGER	8	Sample day
	SAMPYR	INTEGER	8	Sample year
	COUNTY	TEXT	10	County
	COMMUN	TEXT	20	Nearest community
	HOST	TEXT	30	Host genus and species
PATHOGEN	VARIETY	TEXT	15	Host variety or cultivar
	PURPOSE	TEXT	25	Host use (orchard, garden, etc.)
	SOURCE	TEXT	1	Contributing clinic
	SEQNUM	INTEGER	8	Accession number (same as in BASIC)
	PATHNUM	INTEGER	8	Separate number for each pathogen found
	PATHTYPE	TEXT	1	Pathogen group, e.g., fungus
	PATH	TEXT	40	Pathogen genus and species

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previous and average year, first observation date in current year, and maximum incidence in current year. This database contains summaries of 822 surveys.

The database "CLIMATE" contains daily temperature maxima and minima and rainfall data. The TABLES "TUCSON" and "COCHISE" contain records from the Tucson metropolitan area (Pima County) and the Sulfur Spring Valley of Cochise County, respectively. The TABLE "TUCSON" covers the period 1977-1985 for four reporting stations, whereas "COCHISE" covers the period 1975-1977.

There are basically two alternatives for data entry and retrieval within the RB V package: direct use of the command language and use of applications programs. The RB V command language allows the user maximum flexibility in database manipulation. New data may be entered through a user-created form on the screen or from an externally created ASCII file. Data in any TABLE may be examined via the BROWSE and SELECT commands, and simple descriptive statistics are available through the TALLY, COMPUTE, and CROSSTAB commands. The greatest usefulness of relational software lies in the ability to restructure existing TABLEs or to create new ones from those already existing, using the relational "operators" (commands) APPEND, INTERSECT, JOIN, PROJECT, SUBTRACT, and UNION. Thus, in

retrieving information, the user is not limited by the original structure of the database.

New disease observations are currently added to the APDD system by departmental diagnosticians who are also the primary users of the information. These databases have also been used by departmental extension specialists new to Arizona as one method of becoming acquainted with disease conditions in the state. The APDD system has also provided information to the state plant pathologist as well as to the federal NAPIS database (2). In addition to these functions, it is anticipated that the accumulating information in these databases will contribute to an update of the disease index of Streets (1), to any statewide expert systems that are developed, and to the understanding of the epidemiology of plant diseases of statewide importance. Data from the APDD system, which relate primarily to diseases of agricultural crops and landscape plants grown in an arid environment, are available to interested persons upon request.

LITERATURE CITED

1. Streets, R. B. 1969. Diseases of the Cultivated Plants of the Southwest. University of Arizona Press, Tucson. 390 pp.
2. Wallenmaier, T. E. 1986. Development of the computerized state-federal pest reporting system. *Plant Dis.* 70:365-367.

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