CM 67 and ATLAS 68 . . . two new yellow-dwarf

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BARLEY YELLOW DWARF, an apid-transmitted virus disease of small grains, has caused serious losses in barley, wheat, and oats in California since its sudden widespread outbreak in 1952. Although it had not been recognized prior to that time, yellow dwarf is now known to be a major disease in most of the small-grain-producing areas of the world.

Local outbreaks of the disease are an annual occurrence in California, with yield reductions often estimated at 50 per cent or more. Statewide outbreaks, resulting in losses of many millions of dollars, have occurred several times during the 17-year interval since 1952. Data obtained during the three-year period 1967–69 (reported here), indicate that yield losses attributable to yellow dwarf are more substantial, more widespread, and occur with greater frequency than had previously been suspected.

Failure to control this disease, or its apid vector, by cultural methods places emphasis on the necessity of developing resistant varieties. With few or no exceptions, all of the commerical barley varieties grown presently in the United States are susceptible.

Losses from this disease should be reduced by two new barley varieties now available to growers. CM 67 and Atlas 68, both resistant to the yellow dwarf virus, were developed and released by the University of California Department of Agronomy and Range Science, Davis.

Preliminary to the breeding program which led to the development of CM 67 and Atlas 68, approximately 7,000 barleys, collected from all parts of the world, were tested for their reaction to yellow dwarf. Some 117 entries were found resistant enough for potential use as parental material—one from China and the remainder from Ethiopia. A number of these have been used in the breeding program at Davis.

Although CM 67 and Atlas 68 are resistant to the damaging effects of the yellow dwarf virus, infection will occur and limited discoloration (yellowing) will develop. Little or no dwarfing occurs, however, and yield does not appear to be suppressed. This level of resistance appears to provide adequate protection under the most severe conditions.

The two varieties are different enough in areas of adaptation to provide growers throughout California with at least one resistant type adapted to their area. Breeding programs are under way designed to incorporate resistance into other varieties, to provide growers with greater flexibility in their choice of a variety and to capitalize on other desirable attributes, such as stiff straw and resistance to other diseases.

CM 67

CM 67 is a composite of 130 F_5 generation lines from the backcross (California Mariout[5] x CI 2376) × (California Mariout[6] x Club Mariout)[2]. Resistance to the yellow dwarf virus was obtained from CI 2376, an Ethiopian variety, and the white seed characteristic from Club Mariout, a variety previously grown in California. CM 67 is similar to California Mariout in all other characteristics. It is a short-strawed early-maturing six-rowed variety with rough awns. Kernels are large, with a white aleurone and a long-haired rachilla. Although it is susceptible to *Rhyncosporium* scald, under certain conditions it does not appear to be infected as severly as California Mariout.

Table 1 compares yields of CM 67 and varieties of similar adaptation. Since it would be expected to perform similarly to California Mariout when yellow dwarf infection is absent, measured differences provide an indication both of the widespread prevalence of the disease and its suppression of grain yield. When CM 67 was compared with California Mariout in various locations over periods of two or three years, CM 67 yields were better by 6 to 38 per cent (average 19 per cent). Individual differences exceeded 30 per cent in four of the 19 tests (Santa Barbara County, 1967 and 1969; Fresno County, 1968 and 1969).

Location differences

Location differences also provide some information on regional prevalence and severity of yellow dwarf, with maximum differences being measured in the coastal counties, Riverside county, and the San Joaquin Valley, and smaller differences in the Sacramento Valley. In general, this distribution is in keeping with visual observations of the virus's geographic pattern. Its apparent prevalence in the San Joaquin Valley does not conform to past observations, however, so determination of its true prevalence there will require additional tests embracing more locations over a longer period.

CM 67 provides growers with a greater flexibility in the selection of varieties for maximum production. Its area of adaptation is similar to that of California Mariout, with yield of the two varieties being similar in the absence of yellow dwarf. Consequently, growers of California Mariout should capitalize on the added protection afforded by CM 67. The relationship of CM 67 to the varieties Numar and Briggs is more difficult to discern. Since these two varieties have generally given consistently higher yields than California Mariout, they should also outproduce CM 67 in the absence of the disease. Consequently, the prevalence and severity of yellow dwarf in any particular area would affect a decision on whether to grow CM 67 instead of Briggs and Numar, varieties with potentially higher yields, and stiffer straw. Also, the protection against yellow dwarf afforded by use of CM 67 must be weighed against the greater tolerance of the Briggs variety to *Rhynocosporium*

resistant BARLEY VARIETIES

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TABLE 1. YIELDS OF CM 67, NUMAR, BRIGGS, AND ARIVAT BARLEYS AS COMPARED WITH CALIFORNIA MARIOUT

Location	Trials	Years	Yield			
			CM 67	Numar	Briggs	Arivat
	No.	No.	Per cent of California Mariout			
Riverside Co.	3	3	116	123	134	124
Santa Barbara Co.	3	3	130	103	91	91
Orange Co.	1	1	125	132	135	125
Kings Co.	1	1	124	103	101	—
Fresno Co.	3	2	138	106	107	—
Sutter Co.	3	3	106	115	121	118
Yolo Co.	5	3	110	104	125	109
Average	19	3	119	112	117	—
Average	15	3	115	112	120	111

TABLE 2. YIELDS OF ATLAS 68, BRIGGS, ARIVAT, GRANDE, AND HARLAND BARLEYS AS COMPARED WITH ATLAS 57

Location	Trials	Years	Yield				
			Atlas 68	Briggs	Arivat	Grande	Harland
	No.	No.	Percent of Atlas 57				
Sutter Co.	3	3	103	116	111	114	95
Colusa Co.	1	1	115	125	117	139	106
Davis–UCD	4	2	110†	—	—	—	—
Davis–UCD	2	2	106	116	99	94	76
Yolo Co.*	3	3	102	102	99	106	95
Stanislaus Co.	2	2	96	87	96	81	74
San Luis Obispo Co.	1	1	100†	105†	—	—	—
Riverside Co.	2	2	112†	107†	105†	—	—
Average for trials	11	3	103	108	103	104	89

* Off-campus tests.
† Not included in 11 trial average.

scald. In certain areas, and with early planting, the scald disease can be much more important than yellow dwarf.

Although yellow dwarf is a definite hazard to barley production in the Riverside area, the frequency of frost damage to the earlier-maturing varieties at heading time may offset any advantage gained from yellow dwarf resistance. Despite their susceptibility to the virus, Arivat and Briggs have given satisfactory performance in the Riverside area. Some benefit may be obtained by growing Atlas 68 (table 2), since it combines later maturity with resistance to yellow dwarf.

Average yield differentials between California Mariout and CM 67 at two locations in the Sacramento Valley over a three-year period were 6 to 10 per cent, compared with the range of 16 to 38 per cent at other test locations. Briggs was superior to CM 67 at both test locations—because of its stiffer straw, its tolerance to *Rhyncosporium* scald, and its higher yield potential under conditions found in the Sacramento Valley. Numar was equal, or slightly superior to CM 67, and in general, its straw strength and higher-yielding potential offset advantages gained in this area from resistance to yellow dwarf. However, since yellow dwarf is more prevalent and much more destructive on late-planted grain, growers in the Sacramento Valley may benefit by growing CM 67 when planting operations are delayed until February and March.

Although decreased yields at four locations in the San Joaquin Valley indicate that yellow dwarf can be a definite production hazard (Five Points. 1968, 58 per cent; Coalinga, 1969, 10 per cent; Corcoran, 1969, 24 per cent; Lemoore, 1969, 47 per cent), its over-all long-range impact there has not been adequately established. Varietal selection is complicated by favorable performance of the stiff-straw variety, Numar, throughout San Joaquin Valley, and by that of Briggs in some areas. Where California Mariout has performed as well as Numar and Briggs, however, growers should consider switching to CM 67. It is also the choice for late planting.

Atlas 68

Atlas 68 is the fourth improvement of the original Atlas variety which has been released for production in California. It includes the cumulative transfer of six characters—two sources of resistance to powdery mildew, resistance to some races of *Rhyncosporium* scald, resistance to the barley yellow dwarf virus, white aleurone color, and semismooth awns. The basic characteristics of the original Atlas have been retained successfully throughout the backcrossing programs.

Atlas 68 is a composite of 140 F_5 generation lines from the multiple backcross [(Atlas^3 × CI 3920-1) × Atlas 46] × [(Atlas^4 × CI 1179) × Atlas 57^2]^2. It differs from the previous release, Atlas 57, not only in the addition of resistance to yellow dwarf but also in an additional gene for powdery mildew resistance. Atlas 68 is a six-rowed semismooth-awned barley with erect early growth and midseason maturity. The straw is midtall, moderately stiff, with medium-dense spikes. The kernels are large, with white aleurone and a short-haired rachilla. It is similar to Atlas 57 in all other characteristics, including malting and brewing quality.

The Algerian (CI 1179) gene for powdery mildew resistance in Atlas 68 provides protection against all races occurring in California. Although Atlas 57 is resistant to many of the powdery mildew strains occurring in California, it is sus-

ceptible to strains of recent occurrence and can be severely damaged by them. Losses in grain yield as high as 27 per cent have resulted from severe infections of powdery mildew. Atlas 68 possesses the same resistance to *Rhyncosporium* scald as Atlas 57, which is effective against most of the pathogenic races present in California.

Atlas 68 is recommended for production in areas where Atlas 57 has been grown successfully and in areas where its resistance to powdery mildew and yellow dwarf may prove to be advantageous. Table 2 compares yields of the two varieties at seven locations. The average difference (6 per cent), in favor of Atlas 68 reflects differences in yellow dwarf reaction. Powdery mildew infection was not a factor in these tests. This difference, less striking than that between CM 67 and California Mariout, reflects the lower prevalence of yellow dwarf in the Sacramento Valley where most of the tests were conducted.

Comparisons

Table 2 compares yields of Atlas 68 and four additional varieties with similar areas of adaptation to Atlas 57. The number, duration, and distribution of the tests are not sufficient to establish local recommendations, but they do provide some information about the relative performance of the varieties over an extensive area. In general, the earlier-maturing short stiff-strawed varieties, such as Briggs and Arivat, gave the best performance on the medium-textured fertile soil types, with Briggs having a 5 to 17 per cent advantage over Arivat. The differences between these two varieties are in line with previous findings. Types maturing at midseason and later have consistently given favorable performance on heavy soil types and in dry-farmed foothill regions. In such areas, Atlas 68 compared favorably with the other varieties. Atlas 68, like Atlas 57, may find a limited use in the malting and brewing industry.

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ETHREL SPRAYS IN

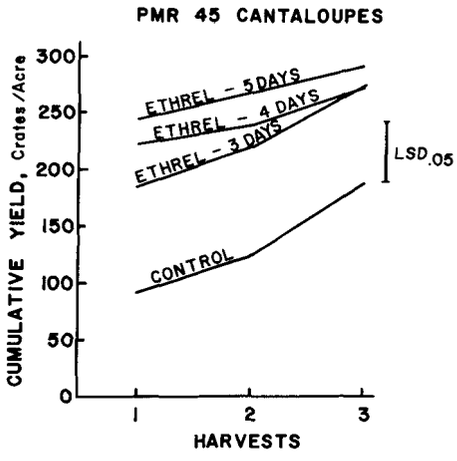
MUCH OF OUR PRESENT RESEARCH effort is directed towards mechanizing the harvesting of our California vegetable crops. This is as true for cantaloupes as it is for asparagus, lettuce, and fresh market tomatoes. Agricultural engineers and plant scientists generally agree that mechanical harvesting of cantaloupes on a commercial scale is still several years in the future. The principal obstacle to machine harvesting of cantaloupes has been the absence of a variety which will mature fruit of acceptable quality in a determinate manner so that the crop can be harvested in a single once-over operation much the way canning tomatoes are harvested.

Although selective harvesters have been tried on cantaloupes, they have proven impractical or uneconomical due to the damage they do to the fruit and vine. Researchers working on cantaloupe mechanization in California now are convinced that non-selective or once-over harvest by machine must be the immediate as well as the long-range goal.

Better ways

Since interest has declined appreciably in the selective harvester as a stop-gap measure between conventional handpicking and once-over machine harvest, various possibilities have been considered to develop better ways to hand harvest cantaloupes. One of these is to achieve sufficient concentration of fruit maturity through spacing, cultural practices, and/or chemical sprays to permit the reduction of hand picks from the 10 to 20 now being used to three or four. Work to explore different possibilities of concentrating fruit maturity has been going on and will be enlarged this coming season in field experimentation in the San Joaquin Valley.

GRAPH 1. YIELD OF MARKETABLE CANTALOUPES AS AFFECTED BY ETHREL APPLICATION 3, 4, AND 5 DAYS BEFORE THE FIRST HAND HARVEST. (SIZES 45 & LARGER.



During the past two seasons work with Ethrel, 2 chloroethylphosphoric acid, a growth regulator and ripening agent, has been fairly successful in concentrating cantaloupe maturity for once-over harvest by machine. To test this chemical as an aid to hand-harvesting of cantaloupes, an experiment was conducted in the west Fresno County near Mendota last September. In a well-replicated series of plots of $\frac{1}{100}$-acre size, Ethrel was sprayed on cantaloupe vines three, four, or five days prior to first hand harvest. Then all plots, including the controls, were hand harvested by commercial crews on three successive days. Yields are shown in graph 1.

Increased yields

The application of Ethrel five days before first harvest resulted in 292 crates of marketable fruit per acre or an increase of 104 crates above the control.