

Yellow Dwarf of Cereals

effect of date of planting and a study of the host range and varietal reaction to the virus

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Second of two articles on a study of yellow dwarf on cereals in California

The damaging outbreak of yellow dwarf on cereals in 1951—responsible for an estimated 10% loss of the California barley crop—was favored by an abnormally warm and continuously wet winter. This weather delayed planting until March and induced a rank cover of wild grasses on which the virus-carrying aphids multiplied. A drought from March 7 to April 25 dried out these grasses and induced large flights of the aphids into the young grain fields.

In 1950-51 when the virus outbreak was severe, grain was late seeded—March 15—and aphid flights from the grasses were early—March 30. In 1951-52 damage was slight as much of the grain was planted in December and aphid flights from the grasses did not take place until mid-April.

Under California conditions—particularly in the Sacramento and northern San Joaquin valleys—yellow dwarf will probably be of economic importance only on barley. Wheat and oats normally are seeded by February 15 and are at an advanced stage of growth when aphid flights from the grasses are likely to occur. When climatic conditions delay grain planting beyond this time, growers originally intending to plant wheat or oats often seed barley instead. However, if oat and wheat fields are sowed in March—as they were in 1950-51—they may be badly damaged by yellow dwarf.

Inoculation studies demonstrated that the cereal yellow-dwarf virus has a very wide host range in the grass family. Of 55 grasses tested, 36 species—represent-

ing eight tribes—proved to be hosts. Twenty of these grasses exhibited typical yellow dwarf symptoms of stunting and either yellow or red leaf discoloration. Included in this group were such common grasses as annual bromes and fescues, wild barleys, wild oats and canary grass. Sixteen species showed no symptoms but proved to be capable of carrying the virus. Widely grown grasses that are symptomless carriers are Bermuda grass, orchard grass, Kentucky fescue and Kentucky blue grass. California's natural winter and spring range growth is made up principally of grasses susceptible to yellow dwarf. Also a considerable proportion of the grasses grown in summer-irrigated pastures are hosts of the virus.

Effect on Varieties

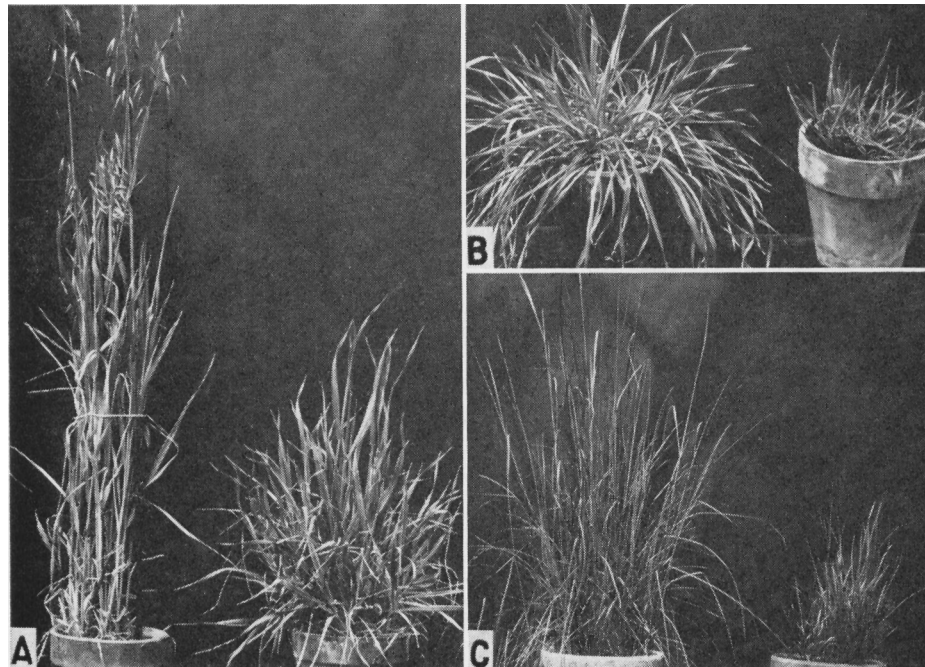
A number of barley and oat varieties including all those commonly grown in California and those selected under field conditions for either extreme tolerance or susceptibility were tested by aphid inoculation at the seedling stage in the greenhouse.

Four barley varieties—C. I.'s 1227, 1237, 2376, and Abate—rated as highly resistant. They exhibited no stunting and little or no leaf yellowing. None is of commercial value, but all represent possible parental material for a disease resistance breeding program.

No oat varieties with this degree of resistance to yellow dwarf have yet been found.

Tolerant commercial varieties include Rojo and Hanchen of the barleys, and Kanota oats. Varieties in this class show considerable pigment changes in the leaves but are only slightly stunted, and yield normally.

Varieties rated in the intermediate class include the barley varieties, California Mariout, Arivat, and Vaughn and the oats, Westdale, Ventura, and Palestine. Plants in this intermediate class are stunted at maturity by approximately one half. Symptom expression is severe. They normally produce heads but yields are drastically reduced. A few varieties in this group, such as Atlas 46, are severely stunted and yellow in the early



The effect of cereal yellow dwarf on three wild grasses. A. Wild oats—*Avena fatua*. Left, five non-inoculated plants four months old; right, five plants four months after inoculation at the seedling stage with viruliferous aphids. Extreme stunting and leaf reddening are the principal symptoms. B. Soft chess—*Bromus mollis*. Left, five non-inoculated plants, three months old; right, five plants three months after inoculation at the seedling stage with viruliferous aphids. C. Annual fescue—*Festuca reflexa*—three months after inoculation with the cereal yellow dwarf virus at the seedling stage. Left, five non-inoculated plants; right, five inoculated plants. Note extreme stunting caused by the yellow dwarf virus.

Alkali Soil Reclamation

most carbon dioxide added to irrigation water
is lost into atmosphere and as reclaiming agent

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Use of carbon dioxide in irrigation water had no significant effect toward the reclamation of black alkali soil in the cases of two Tulare County irrigation systems studied.

Many alkali soils can be reclaimed merely through the use of sufficient water under conditions of good drainage. Other soils require some type of treatment which will effectively supply soluble calcium to replace the sodium combined with the clay.

Alkali soils have one or both of two different chemical characteristics. The so-called white alkali soils contain only soluble salts—of a type which can be washed out readily—but the black alkali soils contain sodium combined with the clay which produces sodium carbonate. This type of alkali dissolves organic matter, yielding dark colored solutions which give these soils their name.

It is difficult and sometimes impossible to wash black alkali from the soil. The remedy is to make available some

soluble calcium which will replace the sodium attached to the clay or which will neutralize the sodium carbonate.

Many alkali soils have been reclaimed through the effects of carbon dioxide, a theoretically cheap source of acid. However, acids are effective in reclaiming alkali soils only to the extent that they make calcium or magnesium—or both—available by dissolving it from insoluble sources usually present in alkali soils.

If plants—of any kind—can be induced to grow on an alkali spot, reclamation will start, provided the soil contains a source of calcium. The roots of the plants give off carbon dioxide which dissolves in the soil moisture and brings some calcium into solution. This calcium replaces sodium, leaving it in a soluble form which can be leached from the soil provided the drainage is adequate. Thousands of acres have been reclaimed by such a natural process.

The tops of a green manure crop—

which are turned under—are of some benefit but most of the carbon dioxide produced by decay processes in the surface soil is lost to the atmosphere and is without effect. However, most of that produced deep in the soil through the decay of roots can be captured and is effective for alkali soil reclamation. The roots of a good cover crop might easily contain 1,000 or more pounds of carbon per acre. The carbon dioxide produced from this amount of carbon has a potential acidity equivalent to more than 2,700 pounds of sulfur or nearly four tons of sulfuric acid.

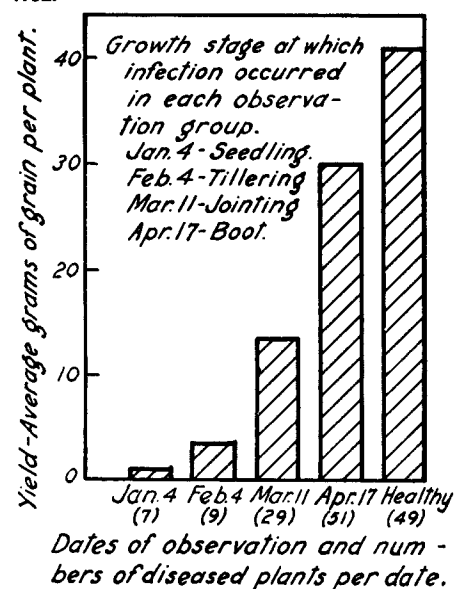
Because of the great power of carbon dioxide produced by roots and by decaying organic matter attempts have been made to introduce carbon dioxide into alkali soils by other procedures. One procedure has been to take exhaust gases—predominantly, carbon dioxide—from engines or from the burning of natural gas or diesel fuel through some

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stages of growth but as heading occurs there is considerable recovery.

The oat varieties, California Red and Coast Black, and the barleys, Tennessee

Correlation between growth stage of the plant when infected with yellow dwarf and ultimate yield of grain of the barley variety, Atlas 46, planted November 1951 and harvested June 1952.



Winter, and Club Mariout rate as extremely susceptible. When infected in the seedling stage these varieties are so severely dwarfed—often by three quarters—that they rarely produce heads.

Field observations indicate that the three most common California wheat varieties—Baart 46, White Federation 38, and Ramona 50—are highly susceptible. Sonora 37 appears to be most tolerant of the California wheats.

Effect on Yield

The three principal California barley varieties, Atlas 46, California Mariout and Club Mariout were planted experimentally in November 1951. Yellow dwarf was uniformly distributed by January to the extent of 3% to 4%. By February the incidence had increased to 15%, by mid-March to 23%, and by April 17 to 50%.

Plants of each variety were grouped at harvest according to the date the disease was first observed. Composite samples were threshed and the average weight in grams of grain per plant was calculated for each variety for each observation date.

There was a direct correlation between

time of infection and ultimate yield of barley. Grain yields of all three varieties when infected in the seedling stage were reduced over 95%. Yields of Atlas 46 and California Mariout when infected at jointing were cut by approximately 70% and that of the more susceptible Club Mariout over 90%. With late infection in the heading stage all showed approximately the same order of reduction—15% to 25%.

To determine the effect of seedling infection on wheat yields, 24 plants of each of three varieties, Baart 38, White Federation 38 and Ramona 50 were inoculated in the greenhouse and transplanted to the field. A comparable number of non-inoculated checks were put out at the same time. Yields in grams of grain per plant were as follows: Baart 38, 6.6 grams per healthy plant, 0.8 grams per diseased plant; White Federation 38, 9.0 grams as against 0.7 grams; and Ramona 50, 6.1 grams as against 1.2 grams.

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