Virus Yellows Control in Sugarbeets

Sanitation and Resistant Varieties

*by J. M. Nelson and M. E. Stanghellini**

Sugarbeet production in central Arizona has generally been hampered by diseases commonly known as virus yellows. The most serious outbreak occurred in the 1969-70 growing season when a high incidence of the virus yellows greatly depressed yields. In that season, root yields were nearly 30 percent lower than those of previous years.

There are two diseases involved: beet yellows and beet western yellows, each of which is caused by a different virus. Both viruses are transmitted primarily by the green peach aphid. Symptoms of the two diseases are similar and consist of yellowish, thickened, and somewhat brittle leaves. Older leaves tend to develop an interveinal bright yellow to orange yellow chlorosis. Eventually these leaves develop necrotic spots and die prematurely. Visual distinction in the field between sugarbeets infected with beet yellows virus (BYV) and beet western yellows virus (BWYV) is difficult.

Beet yellows, the more serious of the two diseases, may reduce yields 20 to 40 percent. Loses from beet western yellows disease are somewhat less, ranging from 10 to 20 percent. When beets are infected with both BYV and BWYV, the losses are additive. Damage is greatest when plants are infected when young.

Disease surveys and transmission tests conducted between 1965 and 1968 by research personnel of the U. S. Department of Agriculture revealed that BWYV was more prevalent than BYV in the Salt River Valley. BWYV was consistently detected as early as November; while BYV was not detected until April or May or late in the growing season.

In the 1969-70 season, when virus yellows were very damaging, disease symptoms were observed in early November. Although it is not known if BYV was present in November, it is probable that infection by this virus also occurred early in the season. It is likely, then, that the heavy losses can be attributed to the additive effects of both viruses infecting beets early in the season.

In California, virus yellows epidemics have generally occurred after one or more years of large acreages, especially when growing seasons have overlapped. This is much the same situation that occurred in Arizona prior to the poor crop in 1970. A combination of large acreage and high yields prolonged the harvest in 1969 and did not allow sufficient time between sugarbeet crops for proper cleanup of beets remaining in fields after harvest (keeper beets). Unless destroyed, keeper beets may serve as a primary source of BYV inoculum for infection of the succeeding beet crop.

Primary spread of the yellows viruses from reservoir host plants (sugarbeets and certain weeds) to beet fields, and secondary spread within fields are dependent upon the occurrence and abundance of the aphid vector. In the Salt River Valley, green peach aphids first appear in September or October. The aphids increase in numbers during the winter months, reaching peak production in the spring. In the 1969-70 season, aphids moved into beet fields early in the fall and persisted in large numbers until late spring, making possible early initial infection and rapid secondary spread of the yellows viruses.

Control of the virus yellows through the destruction of the aphid vector has not proven feasible, even though many insecticides are effective against the aphid. Programs to obtain green peach aphid control may reduce secondary spread of the viruses within fields, but these are expensive and generally ineffective due to the ability of the aphid to persist and reinfest fields throughout a large portion of the growing season.

Cultural practices that prevent carryover of the yellows viruses, particularly BYV, can help greatly in reducing disease losses. A beet-free period (time between harvest and succeeding crop) of approximately one month is essential in an effective control program. This break between sugarbeet crops allows the grower time to carry

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Table 1. Comparison of the yield, sucrose content and bolting of sugarbeet varieties grown at Mesa, Arizona, 1968-69, under moderate virus yellows conditions.

Variety	*Sugar Yield (Tons/A)*	*Root Yield (Tons/A)*	*Sucrose Content (%)*	*Bolting (%)*
US H9A	4.4[a]**	32.3[a]	13.7[a]	8
US H9B	4.4[a]	31.7[a]	13.9[a]	13
S301 H8	3.8[b]	28.9[b]	13.2[a]	1

** *Means followed by the same letter are not significantly different at the 5 percent level.*

out a sanitation program to destroy beets that have escaped harvest before the next crop is planted. The control of keeper beets is of utmost importance, since, as mentioned earlier, the sugarbeet itself can serve as a main reservoir host of BYV. Besides keeper beets, weed beets (beets from seed produced by bolters) and weeds such as saltbush should also be eliminated.

The most promising means of control of the virus yellows diseases would appear to be through the use of resistant varieties, since control by other measures is difficult. Although a high degree of resistance to virus yellows is presently not available in a commercial variety, there are two varieties available with moderate resistance. These varieties, designated US H9A and US H9B, were developed by research personnel at the U. S. Agricultural Research Station at Salinas, California. Both varieties were found to be adapted to a wide range of growing conditions, indicating the possibility of their use in Arizona.

The yellows resistant varieties were subsequently tested at the University of Arizona Agricultural Experiment Station at Mesa over a three year period. In these tests, they were compared with S301 H8, the standard commercial variety. This variety has been well adapted to central Arizona climatic conditions, particularly because of its outstanding resistance to bolting (production of seed stalks). The sugarbeet varieties were planted in replicated plots in September and were harvested in mid-June in the field tests reported here.

In the 1968-69 season, virus yellows damage was moderate. Under those conditions, the yellows resistant varieties produced about three tons more roots per acre and 1200 pounds more sugar per acre than S301 H8 (Table 1). However, bolting was much greater for the yellows resistant varieties. There were no differences among varieties in sugar content in any of the three seasons the tests were conducted.

Root yields and sugar production were greatly reduced in the 1969-70 season as the result of the early and high incidence of virus yellows (Table 2). Under this severe disease situation, the varieties with resistance produced an average of over six tons more roots and one ton more sugar per acre than S301 H8. Bolting was not a factor in this season.

In 1970-71, the incidence of virus yellows was very low until late in the season and consequently yields were outstanding (Table 3). Even under these conditions, the resistant varieties showed some yield advantage over the commercial variety, but they again showed a lack of bolting resistance.

Although US H9A and US H9B out produced S301 H8 each year, they also produced substantially more bolters than is desirable. Bolting is objectionable for a number of reasons: roots of plants that have bolted generally contain less sugar, seed from bolters can produce weed beets, pollen produced may be carried to seed fields, and roots of bolted plants are sometimes more woody than normal, making slicing at the factory more difficult. If a high percentage of bolting does occur in a commercial field, it may be necessary to remove the seed stalks to prevent the production of pollen and seed.

Research directed toward developing varieties with improved resistance to virus yellows is currently being conducted at the U.S. Agricultural Research Station at Salinas. Spreckels Sugar Company breeders are also involved in developing varieties with both virus yellows and bolting resistance. At this time, however, the most effective means of control of virus yellows diseases includes the use of the moderately resistant varieties coupled with a beet-free period and careful sanitation after harvest to reduce the sources of the viruses for the next sugarbeet crop.

Table 2. Comparison of the yield, sucrose content and bolting of sugarbeet varieties grown at Mesa, Arizona, 1969-70, under severe virus yellows conditions.

Variety	*Sugar Yield (Tons/A)*	*Root Yield (Tons/A)*	*Sucrose Content (%)*	*Bolting (%)*
US H9A	3.9[a]**	24.8[a]	15.9[a]	3
US H9B	4.2[a]	26.4[a]	15.9[a]	2
S301 H8	3.0[b]	19.1[b]	15.8[a]	0

** *Means followed by the same letter are not significantly different at the 5 percent level.*

Table 3. Comparison of the yield, sucrose content and bolting of sugarbeet varieties grown at Mesa, Arizona, 1970-71, under mild virus yellows conditions.

Variety	*Sugar Yield (Tons/A)*	*Root Yield (Tons/A)*	*Sucrose Content (%)*	*Bolting (%)*
US H9A	6.0[a]**	40.5[a]	14.8[a]	16
US H9B	5.5[ab]	36.7[ab]	15.0[a]	14
S301 H8	5.0[b]	34.1[b]	14.7[a]	4

** *Means followed by the same letter are not significantly different at the 5 percent level.*