

**WTFRC Project # AH-01-76**

**Organization Project # 13C-3361-4248**

**Project title:** Virus effects on tree vigor and fruit maturity

**PI:** W.E. Howell, Manager, NRSP-5, WSU-Prosser

**Organization:** National Research Support Project #5

Washington State University  
24106 N. Bunn Road  
Prosser, WA 99350

**Co-PI and affiliation:**

K. C. Eastwell, Assoc. Plant Pathologist, WSU-Prosser

**Cooperator:** D. Ophardt, Res. Tech Supervisor, WSU-Prosser

**Contract Administrator:** Dan Nordquist; [dnordquist@wsu.edu](mailto:dnordquist@wsu.edu); 509-335-0000

**Project Objectives:**

1. Determine if certain desirable horticultural attributes (early ripening) associated with 'Yataka' clones in commercial plantings are due to graft transmissible agents or due to other causes.
2. Determine if tree vigor of 'Fuji' trees can be beneficially controlled by virus inoculations.
3. Determine horticulture and disease effects of virus isolates separated by thermo-therapy from apple green crinkle and apple rubbery wood diseased sources. Since all trees in this block are expected to fruit in 2004, final association between virus and green crinkle disease will be complete.

**Significant findings:**

1. Viruses present in the early ripening source of Yataka Fuji appeared to have to induce a slight increase in fruit maturation of BC-2 Fuji, as estimated by starch and soluble solid measurements, but the results were not statistically significant.
2. Apple stem grooving virus (ASGV) and apple stem pitting virus (ASPV) reduced tree vigor by 9 to 11%. Unfortunately, ASGV also reduced yield efficiency and fruit size. Apple chlorotic leaf spot virus (ACLSV) appeared to reduce vigor, but the data associated with this virus were not statistically significant. None of these three viruses affected the other measured fruit attributes of pressure, soluble solids, and shape.
3. Disease development on trees in the "virus-separation block" suggests that apple green crinkle disease is associated with apple stem pitting virus infections.

**Methods:**

1. Evaluate tree vigor and fruiting characteristics of 'Fuji' trees that were graft-inoculated with tissue from virus-free 'Yataka'; from virus-infected early-ripening 'Yataka'; and from apple green crinkle affected trees. Compare these results with those from non-inoculated virus-certified trees. Tree vigor will be monitored by measurements of trunk cross sectional areas. Fruit maturity and quality data is to be collected from all inoculated and control trees. Results from this replicated field trial, which was established in 1997, will resolve whether the early fruit maturity and vigor controlling characteristics associated with these virus sources are graft transmissible.
2. Tree vigor and fruiting characteristics of 'Fuji' trees that have been graft-inoculated with tissue from virus-infected early-ripening 'Yataka' and from apple green crinkle affected trees will be

compared to 'Fuji' inoculated with standard latent virus isolates [apple stem pitting virus (ASPV), apple stem grooving virus (ASGV), and apple chlorotic leaf spot virus (ACLSV)]. This comparison will help determine whether the attributes associated with the early ripening 'Yataka' and apple green crinkle disease are induced by common strains of the latent viruses or by another agent. Other agents might include a different strain of these viruses or an entirely different organism.

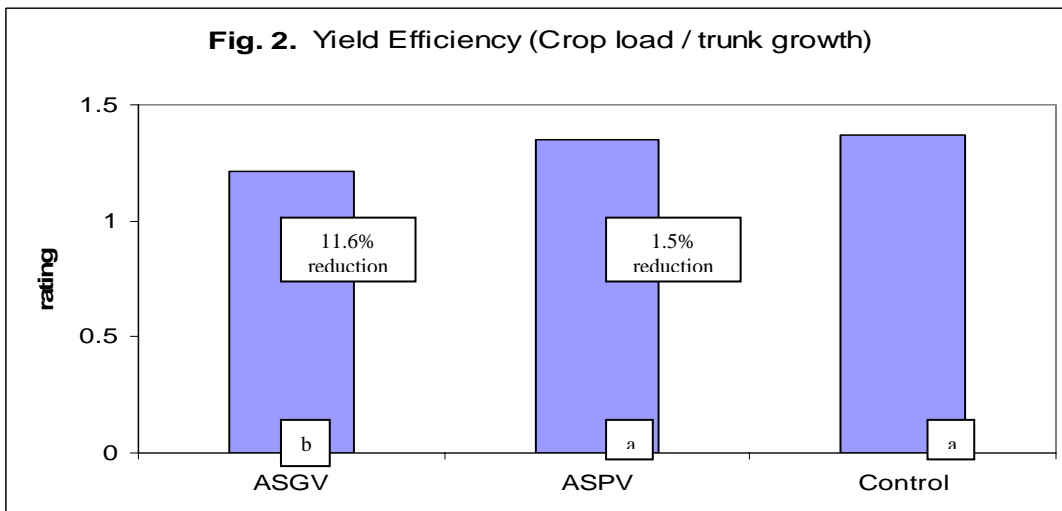
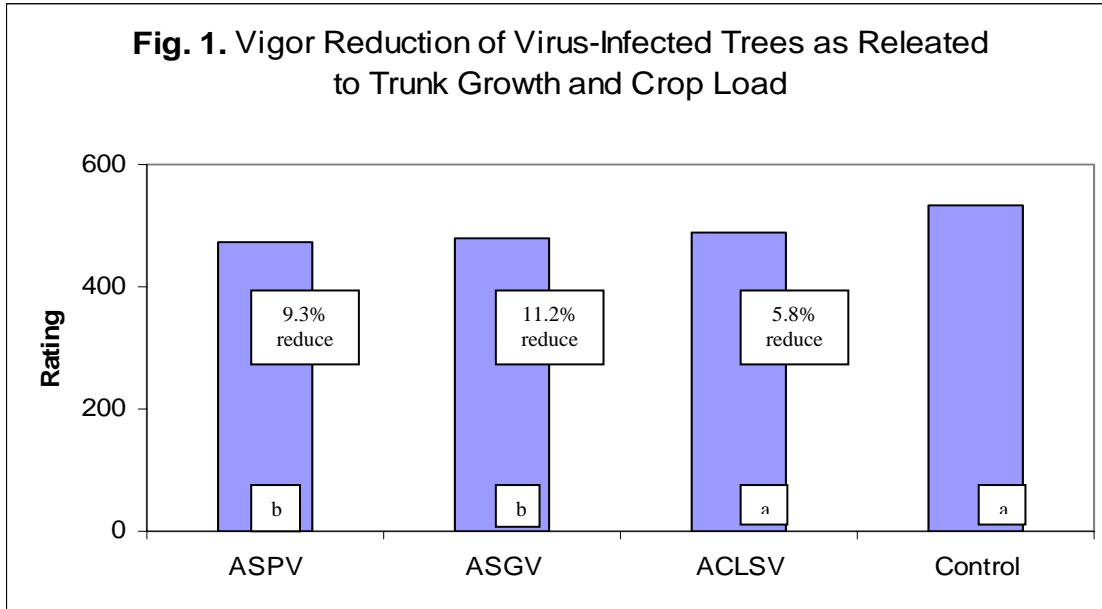
3. Fruit and tree data on 'Golden Delicious' trees established with virus components of apple green crinkle and rubbery wood will be collected. These various combinations of virus were obtained by differential heat therapy of trees propagated from diseased sources.

### **Results and Discussion:**

1. Viruses present in the early ripening source of Yataka Fuji appeared to induce a slight increase in maturation of fruit on trees of BC-2 Fuji, as estimated by starch and soluble solid measurements, but the results were not statistically significant. No measured differences were noted in weight, shape or pressure measurements between these two treatments.
2. One goal of this project was to determine if virus treatments with one or more of the so called apple latent viruses could be used to beneficially reduce tree vigor in orchards where excessive growth was a problem. Of the various treatments, ASGV and ASPV appeared to be the best candidates for use as a means to reduce vigor. By themselves and in combination with other virus treatments, these two viruses reduced tree trunk circumference over the three growing seasons by about a little more than 9% (Figure 1). ACLSV treatments also tended to reduce vigor, but the data was not statistically significant.

Although the greatest vigor reduction (28%) occurred in trees inoculated with tissue from a green crinkle diseased tree, the negative effect of this treatment on fruit quality was dramatic and should not be considered as a viable tool. Thus, ASGV and ASPV seemed like the most suitable viruses for consideration as vigor reduction tools in apples.

Unfortunately, ASGV not only effectively reduced tree vigor, it also appeared to cause slight reductions in tree productivity, as related to crop load and trunk growth (Figure 2). Fruit size was also adversely affected. ASPV did not appear to cause these same deleterious effects. Other fruit parameters such as pressure, soluble solids, and shape did not turn out to be adversely affected by ASGV, ASPV or ACLSV.



3. Based on fruit symptoms observed in the Golden Delicious “virus-separation” block (trees containing various virus combinations, as established by differential heat therapy), it is now apparent that apple green crinkle disease is associated with infections that include apple stem pitting virus. With this information in hand, Dr. Ken Eastwell’s program is in the process of developing laboratory procedures to detect the agent of this disease. Such a test will greatly assist growers and fruit tree propagators in avoiding future problems with this insidious disease.

Although the main goal of this study was to evaluate the potential of virus as a beneficial tool in orchard management, judicious caution should be use when considering their implementation. The above results demonstrate that either ASPV or ASGV were effective in reducing vigor of Fuji trees growing on fertile ground. However, they also demonstrate the potential downside of these treatments in that ASGV also reduced productivity and fruit size and that some ASPV infections are now associated with the economically important disease called apple green crinkle.

**Budget:**

**Project Title:** Virus effects on tree vigor and fruit maturity

**PI:** W. E. Howell

**Project duration:** 2002 to 2004

**Current year:** 2004 was final year

**Project total (3 years): \$7,804**

**Current year request: \$ 00.00**

**Budget:**

Year	Year 1 (2002)	Year 2 (2003)	Year (2004)
<b>Total</b>	\$ 2,500	\$ 2,600	\$ 2,704

**Itemized breakdown**

Item	Year 1 (2002)	Year 2 (2003)	Year 3 (2004)
Wages (Greenhouse Tech I) <sup>1</sup>	\$ 1,800	\$ 1,872	\$ 1,947
Benefits (16%)	\$ 288	\$ 300	\$ 312
Equipment			
Supplies <sup>2</sup>	\$ 412	\$ 428	\$ 445
<b>Total</b>	\$ 2,500	\$ 2,600	\$ 2,704

<sup>1</sup>Wages (Greenhouse Tech I) for maintenance, pruning and harvest of trees; fruit evaluation

<sup>2</sup>Horticultural supplies - fertilizers, sprays