Survey to Determine Frequency of Prunus Necrotic Ringspot Virus and other Ilarviruses in Newly Established Almond Orchards

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Introduction:

Prunus necrotic ringspot virus (PNRSV) is a member of the ILAR virus group and can infect a large number of *Prunus* species including almond. Certain strains, such as the almond calico strain can cause infectious bud failure and impact tree productivity. These viruses are pollen transmitted, but are not venereal. Infection is indirect and requires thrips to wound the flower to allow virus entry. Therefore, PNRSV can spread through an orchard, albeit slowly. More commonly, however, PNRSV is transmitted by grafting when infected tissue is grafted to healthy trees.

Figure 1 and 2. Leaf symptoms of Prunus Necrotic Ringspot Virus within almond. The Calico strain is the causal agent of "Infectious Bud-Failure" which reduces tree productivity.

PNRSV is commonly found in almond orchards world-wide and is a major limiter of production. Within California, however, occurrence has been limited due to quarantine services, and clean stock programs within nurseries. Infected tissue utilized as bud wood can spread the virus to new locations. Once infected tissue is in the field, transmission to non-infected trees occurs. Since the virus is pollen born and is spread through flowers, newly planted trees typically are disease free until they flower. The exception is if the virus was transmitted in bud wood or rootstock tissue produced via cuttings.

There are several strains of PNRSV that impact almond trees differently. Some strains are symptomless, while others can cause severe crop loss. Symptoms are characterized yellow spotting on leaves that are typically only observed in the spring time when viral concentrations are high. Leaf symptoms may be mottled (yellow spots), yellow, or have the presence of ring-looking spots (Fig. 1 and 2). Fruiting bud loss can occur, reducing yield, leading to a willow-like appearance to the tree (Fig. 3 and 4). Similar symptoms may occur with boron deficiency (BD) and non-infectious bud failure (NIFB). BD can be confirmed with a hull analysis. Terminal vegetative buds do not usually grow with NIFB.

Recently, there has been an increase in young to middle aged almond plantings testing positive for PNRSV. Although the initial source of infections is unknown, there is a high possibility that these orchard infections originated with infected nursery material.

Objectives and Methods:

One year old trees that have not flowered were surveyed to determine the frequency of PNRSV infection. Two to three leaves from 10-12 trees of the same variety were selected, pooled, and sent to a commercial lab to screen for PNRSV. Tree source and variety were kept anonymous for the report, but results were shared with the respective nursery if any viruses were detected. 20 orchards were sampled and submitted 41 samples for analysis. Screening for two other ILAR viruses (Tomato ringspot virus(ToRSV) and Prune Dwarf Virus(PDV)) also occurred.

Table 1. Test results for 3 different ILAR viruses from 20 different new orchard plantings within Merced County

Sample ID	Sample Location	Material	Variety	Rootstock	PNRSV	PDV	ToRSV
DD1	1	Potted	Aldrich	Hansen 536	nd	nd	nd
DD2	1	Potted	Nonpareil	Hansen 536	nd	nd	nd
DD3	1	Bare root	Nonpareil	Nemaguard	nd	nd	nd
DD4	1	Bare root	Aldrich	Nemaguard	nd	nd	nd
DD5	2	Bare root	Indepedence	Viking	nd	nd	nd
DD6	2	Potted	Indepedence	Viking	nd	nd	nd
DD7	3	Bare root	Indepedence	Viking	nd	nd	nd
DD8	3	Bare root	Indepedence	Viking	nd	nd	nd
DD9	3	Potted	Indepedence	Viking	nd	nd	nd
DD10	4	Bare root	Nonpareil	Nemaguard	nd	nd	nd
DD11	4	Bare root	Monterey	Nemaguard	nd	nd	nd
DD12	5	Bare root	Aldrich	Krysmk-86	nd	nd	nd
DD13	5	Bare root	Nonpareil	Krysmk-86	nd	nd	nd
DD14	5	Bare root	Wood Colony	Krysmk-86	nd	nd	nd
DD15	6	Bare root	Aldrich	Viking	nd	nd	nd
DD16	7	Bare root	Nonpareil	Nemaguard	nd	nd	nd
DD17	7	Bare root	Wood Colony	Nemaguard	nd	nd	nd
DD18	7	Bare root	Supareil	Nemaguard	nd	nd	nd
DD19	7	Bare root	Aldrich	Nemaguard	nd	nd	nd
DD20	8	Bare root	Nonpareil	Nemaguard	nd	nd	nd
DD21	8	Bare root	Monterey	Nemaguard	nd	nd	nd
DD22	9	Bare root	Nonpareil	Nemaguard	nd	nd	nd
DD23	9	Bare root	Wood Colony	Nemaguard	nd	nd	nd
DD24	9	Bare root	Nonpareil	Nemaguard	nd	nd	nd
DD25	10	Bare root	Nonpareil	Krymsk-86	nd	nd	nd
DD26	10	Bare root	Monterey	Krymsk-86	**POSITIVE**	nd	nd
DD27	11	Bare root	Indepedence	Lovell	nd	nd	nd
DD28	12	Bare root	Indepedence	Lovell	nd	nd	nd
DD29	13	Bare root	Indepedence	Nemaguard	nd	nd	nd
DD30	14	Bare root	Indepedence	Nemaguard	nd	nd	nd
DD31	15	Bare root	Indepedence	Nemaguard	nd	nd	nd
DD32	16	Potted	Monterey	Nemaguard	nd	nd	nd
DD33	17	Bare root	Nonpareil	Hybrid	**POSITIVE**	nd	nd
DD34	17	Bare root	Carmel	Hybrid	**POSITIVE**	nd	nd
DD35	18	Bare root	Nonpareil	Nemaguard	nd	nd	nd
DD36	18	Bare root	Fritz	Nemaguard	**POSITIVE**	nd	nd
DD37	19	Potted	Nonpareil	Krymsk-86	nd	nd	nd
DD38	19	Potted	Monterey	Krymsk-86	nd	nd	nd
DD39	19	Potted	Carmel	Krymsk-86	nd	nd	nd
DD40	20	Bare root	Butte	Nemaguard	nd	nd	nd
DD41	20	Bare root	Padre	Nemaguard	nd	nd	nd

Results and Discussion:

Four out of 41 samples tested positive for PNRSV from three different sites and three different nurseries (Table 1). Nurseries with positive results were contacted to screen their respective bud wood source trees. The other viruses were not detected.

The occurrence of this virus at a nearly 10% occurrence within newly planted orchards warrants further investigation. Within the study, the occurrence was limited to three nurseries all which have participated in viral indexing programs through State agencies. This suggests that either false negatives occur or bud wood is selected from trees that aren't tested. Bud wood sourcing from non-tested trees has happened in the past during periods of high planting.

From a grower's perspective, the presence of PNRSV within newly planted trees is concerning. Infected trees that are planted will most likely have low production and serve as a reservoir of the pathogen. Over time, the pathogen will spread to unaffected trees within an orchard, resulting in lower productivity and eventual orchard removal. Considering that this pathogen is a virus and is spread by thrips, there is no economical chemical control besides prevention of disease establishment.

To prevent disease establishment and spread within an orchard, trees should be certified disease free. Check with the nursery to see if they are participating in State virus screening programs, and if not, choose another nursery. Newly planted trees can be checked by pulling leaf tissue in mid-April through May. Mature "bull trees" or any other low yielding tree should be checked for leaf symptoms in the spring and also tested. If positive, trees should be removed prior to bloom the following year to reduce transmission to healthy trees.

Figures 3 and 4. Symptoms of Infectious Bud Failure within almond reduces crop yields. The virus prevents the development of buds, creating a "willow-like" look when successive fruit and vegetative buds fail. This is different from non-infectious bud failure (i.e. crazy top) due to growth at the terminal buds.

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