nutrient sprays of either phosphorus, phosphorus plus zinc, or phosphorus plus zinc plus iron during the dormant season of 1960-61, and three times during the 1961 growing season. Others were sprayed with zinc chelate (Zn EDTA, 14.2 per cent zinc as metallic) at 5 pounds in 100 gallons of water on October 17, 1960 and again May 3, 1961. Others received 1.5 or 3 pounds of iron chelate (Fe EDDHA, 6.0 per cent iron as metallic) broadcast from the trunks out about 8 feet and raked into the soil on October 25, 1960, or March 24, 1961. Still others were injected with 2,400 ml of iron chelate at a concentration of 360 ppm (iron as metallic) on October 19-20, 1960.

Bark scoring

During October 1960 and March 1961, 362 trees were scored vertically to stimulate callus formation and possibly provide an avenue for food and water movement through the area near the graft union, where plugging of the sieve tubes had caused the girdling effect associated with decline. Six to eight score wounds were made through the bark down to the wood on each tree, with either a heavy knife or a blight scraper. Short score wounds (4 to 6 inches above and below the graft unions) were made on half of the trees, and long score wounds (from 4 to 6 inches below the unions to 4 to 6 feet above) on the others. Two-thirds of the scored trees had their wounds filled with asphalt emulsion grafting compound, and a third were untreated.

Thus far, none of the sprays, ground applications, injections, or scoring treatments have affected the progress of pear decline. None of the treated or control trees improved, a few apparently held their own, but most deteriorated.

The relative severity of decline in the three locations at the beginning of the study was shown by the number of trees with brown lines at their graft unions (see Table): 20.7 per cent in the Ryde orchard, 76.5 per cent at Gold Hill, and 62.7 per cent at Camino. Trees with a brown line October 1960 had made less growth during 1960 at Ryde than at Gold Hill and Camino. In all three locations, however, trees with a brown line at the beginning of the study made less growth, bore less fruit, developed more red foliage, and had a higher death rate than those lacking a brown line at that time.

The steady progress of decline is shown by the percentage of trees lacking a brown line in October 1960 that developed one by October 1961. These percent-ages (respectively 35.9, 50.0, and 36.4 for Ryde, Gold Hill, and Camino) were rather consistent for all three locations.

Pear psylla

During November 1961, workers in Washington presented evidence that pear decline is caused by a systemic toxin introduced by pear psylla (Psylla pericola, Forester) feeding on the foliage. They found that the number of psylla per leaf was directly related to the amount of phloem injury, but that the toxin is so potent that relatively few psylla can cause great damage to pear trees on susceptible rootstocks. They reasoned that psylla alone may cause slow decline and that psylla coupled with adverse cultural environmental conditions (e.g., hot dry periods) causes collapse or quick decline.

If psylla are the cause of decline, the death rate and steady deterioration of trees in the Ryde orchard substantiate the conclusion that heavy populations are not required for severe damage. Surveys by University entomologists showed that psylla populations are much lighter in Sacremento River orchards than around Placerville and Camino. In the three orchards under study, psylla control has been adequate to permit the production of fruit suitable for fresh shipment.

Present study

The present study points to high summer temperatures as an important adverse condition that, in combination with psylla feeding, can cause the death of trees. This is shown by the low death rate of declining trees at Camino (3,000 feet elevation) compared with those at Gold Hill (1,900 feet) and Ryde (19 feet). At Camino, there were only two days during the two-year period (1960-61) when the temperature reached 100 degrees F. or above, whereas Walnut Grove (Ryde) had 35 days and Placerville (Gold Hill) had 43 days (see weather table). High temperatures seem to be the most logical factor causing stress in the trees near Ryde, since for many years the trees have been carefully irrigated under a system providing unlimited water. At Gold Hill, where tree losses have been heavier than in the other two orchards, additional stress may have been caused by lack of moisture for short periods in late summer.

Jordanoelo, Ne Plus Ultra, Peerless and Texas (Mission) varieties will make a satisfactory graft combination with Marianna stocks. Mature trees are somewhat smaller, however, than almond trees on peach or almond rootstocks and some overgrowth appears at the union. On the other hand, Nonpareil, Davey and Drake do not normally make a satisfactory graft combination with Marianna stocks. Trees of these latter combinations usually die within a few years although individual trees will occasionally make reasonably good growth for a longer period.

Incompatibility indicated

Incompatibility with Marianna 2624 rootstock was recently indicated by Texas, Peerless and, to a lesser extent, Ne Plus Ultra trees in newly planted commercial orchards. These varieties have usually made satisfactory combinations on this stock. One of two symptoms observed was the yellowing of the leaves and prema-
STOCKS FOR ALMONDS
emphasized in source mix-up with certain plum combinations

ture defoliation as early as August—ac-
companied by weak growth, shoot die-
back and some swelling at the union. Such
trees had to be replaced by the end of
the first year in some orchards and
others in succeeding years.

A second symptom was the presence
of brown areas at the graft union which
could be readily observed upon cutting
into the union. Occasionally these areas
were found in the first year wood but
in others they did not develop much until
the second year. Microscopic examination
showed distinct discontinuities at the
union in both the bark and the wood.

Texas trees obtained from one nursery
showed these abnormal symptoms in one
orchard, whereas trees of the same vari-
ety from another nursery were normal.
Buds were collected from: (a) rootstock
suckers under the normal trees, (b) root-
stock suckers under the abnormal trees,
(c) normal Texas and (d) abnormal
Texas. Each was budded into Marianna
2624 of known source in the nursery at
Davis. After one year in the nursery, they
were planted in the field.

Texas trees propagated from buds of
the abnormal source trees were com-
pletely normal at the end of the second
year in the field, indicating that the
trouble could not be attributed to the type
of Texas used. The supposed Marianna
rootstocks from the two sources were dis-
tinctly different from each other, how-
ever. The rootstock under the normal
trees was identified as Marianna 2624,
whereas the rootstock under the abnor-
mal trees was apparently some other
plum. This plum was thought to be one
of the myrobalan selections. Differences
between Marianna and myrobalan can
be observed on leaves of the Marianna
2624 in that they tend to be somewhat
flat rather than wavy. Even more striking
is development of a bronze color in late
fall whereas the leaves on myrobalan
trees are yellowish or green. At other
times of the year trees of the two plums
are difficult to distinguish.

Almond on Marianna

Trees of Texas, Peerless and other al-
mond varieties on Marianna 2624 root-
stock were grown at the Wolfskill Exper-
imental Orchard, Winters, as part of a
test started in spring, 1958, to study in-
compatibility. At the end of three years
in the field (four-year-old trees) both the
Texas and Peerless were completely nor-
mal, had made excellent growth, had re-
tained their leaves well into the fall and
showed no abnormalities at the graft
union.

Davey and some other varieties showed
incompatibility symptoms on Marianna
2624. The symptoms were found to differ
in certain aspects from the incommati-
ability symptoms shown by the Peerless
and Texas from the earlier described
commercial sources. Premature defoli-
ation, poor growth and dieback were simi-
lar in the two cases. A striking difference,
however, was that discontinuity at the
graft union of almond on known Mari-
anna existed only in the bark region and
did not occur in the wood. No telltale
brown line occurred on macroscopic ex-
amination, and neither did the character-
istic discontinuities appear at the union.

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