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 5, 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 percentages (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 Sacramento 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.

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PLUM ROOT

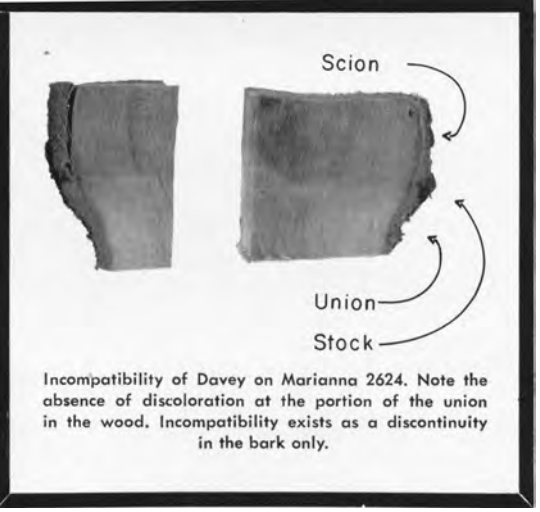
Incompatibility

An apparent mix-up within commercial sources of the vegetatively-propagated Marianna plum stocks with some other similar plum stocks has been revealed. Myrobalan plum seedlings, several vegetatively propagated myrobalan selections and two Marianna clones (2623 and 2624) have been commercially propagated for roostocks of stone fruits for a number of years. Of these, only the two Marianna stocks can be used successfully for almonds, and then only for certain varieties. Marianna 2624 is the more important because of its resistance to oak root fungus and is the one most often propagated for almond rootstock.

JORDANOLO, 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-



Incompatibility of Davey on Marianna 2624. Note the absence of discoloration at the portion of the union in the wood. Incompatibility exists as a discontinuity in the bark only.

STOCKS FOR ALMONDS

emphasized in source mix-up with certain plum combinations

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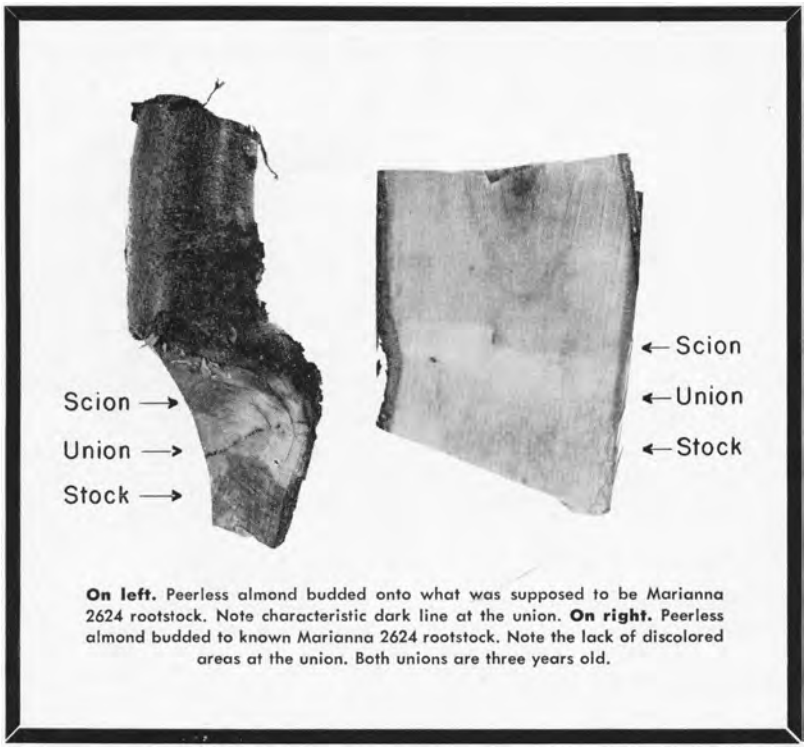
ture defoliation as early as August—accompanied by weak growth, shoot dieback and some swelling at the union. Such trees had to be replaced by the end of the first year in some orchards and others in succeeding years.

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 variety from another nursery were normal. Buds were collected from: (a) rootstock suckers under the normal trees, (b) rootstock 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 completely 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 distinctly different from each other, however. The rootstock under the normal trees was identified as Marianna 2624, whereas the rootstock under the abnormal 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.



On left. Peerless almond budded onto what was supposed to be Marianna 2624 rootstock. Note characteristic dark line at the union. **On right.** Peerless almond budded to known Marianna 2624 rootstock. Note the lack of discolored areas at the union. Both unions are three years old.

Almond on Marianna

Trees of Texas, Peerless and other almond varieties on Marianna 2624 rootstock were grown at the Wolfskill Experimental Orchard, Winters, as part of a test started in spring, 1958, to study incompatibility. At the end of three years in the field (four-year-old trees) both the Texas and Peerless were completely normal, had made excellent growth, had retained 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 incompatibility symptoms shown by the Peerless and Texas from the earlier described commercial sources. Premature defoliation, poor growth and dieback were similar in the two cases. A striking difference, however, was that discontinuity at the graft union of almond on known Marianna existed only in the bark region and did not occur in the wood. No telltale brown line occurred on macroscopic examination, and neither did the characteristic discontinuities appear at the union.

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