Branch showing both the bud-failure and the roughbark characteristics, taken from a seedling of the progeny Nonpareil Bf x Peerless Bf

Eradication of noninfectious

Bud-Failure in Almonds

objective of breeding program

Dale E. Kester and E. E. Wilson

Noninfectious bud-failure, or crazy-top as it is often called, is a disorder that affects certain almond varieties and not others. The disorder occurs extensively in Nonpareil, Peerless, Jordanolo and, to a limited extent, Mission (Texas). It is not known to occur in Ne Plus Ultra, Davey, or IXL.

Noninfectious bud-failure is bud-perpetuated, carried in propagating wood, and not transmitted through a graft union to other parts of a plant. Transmissibility tests over many years have pretty well determined that the cause is not a virus. Noninfectious bud-failure appears in seedlings originating from a tree with the disorder.

A virus disease found naturally in the Drake almond produces similar symptoms but differs from the noninfectious disorder in that healthy trees contract the disease when grafted with scions from infected trees but do not transmit the disorder to seedlings.

Noninfectious bud-failure has two

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grazing system used. The native pastures, in contrast, were very low in feed production at this time. Under Hopland conditions, range utilization was best for livestock production by using fertilized pastures from about November 15 until March 1 and then moving the stock to the native pastures. Considerable feed would be left in the fertilized pastures by the end of the growing season if grazing concluded about March 1, but this surplus could be put as hay, or otherwise used.

The gain of lambs after March 1 was less in the fertilized pastures than in the native pastures. One possible reason is the difference of species in the two areas. The fertilized pastures had a high percentage of weedy undesirable plants, which mature early and become relatively unpalatable earlier than do the native pastures. The greater abundance of weeds in the fertilized field probably developed from the previous use. The fields were used for hay production, and influx of weeds was considerable under this type of cultivation. The lambs in the fertilized pasture thus had less palatable feed to select from late in the growing season, which probably accounts for the inferior gain.

Gains

Protein percentage was 4.4% higher in January on fertilized range than on native pastures and only 1.7% higher at the conclusion of grazing. This higher protein, plus more feed available, may be one reason for better lamb gains in the fertilized fields during the first half of the grazing period.

The value received in meat, wool, and grazing use indicated that the cost of fertilizer was returned plus a profit of $13.04 per acre. An average of one and one-half tons of feed residue per acre was left on the fertilized field each year when the lambs were sold in June. This remaining dry feed was partially used during the summer by ewes. Phosphorus fertilizer was applied the first year only, but the cost was distributed over all three years, since this heavy application would have considerable carry-over value.

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types of symptoms. One is the failure of leaf buds to grow. In severe cases, all or most of the lateral buds on many shoots fail to open in the spring and eventually die. The few surviving buds produce long shoots on which the buds fail the next year. In a few years, the tree develops bushy branches, disorderly arranged, with few leaves. Such symptoms may appear on one branch or on all branches of the tree. The second symptom involves rough areas of bark, 6″ to 18″ long, that encircle the branches. Such areas develop when patches of the outer bark on terminal shoots die. As the shoots grow into branches the patches of dead bark persist as rough, scaly areas.

Once the disorder appears, the affected parts of the tree will not recover. Usually the disorder becomes progressively worse, and eventually the branch or tree is unproductive. The best remedial procedure is either to topwork the tree with scions from trees that do not have the disorder or to pull the tree and replant.

Genetic Studies

Recent studies on the genetic nature of the disorder involved hybridization between trees with bud-failure; between normal trees and trees with bud-failure; and between normal trees without visible symptoms. Nonpareil and Peerless varieties were used as parents. In addition, observation has been made on the appearance of bud-failure in progeny from other crosses.

The Nonpareil and Peerless trees with bud-failure differed genetically from the normal Nonpareil and Peerless trees used as parents. In those two varieties the bud-failure disorder appears to have arisen from mutation.

The percentage of seedlings with bud-failure was high when both parents had the disorder, lower when only one parent had the disorder, and lowest when neither parent had the disorder.

The tendency toward the disorder evidently is carried by some apparently normal varieties and may be passed along to their seedling offspring. Equally significant was that the age at which symptoms appeared differed among seedlings, depending upon the varieties used as parents.

The seedlings in the Nonpareil–Peerless test were first transplanted into the nursery in 1955. The number of affected seedlings in each population has regularly increased every year so that undoubtedly a number of individuals, normal in 1961, will show symptoms in the future. At the end of six years, where both parents had bud-failure more than 60% of their offspring showed moderate to severe symptoms. When only one parent had bud-failure the number was 30% or less, and individual seedlings were less severely affected. When both the Nonpareil and Peerless parents were normal, the percentage was only a few percent and symptoms were difficult to identify. It is estimated that many years might elapse before symptoms are apparent in all seedlings that actually have the disorder.

Jordanolo tree showing severe bud-failure over entire tree

Jordanolo

Information obtained in the genetic studies makes it possible to interpret the development of bud-failure in the Jordanolo variety. Jordanolo was a seedling resulting from a cross between varieties Nonpareil and Harriot, both of which were evidently normal but carriers of the predisposing genetic factor. The widespread, rapid development of bud-failure in Jordanolo led to the belief that the variety acquired the disorder through the seed. Use of the Jordanolo as a parent in crosses—in some cases from the original seedling tree itself—shows that it transmits bud-failure to a high percentage of seedling offspring.

All Jordanolo trees make up a clone, or parts of a single seedling tree that may be separately reproduced onto individual rootstocks. Characteristics of the disorder were not shown by the original seedling tree but only appeared in the clone after it had attained greater age with repropagation. However, the age at which these characteristics have appeared in individual trees is not the same throughout the clone but is influenced by unknown factors.

The delay in development of bud-failure characteristics is believed to be

New variety

Blanco Mariout Barley

may replace other varieties in some growing areas

Coit A. Suneson, Milton D. Miller, and George F. Worker

A part of the three-quarters of a million California acres long sown to California Mariout barley will begin to give way to the new Blanco Mariout after the 1961 harvest.

A typical product of the backcross system of plant breeding—some economic gains without any upset of genetic factors governing varietal adaptation—the new Blanco Mariout is adapted for use in the districts where California Mariout is now grown. These are the warmer, drier, and more alkaline-soil parts of the state. Varieties Blanco Mariout will tend to replace include California Mariout and Arivat.

Blanco Mariout was produced from multiple backcrossing of male sterile Club Mariout × California Mariout[7] at Davis, in a program that began in 1943. Testing began in 1956, but Breeder's seed was not produced until 1959. Then 192 somewhat diverse lines were bulked to give 105 pounds of Breeder's seed. The principal 1960 Foundation Seed increases were made at the Imperial Valley Field Station and from a summer sown crop at Davis. From these increases 11 grower members of the California Crop Improvement Association received allocations totaling about 12,500 pounds of Registered seed for planting in 1960–61.

Blanco, a Spanish word for white or colorless, describes the seed color change from the blue California Mariout prototype. It was the sought change, involving principally the aleurone cells of the endosperm. In the field before harvest, Blanco Mariout will show a darker green leaf and somewhat denser spikes. The threshed grain is strikingly brighter, with more variable rachilla hairiness and lengths of rachillas than California Mariout. The grains also average larger in size and softer in texture and show less skinning and cracking from threshing than California Mariout. The reduced threshing damage is due to improved hull or glume adherence to the seed. This feature reduces test weight slightly. Blanco Mariout will show essentially the same early maturity, height, disease reaction, and drought and alkali tolerance as California Mariout.

No really significant yield differences, reported in pounds per acre, were established in statewide tests.

Blanco Mariout has better and broader marketing prospects, compared with blue California Mariout, because white—colorless aleurone—barleys have generally brought growers a slight premium in most years since 1945. There is a distinct market preference for barleys with a colorless aleurone for export for food use, particularly in Japan and Korea; for domestic use for pearling, dietary flour, or malt products; and for malting and brewing. Use of some Blanco Mariout in brewing ultimately is possible,

Yields in Pounds per Acre of California Mariout and Blanco Mariout Barley, in Statewide Tests

Test area	No. of years	Calif. Mariout	Blanco Mariout
University Farm, Davis	5	3304	3375
Meloland Field Station	4	3167	3241
Extension sponsored farm tests	3	2833	2712

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prevalent in the normal × normal progenies of the Nonpareil–Peerless experiments.

Probably Jordanolo should not be propagated in nurseries or in topworking other trees. However, many Jordanolo orchards are still normal and may remain so for a number of years.

The studies on noninfectious bud-failure indicate a genetic disorder in which control depends upon proper selection for propagation. The method of selection depends upon the particular variety.

One group of varieties includes Nonpareil, Peerless, and probably Mission (Texas), in which bud-failure is evidently acquired by mutation. To propagate trees in this group, budwood sources should be free of bud-failure, although it is difficult to prove the source to be free of the disorder. Scionwood should come from trees examined carefully for freedom from the disorder, but an individual tree may show slight or no symptoms for many years. However, in most cases, symptoms do develop by the time the tree reaches an age of five or six years. Collection of budwood from very old trees is less hazardous, but such trees may carry virus diseases that render them undesirable budwood sources.

Tracing scionwood sources known to be free of bud-failure through nursery records to their behavior in individual orchards would require a system of record keeping and time to put into effect but could be of considerable significance in protecting the almond industry of California.

A second group of almond varieties subject to noninfectious bud-failure includes Jordanolo and probably Jubilee which, in the Paso Robles area, has a history similar to that of Jordanolo. These varieties apparently acquired the disorder through the seed, but its potential severity was not immediately revealed.

The basic problem in testing varieties is to identify potential bud-failure before the clone is introduced into commercial plantings.

Long-range experimental work is being started to learn whether controlled crosses between trees can be used to test budwood sources and whether the incidence of bud-failure among the offspring could be used in estimating the bud-failure potential of the source.

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