In-Field Chipping and Shredding of Almond Prunings as an Alternative to Burning

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Objectives:

1. **To determine the feasibility of in-field chipping or shredding of almond prunings as an alternative to burning.**

2. **To determine the desired initial particle size after shredding to achieve satisfactory woody residue levels by harvest.**

3. **To determine if nitrogen or other amendments applied after shredding will aid in microbial decomposition of shredded brush.**

Introduction:

Most almond orchards are pruned each year and brush is typically pushed out of the orchard and burned. Due to increasing concerns over air quality and the inconvenience of waiting for burn days, we are exploring the practice of in-field chipping or shredding of almond prunings as an alternative to burning. Although shredding is a common practice in vineyard and stonefruit farming systems, woody debris on almond orchard floors can be problematic. Debris that is picked up with the nuts at harvest and not separated from the hulls during the hulling process will increase hull crude fiber content. Hulls are sold to dairy producers and represent a significant income for hullermen. Hulls containing more than 15% crude fiber are significantly less valuable. In addition, wood debris separated at the huller is considered to be industrial waste and must be disposed appropriately.

"Chipping" vs. "Shredding". Our first trial conducted during 1996-1999 compared "chipping" which produces small, cut, angular pieces with smooth sides and sharp edges against "shredding" which results in a longer, thinner, torn or frayed product. The chippers were large, hand-fed machines similar to ones used by municipalities in urban landscapes. Two shedders were used in this trial: a Rears® tractor-mounted shredder and a high-horsepower, self-powered shredding machine designed by Burt Walters of Stanislaus County. Prunings were chipped or shredded in the fall after pruning each year. Treatments were evaluated each year at harvest by measuring the percent woody material in windrows, nut carts and in processed hull piles.

Results (published in 1998 & 1999 Almond Industry Conference Proceedings) showed that shredding with the Rears® shredder (one pass) and chipping resulted in significant increases in woody material in the finished hull product in all three years. Chipped prunings had the highest percent wood in windrows, nut carts, and hull piles. Woody debris in rows shredded with Bert Walter's self-powered shredder was similar to rows where brush was pushed out and burned due to the small initial particle size after shredding. In general, there was less woody debris each year in the native vegetation block presumably due to additional fragmentation from closer and more frequent mowing than the block with a planted and maintained legume cover crop.

Maximum particle size. In 1998, a second trial was initiated to determine to what particle size prunings must be initially shred to achieve satisfactory results at harvest the following year. In this microsprinkler-irrigated trial, two, three, or four passes with a tractor-mounted Rears® shredder was compared against the conventional practice of removing brush from the orchard and burning it. After shredding, debris was collected and separated into particle size categories to determine the fate of differing sizes of woody debris. As expected, average particle size decreased with each pass of the shredder. In turn, the amount of woody debris collected in windrows and nut carts the following season decreased as the number of passes increased. Debris up to 1 cm in length was essentially removed during the harvesting process and left in the field. Most debris over 9 cm (3.5 inches) was separated during the hulling process. Regardless of brush disposal method, wood debris ranging from 1-9 cm in length proved to be most problematic because they were not separated well from the hulls and tended to accumulate in the hull pile. In these trials, rows where brush was removed and burned still had lower levels of woody debris in windrows and nut carts than even rows where brush was shred with four passes (1999 Almond Industry Conference Proceedings). An attempt to confirm the 1998-99 results failed when all the data rows were inadvertently shredded with four passes in 1999-2000.

Use of Topical Amendments to Speed Decomposition. A third chipping trial was conducted to see if the application of various fertilizers and amendments would increase the rate of woody residue decomposition. In November 1999, a microsprinkler-irrigated Nonpareil orchard in Stanislaus County was moderately heavily pruned and the prunings were stacked in every other row. On approximately December 1, the prunings were shredded with one pass of a tractor-mounted brush shredder. Debris was not incorporated into the soil. One of several fertilizers or amendments were sprayed over the top of the shredded debris in a randomized complete block design with three replications of each treatment. Each replication was four rows wide. The treatments included UN32 applied at a rate of 50 units of nitrogen per acre, UN32 at 100 units N per acre, N-pHuric at 35 gallons per acre, an acidic 8-0-0-9 fertilizer, and untreated controls. Prunings from three rows at the edge of the trial were pushed out of the orchard and burned for observational comparison.

On August 21, 2000, windrowed almonds were harvested off the orchard floor with a commercial pick-up machine. Random samples were collected from each treatment as harvested material spilled into the nut carts. In the laboratory, samples were separated into categories of hulls, nuts & shells, sticks broken during harvest operations and "shredded" woody debris. The shredded woody debris was categorized by length; less than 1 cm in length, 1-3 cm, 3-6 cm, 6-9 cm, 9-12 cm, 12-15 cm, and greater than 15 cm. As shown in Figure 1, very little debris less than 1 cm in length went into the nut carts because most of this small material was blown away or fell through the screen of the pick-up machine. The majority of woody debris (by weight) was 1-9 cm in length which is the size shown in our previous trials to most likely end up in the finished hull pile product.

1999-2000 Almond Shredding Trial, Stanislaus County.

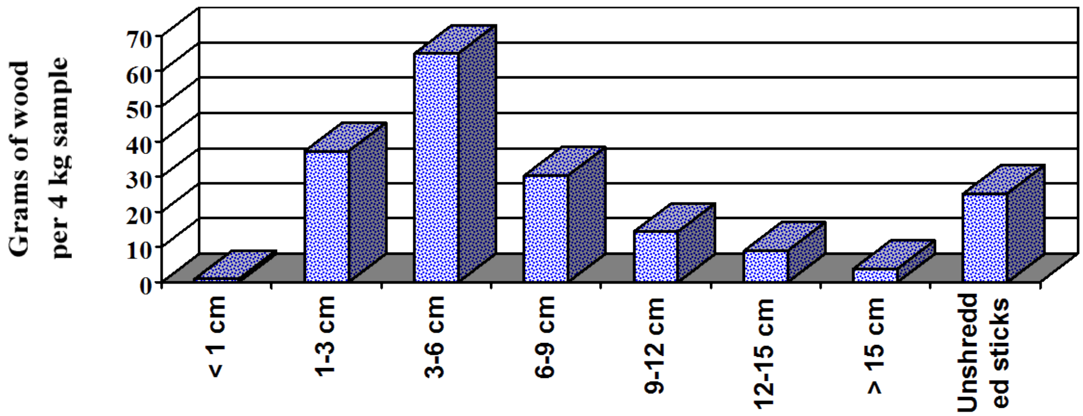

Fig. 1. *Woody debris in nut cart samples at harvest segregated by length. Prunings were shredded the previous fall with one pass of a tractor-mounted brush shredder.*

As shown in Figure 2 below, none of the amendments applied to the debris after shredding appeared to increase the rate of decomposition. All shredded treatments had similar levels of woody residue at harvest. Wood content was excessive in all areas except where prunings were pushed out of the orchard and burned.

1999-2000 Almond Shredding Trial, Stanislaus County.

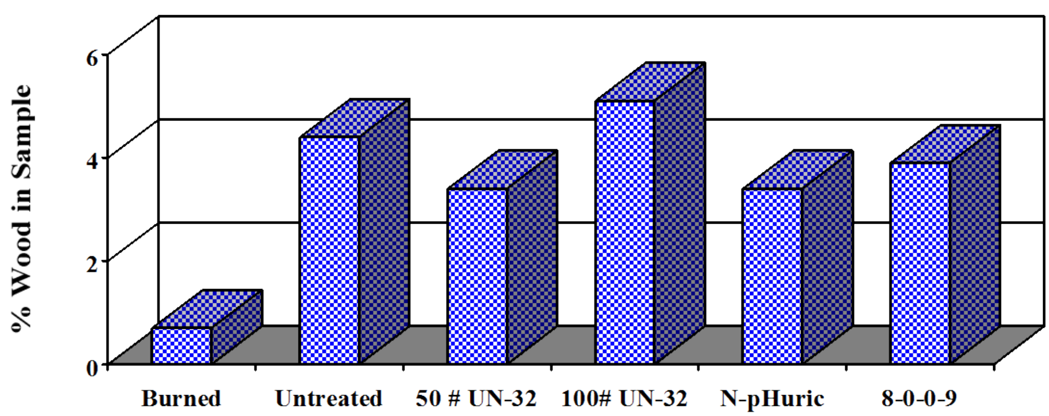

Fig. 2. *Percent woody debris in nut cart samples ten months after prunings were shredded and treated with various amendments. Treatment means are not significantly different at P$\leq$ 0.05. Three rows of prunings were pushed out of the orchard and burned for observational purposes only and were not included in statistical analyses.*

Discussion:

Current almond harvest operations include mechanically sweeping the nuts and hulls from the orchard floor and depositing them into nut carts. Woody debris longer than one centimeter is collected with the almonds. This is problematic because wood not separated during the hulling process often ends up in hull piles, significantly decreasing their value. Sticks longer than nine centimeters are usually separated by the hulling operation but represent a disposal problem.

With currently utilized harvest machinery, chipped or shredded wood must be no larger than one centimeter in length by the time of harvest. Decomposition of shredded and chipped wood is very slow under San Joaquin Valley almond orchard conditions even when high amounts of nitrogen fertilizers are applied. Incorporating debris into the ground may aid decomposition but most growers are reluctant to disrupt their no-till system. This means woody debris must not be much larger than one centimeter in length immediately after shredding. To obtain this small size, multiple passes are necessary with currently available tractor-mounted brush shredders. Larger, high-horsepower machines are being developed for custom operators, but even these often miss several limbs in each row, requiring additional efforts.

In our estimation, the first pass with a tractor and shredder costs at least $15 per acre under moderate pruning conditions. Each successive pass is less expensive as shredding is easier and requires significantly less time and horsepower. Assuming three to four passes are usually necessary to achieve satisfactory results under moderate pruning conditions, the cost may be $30-$40 per acre. Custom operators with self-powered, high horsepower shredders typically charge $30-$40 per acre depending on severity of pruning. The current standard practice of pushing brush out of the orchard and burning it costs approximately $7 per acre.

We have shown it is possible to shred almond prunings in the field without significantly increasing hull crude fiber content. However, this required multiple passes with the best currently available tractor-mounted implements. Although machinery is improving every year, this practice is not likely to be justified economically under current regulatory conditions. The agronomic value of returning organic matter to the soil in the form of shredded brush needs to be quantified.