

Small-Scale Western Juniper (*Juniperus occidentalis*) Whole Tree Chipping Trial and Particle Size Screening Results

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Purpose: The purpose of this project was to obtain raw material for a variety of on-going Oregon State University western juniper product trials. This report documents the chipping operation used to obtain the raw material and particle size classification. Particle size classification was conducted to determine potential to produce consistent-size material that could be used in livestock operations with liquid manure guns.

Raw Material: Two western juniper trees were whole-tree chipped for this project (i.e. with bark, branches and foliage). The trees were located on a ranch owned by Richard and Janie Dodge, located about 14 mi. southwest of Maupin, between Hwy. 216 and adjacent to the northern boundary of the Warm Springs Indian Reservation. The two trees were felled, yarded and chipped on the same day (November 18th, 2005).

Ranch and Equipment Owner, and Machine Operators: Richard Dodge, Dodge Logging, donated use of the equipment, machinery and supplies used to produce the whole tree chips needed for this project. Gus Delco and Lyle Brittan, Dodge Logging employees, operated the rolling stock and chipping machinery. Mr. Dodge selected the two western juniper trees that were chipped.

Sample Tree Site Description:

The site where the juniper trees were cut appears to be highly productive rangeland. Elevation is about 2,100 ft. and the trees were located on a slight northerly slope. Junipers in this area are generally scattered (<35 trees/ac) or sparse. Juniper is mixed in with Oregon white oak (*Quercus garryana*) in the immediate area where the two trees were cut. Understory consists



of scattered sagebrush (*Artemisia* sp.) and bitterbrush (*Purshia tridentata*). Groundcover consists of various grasses and forbs. A pure stand of white oak is located a couple of hundred feet to the west and north of where the junipers were removed.

Sample Tree Description: The two trees felled for this project grew out of the same stump. Both trees were about 20- to 25-ft tall and 10- to 12-in. DBH. Tree rings at stump height indicated an age of about 70 years.

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Rolling Stock and Machinery Description: The two juniper trees were carried from the site to a nearby semi-stationary chipper with a front-end loader. The chipper is located adjacent to a log yard used by Dodge Logging to deck logs prior to chipping. The chipper and associated machinery are portable (mounted on axles, wheels and trailers), but have been in the same location for over a year. The chipper is a Precision self-loading model. A Nicholson debarker is mounted on a trailer at one end of the chipper in-feed, but was not used for this project. An “Oregon Beaver” rotary classifier with rechipper for oversize chips and reciprocating underscreen to separate fines is located on the other end. The entire system (debarker, chipper and classifier) is set-up to produce consistent, high-quality chips for the pulp and paper industry. Maximum log is about 22-in. diameter. It is unusual in Eastern Oregon to have a Nicholson debarker on the front-end of an in-the-woods chipper and a classifier for screening chips on the other.

According to Mr. Dodge, total cost new for the system described, including debarker, chipper and classifier, custom-mounted on flat-beds, would be about \$1,000,000 new and \$400,000 good used. The Oregon Beaver rotary chip classifier itself would cost about \$180,000 new (good used from \$125,000 to \$150,000).



Chipping Operation Description:

The self-loader on the chipper placed each tree onto the in-feed chain, and then helped guide the tree into the chipper until the feed rollers were able to engage and self-feed tree and limbs into the chipper (see photo). Some difficulty was experienced trying to feed the tree and limbs into the chipper because the infeed chute is designed for logs, not whole trees with large, flexible limbs. The self-loader was also hindered by its heel boom attachment which prevented it from pulling shorter lengths into the infeed chute.

Sample Chipped Material Collection: The Oregon Beaver rotary classifier/rechipper

was not operated at the same time as the chipper (see photo). The purpose was to allow retrieval of unclassified chips from the infeed hopper for the classifier/rechipper. After the two junipers were chipped, 22 polypropylene-woven or burlap feed sacks were filled with unclassified chips, averaging about 25 lbs. each. The classifier was then turned on and another 20 sacks were filled with chips that went through the classifier and rechipper. The equivalent of 20 sacks or more of chips were left in a pile under the



discharge chute. All sacks were labeled and tied off with plastic ties.

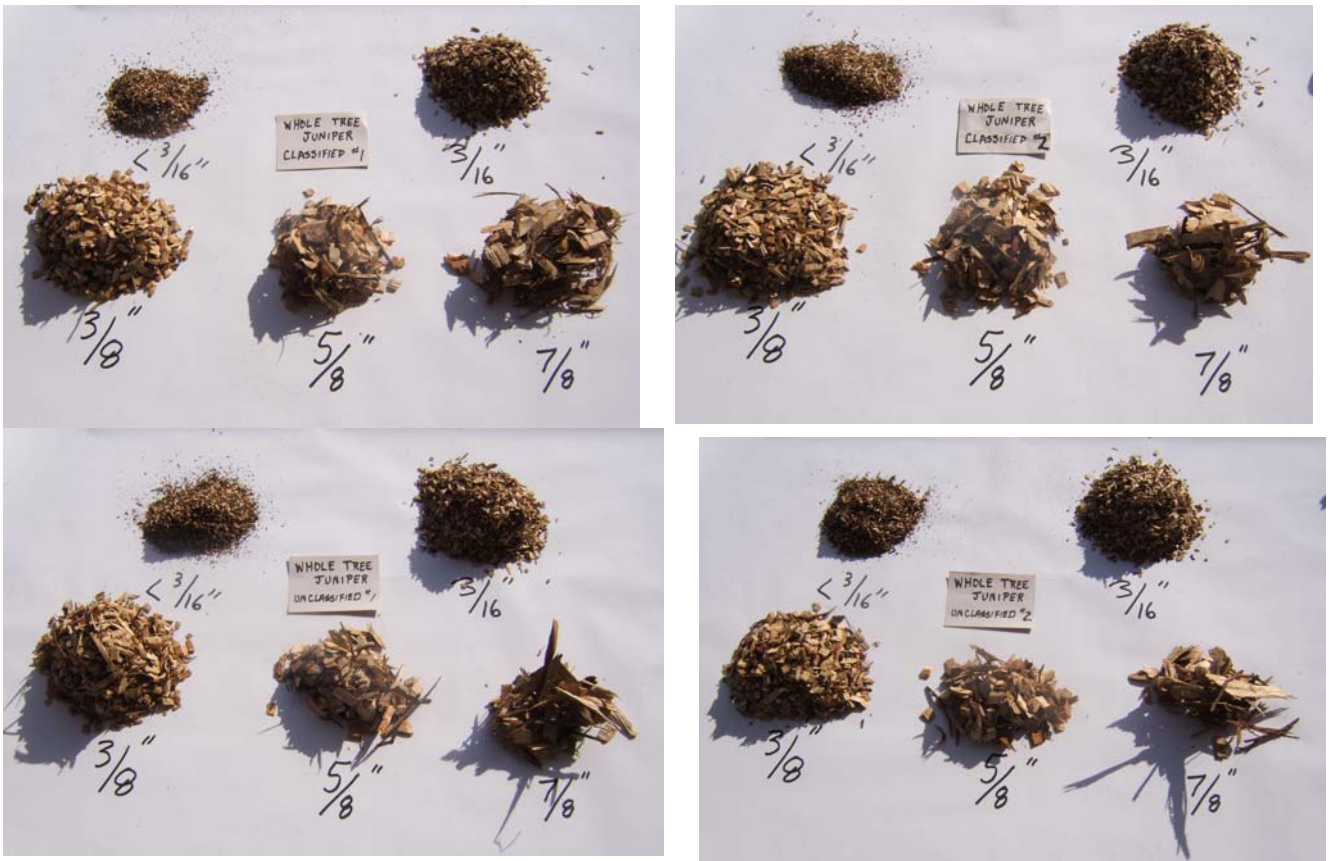
Raw Material Appearance: The whole tree chipped material, prior to classifying and rechipping, included a range of chip sizes. There were also some small twigs and branches less than ½-in diameter and less than 12-in long. After classifying and rechipping, the whole tree chipped material still contained a range of sizes, but fewer small twigs and branches.

Equipment Operator Comments: Equipment operators noted that the chipper was not operating at its optimal level – chip knives had not been sharpened for the trial, thick chips indicated that the chipper anvil setting might need adjustment, and difficulties experienced feeding entire juniper trees into infeed rollers meant that chipping knives tended grab the material, producing larger chunks and pieces than normal.

Storage and Transportation: The 42 sacks of whole tree-chipped juniper were transported in a pick-up with camper shell to Klamath Falls the same day they were chipped. The sacks were transferred to another truck with camper shell and transported to Oregon State University on November 21st, 2005. During the time the chips were stored in Klamath Falls, temperatures averaged in the 20s and 30s (Fahrenheit) during the night, and the 40s during the day. Moisture from the green chips was evident on the inside windows of the two camper shells used.

Particle size characterization: Particle size was characterized by screening. Small samples of classified and unclassified juniper, as well as western redcedar (*Thuja plicata*) shavings, a common livestock bedding in Western Oregon, were selected that appeared to represent the material as a whole. The "screens" used for this study were punched metal plates with round holes of various sizes (< 3/16", 3/16" to 3/8", 3/8" to 5/8", 5/8" to 7/8", > 7/8"). Screens were stacked in series in a vibrating frame, with a pan at the bottom to collect the fraction of sample <3/16". Chips were screened at moisture content as received into the five size classifications. After screening, chips were dried over night at 103° C to determine oven-dry weight. Results are shown in Table 1 at the end of this report. Following are photos showing classification of particle size in each of the samples.





Interpretation and Implications: The purpose and scope of this chipping trial was limited. The primary reason was to obtain raw material for Oregon State University juniper projects, however, in the opinion of the author, results probably represent difficulties similar to those that would be encountered in a larger trial involving many more trees and everyday operational conditions.

Screening was performed with a small sample to determine chip size, shape and homogeneity for possible use as calf bedding material in dairies with liquid manure guns. The juniper chip samples screened contained 28% to 40% material larger than 5/8". This material is likely to cause plugging of liquid manure handling equipment used in livestock operations. On the other hand, western redcedar shavings, purchased bulk by the College of Veterinary Medicine (Oregon State University), only contained about 4% material larger than 5/8".

Probably the key finding of the screening portion of this trial is that even if costs are ignored, in-the-woods whole tree juniper chipping is unlikely to produce consistent enough results for some applications, such as dairy bedding, where consistent chip size is required to meet waste system operational constraints, such as the nozzle on liquid manure guns. This does not mean that juniper cannot be used for animal bedding, simply that where consistent size is important, whole-tree chipping in the field is not a viable option. Paddock and stall bedding, and other large animal bedding applications would not be nearly as demanding and juniper could be either chipped or ground.

An alternative to in-the-woods chipping is to delimb and truck logs to a stationary chipping facility. This alternative is especially attractive if a consistent size chip is

needed for a particular product or application, there is marginal road access for chip vans and chipping equipment, and year-round access to raw material and chipped product is desired. The stationary chip/storage scenario is estimated to cost \$70-\$90/green ton, FOB chip/storage site (includes reloading) vs. \$55-\$60/green ton for in-the-woods chips, FOB landing (based on prior experience).

TABLE 1 - Juniper Chip Screen Classification

Note: Chips were screened at moisture content as received into five (5) size classifications. After screening, chips were dried over night at 103 C to determine the oven-dry weight.

Sample Description	Size	Pan(s) Mass (g)	Pan(s) and Wood		Wood Mass (g)	Mass Fraction (%)
			As Received	Dry		
Whole Tree Juniper, Classified: Sample 1	> 7/ 8"	6.60	185.35	122.50	115.90	22.9
	7/ 8" - 5/ 8"	6.68	142.45	96.44	89.76	17.7
	5/ 8" - 3/ 8"	13.52	260.93	176.21	162.69	32.1
	3/ 8" - 3/16"	13.29	174.49	116.83	103.54	20.4
	< 3/16"	6.62	70.70	41.64	35.02	6.9
					506.91	
Whole Tree Juniper, Classified: Sample 2	> 7/ 8"	6.59	133.06	91.95	85.36	16.0
	7/ 8" - 5/ 8"	13.29	170.13	120.83	107.54	20.1
	5/ 8" - 3/ 8"	13.30	263.12	182.37	169.07	31.7
	3/ 8" - 3/16"	13.35	195.83	133.55	120.20	22.5
	< 3/16"	6.70	98.42	58.61	51.91	9.7
					534.08	
Whole Tree Juniper, Unclassified: Sample 1	> 7/ 8"	6.59	138.80	88.08	81.49	13.8
	7/ 8" - 5/ 8"	6.59	166.61	103.25	96.66	16.3
	5/ 8" - 3/ 8"	13.30	333.89	205.91	192.61	32.5
	3/ 8" - 3/16"	13.33	264.71	158.98	145.65	24.6
	< 3/16"	6.70	168.72	82.49	75.79	12.8
					592.20	
Whole Tree Juniper, Unclassified: Sample 2	> 7/ 8"	6.69	124.39	76.85	70.16	13.2
	7/ 8" - 5/ 8"	6.67	140.55	89.19	82.52	15.5
	5/ 8" - 3/ 8"	13.16	275.10	170.85	157.69	29.6
	3/ 8" - 3/16"	13.22	256.99	154.82	141.60	26.6
	< 3/16"	6.78	177.38	87.19	80.41	15.1
					532.38	
Cedar Bedding: Sample 1	> 7/ 8"	6.67	8.76	7.66	0.99	0.7
	7/ 8" - 5/ 8"	6.67	17.40	11.55	4.88	3.2
	5/ 8" - 3/ 8"	13.16	103.33	52.61	39.45	26.0
	3/ 8" - 3/16"	13.22	127.87	62.57	49.35	32.5
	< 3/16"	6.77	143.63	63.90	57.13	37.6
					151.80	
Cedar Bedding: Sample 2	> 7/ 8"	6.62	7.64	7.12	0.50	0.3
	7/ 8" - 5/ 8"	6.69	19.20	12.57	5.88	4.0
	5/ 8" - 3/ 8"	13.55	99.75	51.70	38.15	25.7
	3/ 8" - 3/16"	13.28	122.51	61.03	47.75	32.2
	< 3/16"	6.62	139.86	62.83	56.21	37.9
					148.49	