Hi Judy,

Some background, some observations, and some general information.

Background:

When Pasco cherry grower Ron Lucas decided he needed some wind machines to frost protect his orchard, he contacted industry giant Orchard Rite Ltd and H.F. Hauff, a smaller, family-owned business, both of Yakima.

Both companies sent representatives to meet with Ron is his orchard and both presented information on their respective machines. Dean Hauff, however, intrigued Ron by showing him the results of a 1993 field trial comparing an Orchard Rite wind machine blade with a Chinook blade. The report stated that the Chinook blade produced twice the amount of air flow at 400 feet from the tower with a substantially larger sector angle. The sector angle determines the length of time of air flow past the fruit buds, which is critical to frost protection. A study at the University of California, Davis in 1952 determined that air flow over fruit buds to prevent ice crystals from forming must return in under 4.5 minutes.

With the encouragement of local orchardist, innovator, field representative and fruit guru, Jim Kelley, Ron arranged a demonstration for local farmers to again compare the Orchard Rite and Chinook blades, because if the differences between them could be substantiated, it could be significant for the industry. Ron invited both Orchard Rite and Chinook to provide blades for the demonstration and located a tower on level ground with a 400 foot down-drift path in a cherry orchard owned by Glenn Clifford. Orchard Rite declined to attend.

Demonstration:

The morning of January 15th, the weather was cold with a slight north wind across the flagged 400 foot path. About 20-25 growers attended, including Jack Watson from WSU. The wind meter was moved down wind from the tower to prevent a cross wind. The tower had a newly installed Orchard Rite blade and gear box, which was started and run for several rotations before beginning to gauge its efficacy. At 300 feet, its air flow was approximately 6-8mph with a 47 degree sector. This was with a 3-5mph wind behind it. A Chinook V-10 blade was then installed and it produced 10-11mph of airflow with an 80 degree sector, with a 3-5 mph wind behind it. The growers noted a very noticeable increase in air flow from the V-10 while standing at 300 feet from the tower, and commented on the unusual sound of the blade. Due to the wind, further demonstration was postponed for calm conditions.

The morning of January 16th at 7am, Ron, Glenn Clifford, and Neil Hauff returned to the site in calm conditions. They ran the Chinook V-10 blade, then the Chinook 460, then the Orchard Rite blade. In testing, they timed the tower rotation at over 4 minutes, 40 seconds per revolution. This exaggerates sector angle as Chinook towers revolve at 4 minutes, 30 seconds per revolution. Ron and Glenn noted substantial tree branch movement to the 500 feet mark during the Chinook runs, and some tree branch movement to the 250 foot mark during the Orchard Rite run.

Results:

	Air movement at 400 feet	Sector angle	Motor rpm	Motor vacuum
Orchard Rite	none discernible	none discernible	2620	6.25"
Chinook 460	8.63mph (adjusted for drift)	92.8 degrees	2700	8"
Chinook V-10	8.56mph (adjusted for drift)	80.4 degrees	2700	7.5"

Conclusion:

The two Chinook blades produced much more air flow at 400 feet than the Orchard Rite blade, taking wind drift into account, with a larger sector angle, and with higher motor speed and less drag on the motor, therefore, less fuel consumption. For the grower, this translates into more air flow past the bud, larger effected area of air flow, longer exposure to air flow, with less engine wear and fuel cost.

The demonstration has sparked an interest in Jack Watson of WSU, who has invited H.F. Hauff to provide the components necessary to help WSU with an independent study to substantiate these field trials.

Note: Orchard Rite representatives Rod Robert and Dave Harmening came to Glenn Clifford's orchard Friday, January 17, and speculated that the results may have been skewed by a defective blade. They took the Orchard Rite blade back to their shop to test it.

Further Background:

H.F. Hauff was founded in 1947 by Howard and Helen Hauff and has been in the wind machine business for 33 years. Since Howard died in 1998, Helen is the owner and works 6 days a week at the plant with her sons, Dean and Neil. H.F. Hauff makes the wind machines from the ground up, building the towers, machining the drive lines and hubs and forming the fiberglass blades in their Yakima plant. They use fan cooled gear boxes by De'Ran, one of the three largest gear box manufacturers in the world, and Ford 460 and the new Ford V-10 motors. The more powerful V-10's allowed Hauff's to build the more aggressively pitched V-10 blades. Their drive lines are seamless and balanced at 1400 rpm. The Hauffs put servicing their customers first, and despite enduring years of unscrupulous business practices by their competitors aimed at putting them out of business, their product speaks for itself. The Hauffs will replace any blade with one of their own for a free trial period during frost protection, and will re-install the previous blade if the grower is not satisfied.

Ron's Opinion:

"Based on the demonstration and my numerous conversations with both Orchard Rite and H.F. Hauff's representatives, my wind machine purchases with be Chinooks from Hauff's and I look forward to any future research provided by WSU on the subject."

Anyone interested in more information can contact Ron or contact H.F. Hauff directly, 509-248-0318.

And many thanks to Capital Press for their interest and to Judy for enduring the cold!!

Chinook
Wind Machines

a warm tropical breeze

H. F. Hauff Company
1801 Presson Place - Yakima, WA 98903
Phone: 509-248-0318 Fax: 509-248-0914

January 20, 2003

Those in attendance at the Glen Clifford orchard on 1/15/2003

We at H. F. Hauff Company would like to thank each and every one of you who attended the propeller comparison demonstration held at the Glen Glifford orchard in Pasco, WA on January 15, 2003.

Though the weather conditions were disappointing, we were able to verify the sector angle coverage of the wind machine as we had previously reported in our test of January 21, 1993. However, the velocity increase of the wind speed test was negated because of the shift of our test site and the 3-7 MPH drift that was present from the North.

Enclosed are results from January 16, 2003, the following day, as witnessed by Ron Lucas, Glen Clifford and myself. Also enclosed are background notes, observations and general information as written by Ron and Kathy Lucas.

Please call me with any questions about the test.

Once again, thank you for taking time out of you busy schedules to observe our propeller comparison demonstration.

Sincerely,

Neil Hauff

Neil Hauff

H. F. HAUFF CO. 509-248-0318
YAKIMA,WA
NEIL HAUFF
MECHANICAL ENGINEER, EIT

PROPELLER COMPARISON DEMONSTRATION
CHINOOK, ORCHARD-RITE

TEST DATE 1/16/03
Glen Clifford OR wind machine tower # 98251 184.4 hrs
NEW 160 HP BLADE AND GEAR BOX DIFF. RATIO INSTALLED 2 WKS PRIOR

PARAMETER	CHINOOK 40017ZB-460	CHINOOK 50022ZB-V10	ORCHARD RITE N444Q-160hp
FAN START TIME	10:02 AM	7:45 AM	11:20 AM
WEATHER CONDITION	Overcast	Overcast, Fog	Overcast
AMBIENT TEMPERATURE	40.2 degree F	37.0 degree F	42.2 degree F
ENGINE RPM	2700	2700	2620
ENGINE VACUUM	8" Hg	9" Hg	6.25" Hg
TEST DISTANCE FROM TOWER	400 feet	400 feet	400 feet
TEST DIRECTION FROM TOWER	West	West	West
WIND DRIFT DIRECTION FROM	South East	East	None
APPROX DRIFT MPH	1.2 MPH	2 MPH	0.0 MPH
TOWER ROTATION TIME	284.75 Seconds	284.75 Seconds	293.44 Seconds
ESTIMATED PROPELLER WEIGHT	100 Lbs	100 Lbs	210 Lbs
BLADE LENGTH	18 Feet	18 Feet	19' 9.5"
AVG PROPELLER WIND SPEED INCREASE	**8.63 MPH**	**8.26 MPH**	**0.0 MPH *******
AVG TIME AIR IS MIXED / 284 SEC CYCLE	**69.6 Seconds**	**60.3 Seconds**	**0.0 Seconds *******
AVG SECTOR ANGLE DEGREES	**88 degrees**	**76.4 degrees**	**0.0 degrees *******
AVG VOLUME OF AIR MIXED AT TEST SITE	**3,690,117 CFM**	**3,059,972 CFM**	**0 CFM *******

******* IT IS TO BE NOTED THAT THE ORCHARD RITE BLADE DID NOT HAVE ANY RECORDABLE AMOUNTS OF WIND AT THE 400 FOOT LOCATION FOR ONE HOUR. LOCATION WAS CHANGED FROM 400 FEET TO 250 FEET BEFORE ANY WIND WAS OBSERVED ON THE STAKED FLAGS. IT WAS AGREED THAT NO MEASUREMENTS WOULD BE MADE AT 250 FEET FLAG BECAUSE ALL THE TESTS WOULD HAVE TO BE RERUN .**

IT IS TO BE NOTED THAT THE CHINOOK PROPELLERS WERE NOT RUNNING UP TO DESIGN SPEED. EVEN WITH THE REDUCED SPEED, BOTH THE SECTOR ANGLE COVERAGE AND WIND SPEED WERE IMPRESSIVE COMPARED TO THE ORCHARD RITE BLADE FURTHERMORE, ORCHARD RITE WITH THEIR DESIGN WILL HAVE INCREASED FUEL CONSUMPTION, ACCELERATED ENGINE WEAR, ACCELERATED LOWER GEAR BOX WEAR AND ACCELERATED OIL DEGRADATION. WITH ORCHARD RITE'S INCREASED ROTATION TIME, THE TIME DURATION OF THE AIR ON THE BUD OR FRUIT WILL BE LESS.

IT IS TO BE NOTED THAT GLEN CLIFFORD WAS GOING TO CALL ORCHARD RITE AND HAVE THEM TEST THEIR BLADE FOR SECTOR ANGLE, WIND SPEED AND CFM DELIVERED AT 400 FEET FROM THE WIND MACHINE. THE STAKED FLAGS WERE LEFT FOR THAT PURPOSE.

THIS DEMONSTRATION WAS CONDUCTED AT THE REQUEST OF RON LUCAS OF RICHLAND, WA . ORCHARD RITE WAS INVITED BUT CHOSE NOT TO ATTEND.