Emission Factors/Almond Harvesting

Project No.: **07-ENVIR10-Capareda**

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Objectives:

1. To quantify the possible emission reductions achieved through the use of reduced blower passes during sweeping operations
2. To quantify the amount of crop left in the field due to the reduction in blower passes
3. To propose improvement of the baseline emission factor for standard sweeping operations
4. To continue the investigation of sampling bias of FRM PM samplers including the analysis of the particle size distribution of dust collected from ambient filters

Interpretive Summary:

The focus of this project is to provide baseline PM_{10} emission factor data for almond sweeping operations as well as to move forward on quantification of a possible conservation management practice (CMP) for almond sweeping. In conjunction with the emission factor development work, continued quantification of sampler bias was conducted. This report provides an assessment of the progress of the work and updates the almond sweeping portion of the current PM_{10} emission factor. Two sampling sites and 1 sweeping implement were used to conduct this research. The first sampling location was in the Wasco area of the Southern San Joaquin Valley, the same sampling site that has been used for the past several years. This year, a second sampling site located near Arbuckle, north of Sacramento, was used in the study for the first time. The goal was to use two geographically diverse orchards in order to quantify variability associated with almond sweeping.

Aerosol monitors developed by Texas A&M University (TAMU) were used throughout the experiment. These consisted of a total of 12 independent monitors located in 5 different locations around the source. There were a total of five (5) suspended

particulate (TSP) samplers, 5 Federal Reference Method (FRM) PM_{10} samplers and 2 FRM $PM_{2.5}$ samplers.

In the past years, emission factors for almond operations had been developed using gravimetric FRM PM samplers and various dispersion models by UC Davis and TAMU. This year a single dispersion model was used to determine the emission factor. The model, Industrial Source Complex-Short Term Version 3 (ISCSTv3), is the former EPA approved dispersion model. This was used to make the emission factors directly comparable to emission factors developed in previous years using the same model. This method also allows for the use of single height monitors allowing for quicker movement between sampling plots and the use of less labor at the sampling site.

The equipment used in all tests was the same Flory model 7677 with a 7.5' wide sweeper head and low profile cab. The equipment was operated by the same operator throughout all tests at both sampling locations. This allowed the use of controllable variables such as operating speed and sweeping pattern through the orchard.

Table 1 shows the emission factors developed from this work. The true PM_{10} and true $PM_{2.5}$ emission factor for standard harvesting (3 blower passes) of 382 kg/km^2 from this work agrees well with the previous true PM_{10} emission factor developed for traditional sweeping operations of 321 kg/km^2. The measured emission factor with reduced blower pass was 194 kg/km^2. The reduction in emissions achieved through reducing blower passes not only improves environmental air quality, but has the potential to decrease the time it takes to harvest a field thus resulting in possible reduced expenditures for the farmer.

The $PM_{2.5}$ emissions produced during harvest were calculated using the measured PSD of the TSP filters. The result is a true $PM_{2.5}$ emission factor of 16 kg/km^2 for three blower passes and 8 kg/km^2 for one blower pass. As with most agricultural sources that originate from soil material, there is very little emission in this size range.

Table 1. True PM_{10} and $PM_{2.5}$ emission factor (kg/km^2) and reduction in emissions for both sweeping treatments tested at both locations and the aggregated reductions.

	True PM_{10} Emission Factor		True PM 2.5 Emission Factor		
	3 Blower Passes	1 Blower Pass	3 Blower Passes	1 Blower Pass	% Reductions
Site 1	388	196	12	6	49.5
Site 2	374	192	20	10	48.7
Aggregate	382	194	16	8	49.5

Harvest efficiencies were determined by CSU Fresno. This consisted of comparing the amount of product left in the field for each treatment. The amount of product left in the field using the two different sweeping operations were reported in average yield of nut meat in pounds per acre. Table 2 shows the total nut losses for both orchards and treatments.

Table 2. Meat loss (lb/acre) for both treatmens.

Blower Passes	Total Non-Harvested Meats lb/acre	
	Wasco	Arbuckle
1	57.3	17.8
3	28.7	15.9
Difference	28.6	1.9

The methodology and further details of this work can be found in the complete report on the Conference CD.

Current Research:

The 2007 sampling campaign was focused on expanding the knowledge base of possible conservation management practices for reduction of particulate matter. Specifically tests were conducted to quantify the possible reductions achieved through the use of reduced harvester speed. To achieve this, tests were conducted in the Wasco and Arbuckle regions over 2 weeks during the 2007 harvest. Due to the varied conditions in each orchard, the operator selected the maximum achievable speed according to conditions, and this was used as the high speed test. Subsequently, the speed was halved and this was used as the harvester speed in conducting the tests.

Recognition:

The Researchers would like to thank Mr. Gerry Rominger, Rominger Farms, and Mr. Don Castle, Paramount Farming Company for their assistance and support allowing our harvester project to be tested in your orchards.