Chapter 10. Agricultural Harvesting

10.1 Characterization of Source Emissions

Harvesting emissions are generated by three different operations: crop handling by the harvest machine, loading of the harvested crop into trailers or trucks, and transport by trailers or trucks in the field. Emissions from these operations are in the form of solid particulates composed mainly of raw plant material and soil dust that is entrained into the air. These emissions may simply be due to the vehicles traveling over the soil, or via the mechanical processing of the plant material and underlying soil, or, as in the case of almonds, via the actual blowing or sweeping of the crop to remove waste materials and position it for pickup. Defoliants and/or desiccants are used on some crops several weeks before harvesting which can produce PM emissions from the drifting of these chemicals equal to about 1% of the product applied on the crop.[1]

10.2 EPA's Emission Estimation Methodology

Section 9 of EPA's Compilation of Air Pollutant Emission Factors (AP-42) addresses emission factors for mechanical harvesting of three different crops (cotton, wheat and sorghum). This section of AP-42 was last updated in February 1980. However, it does not list TSP or PM10 emission factors for agricultural harvesting. Instead it lists PM7 emission factors for the three crops expressed in units of pounds per square mile for crop handling by the harvest machine, loading of the harvested crop into trailers or trucks, and transport by trailers or trucks in the field. The sum of the PM7 emission factor for these three separate operations total 0.0086 lb/acre for mechanical picking of cotton, 0.041 lb/acre for mechanical stripping of cotton, 0.0027 lb/acre for wheat, and 0.012 lb/acre for sorghum.[1] The PM7 emission factors for harvesting cotton are based on an average machine speed of 3 mph for pickers and 5 mph for strippers, a basket capacity of 240 lb, a trailer capacity of 6 baskets, a lint cotton yield of 1.17 bales/acre for pickers and 0.77 bales/acre for strippers, and a transport speed of 10 mph. The weighted average stripping factors assumes that 2% of all strippers are 4-row models with baskets and, of the remainder, 40% are 2-row models pulling trailers and 60% are 2-row models with mounted baskets. The PM7 emission factors for harvesting wheat and sorghum are based on an average combine speed of 7.5 mph, a combine swath width of 20 feet, a field transport speed of 10 mph, a truck loading time of 6 minutes, a truck capacity of 13 acres for wheat and 7 acres for sorghum, and a filled truck travel time of 2 minutes per load. These AP-42 PM7 emission factors developed more than 25 years ago for the entire US are much lower than CARB's PM10 emission factors developed in early 2003 for California.

10.3 CARB's Emission Estimation Methodology

> This section was adapted from Section 7.5 of CARB's Emission Inventory Methodology. Section 7.5 was last updated in January 2003.

The California Air Resources Board (CARB) has published a PM10 emission estimation method for fugitive dust emissions originating from agricultural harvesting operations.[2] Unlike the soil preparations activities (e.g., disking, tilling, etc.), harvest operations tend to be fairly unique for each crop. Because of this, harvest emission factors combine all of the operations that go into harvesting a commodity into a single factor that includes emissions from all of the relevant operations. PM10 emission factors have been measured in California by UC Davis for harvesting cotton, almonds and wheat.[3] These emission factors are shown in Table10-1. Using these emission factors as a baseline, harvesting emission factors were assigned to other major crops grown California crops in consultation with agricultural experts. These PM10 emission factors are also included in Table 10-1.

Table 10-1. Harvesting PM10 Emission Factors

Crop	PM 10 Emission Factor (lbs/acre)
Almonds	40.8
Corn	1.7[a]
Cotton	3.4
Fruit trees	0.085[b]
Onions	1.7[a]
Potatoes	1.7[a]
Sugar beets	1.7[a]
Tomatoes	0.17[c]
Vine crops	0.17[c]
Walnuts	40.8[d]
Wheat	5.8

[a] EF = 50% EF for cotton
[b] EF = 2.5% EF for cotton
[c] EF = 5% EF for cotton
[d] EF = same EF as almonds

UC Davis has recently completed a study measuring PM10 emissions from almond harvesting that indicates that CARB's PM10 emission factor for almond harvesting may be over-estimated by 62%.[4] The complete list of harvesting emission factors assigned to over 200 crops is presented in Attachment 10-1 at the end of this chapter. The acreage data used for estimating harvest emissions for different crops are available from each state's Department of Food and Agriculture as well as from individual county agricultural commissioner reports.

Crop Calendar and Temporal Activity. Harvesting is performed at very specific times each year, so crop calendar data, which tells when harvest activities occur, is important. Temporal activity for harvesting is derived by summing, for each county, the monthly emissions from all crops. For each crop, the monthly emissions are calculated based on its monthly profile, which reflects the percentage of harvesting activities occurring in that month. An example of the monthly harvesting profile for almonds, cotton, and wheat is shown in Table 10-2. Because the mix of crops varies by county, composite temporal profiles combining all of the other county crops vary by county. An example of a composite harvesting profile by month for Fresno County, showing the combined temporal profile for all of the harvesting activities in the county, is shown in Table 10-3.

Table 10-2. Sample Monthly Harvesting Profile of Crops

Crops	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Almonds	0	0	0	0	0	0	0	0	50	50	0	0
Cotton	0	0	0	0	0	0	0	0	0	50	50	0
Wheat	0	0	0	0	0	50	50	0	0	0	0	0

Table 10-3. Sample County Harvesting Profile Composite

County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fresno	0.1	0.1	0.2	0.2	0.1	5.6	5.9	0.8	30.7	42.8	13.6	0.1

Assumptions. The CARB methodology is subject to the following assumptions:

1. The current harvest emission factors assume that for each crop, harvesting produces the same level emissions under all conditions for all equipment.

2. The emission factors for crops other than almonds, cotton, and wheat were assigned to reflect the relative geologic PM10 generation potential of various harvest practices.

3. Crop calendar data collected for San Joaquin Valley crops and practices were extrapolated to the same crops in the remainder of California.

PM2.5 Emission Factors. In July 2006, EPA revised the PM2.5/PM10 ratios listed in AP-42 for fugitive dust resulting from different fugitive dust source categories based on MRI's controlled laboratory experiments conducted for WRAP in 2005.[5] The revised PM2.5/PM10 ratios range from 0.1 for unpaved roads to 0.15 for paved roads, wind erosion, and transfer of aggregate material. CARB is considering adopting a PM2.5/PM10 ratio of 0.15 for both agricultural tilling and agricultural tilling based on MRI's findings.[6]

10.4 Demonstrated Control Techniques

Soil dust emissions from field transport can be reduced by lowering vehicle speed. Also, the use of terraces, contouring, and strip cropping to inhibit soil erosion will suppress the entrainment of harvested crop fragments in the wind. Shelterbelts, positioned perpendicular to the prevailing wind, will lower emissions by reducing the wind velocity across the field. By minimizing tillage and avoiding residue burning, the soil will remain consolidated and less prone to disturbance from transport activities.

Table 10-4 summarizes tested control measures and reported control efficiencies for measures that reduce the generation of fugitive dust from agricultural harvesting.[7-9] A list of control measures for agricultural harvesting operations is available from the California Air Pollution Control Officers' Association's (CAPCOA) agricultural clearing house website (http://capcoa.org/ag_clearinghouse.htm). The list of control measures for harvesting field and orchard crops include: the use of balers to harvest crops that are traditionally harvested by chopping, new drying techniques for dried fruit, increasing equipment size to reduce the number of passes, fallowing land, green chop (i.e., harvesting a forage crop without allowing it to dry in the field), hand harvesting, night harvesting, switch to a crop that requires no waste/residue burning, applying a light amount of water or other stabilizing material to the soil prior to harvest, packing commodities in an enclosed area, and utilizing a shuttle system to haul multiple trailers per trip.

Table 10-4. Control Efficiencies for Control Measures for Harvesting[7-9]

Control Measure	PM10 Control Efficiency	References / Comments
Equipment modification	50%	MRI, 1981. Control efficiency is for electrostatically charged fine-mist water spray.
Land set-aside/fallowing	100%	SJVAPCD, 2003.
Limited activity during high winds	5 - 70%	URS, 2001. Emissions reduction depends on wind speed.
Night farming	10%	SJVAPCD, 2003. Harvest when humidity and soil moisture is higher than during day.
New techniques for drying fruit Continuous tray Dried on vine (DOV)	 25% 60%	SJVAPCD, 2003.
Precision farming	8%	SJVAPCD, 2003. Use of GPS system.
Reduced harvest activity	29 – 71 %	URS, 2001. Applicable to cotton, alfalfa, hay.
Soil moisture monitoring	30%	URS, 2001.

10.5 Regulatory Formats

Fugitive dust control options have been embedded in many regulations for state and local agencies in the WRAP region. However, most air quality districts currently exempt agricultural operations from controlling fugitive dust. Air quality districts that regulate fugitive dust emissions from agricultural harvesting include Clark County, NV and several districts in California such as the Imperial County APCD, the San Joaquin Valley APCD and the South Coast AQMD. Imperial County APCD prohibits fugitive dust emissions from farming activities for farms over 40 acres. The San Joaquin Valley APCD and the South Coast AQMD prohibit fugitive dust emissions for the larger farms defined as farms with areas where the combined disturbed surface area within one continuous property line and not separated by a paved public road is greater than 10 acres. Example regulatory formats downloaded from the Internet are presented in Table 10-5. The website addresses for obtaining information on fugitive dust regulations for local air quality districts within California, for Clark County, NV, and for Maricopa County, AZ, are as follows:

- Districts within California: www.arb.ca.gov/drdb/drdb.htm
- San Joaquin Valley APCD, CA: valleyair.org/SJV_main.asp
- South Coast AQMD, CA: aqmd.gov/rules
- Clark County, NV: www.co.clark.nv.us/air_quality/regs.htm
- Maricopa County, AZ: www.maricopa.gov/aq

CAPCOA's agricultural clearing house website (http://capcoa.org/ag_clearinghouse.htm) provides links to rules of different air quality agencies that regulate fugitive dust emissions from agricultural operations.

Table 10-5. Example Regulatory Formats for Harvesting

Control Measure	Agency
Any person engaged in agricultural operations shall take all reasonable precautions to abate fugitive dust from becoming airborne from such activities.	Clark County Reg. 41 7/01/04
Limit fugitive dust from off-field agricultural sources such as unpaved roads with more than 75 trips/day and bulk materials handling by requiring producers to develop and implement a Fugitive Dust Management Plan with district approved control methods.	SJVAPCD Rule 8081 11/15/01
Cease activities when wind speeds are greater than 25 mph.	SCAQMD Rule 403.1 4/02/04

10.6 Compliance Tools

Compliance tools assure that the regulatory requirements, including application of dust controls, are being followed. Three major categories of compliance tools are discussed below.

Record keeping: A compliance plan is typically specified in local air quality rules and mandates record keeping of source operation and compliance activities by the source owner/operator. The plan includes a description of how a source proposes to comply with all applicable requirements, log sheets for daily dust control, and schedules for compliance activities and submittal of progress reports to the air quality agency. The purpose of a compliance plan is to provide a consistent reasonable process for documenting air quality violations, notifying alleged violators, and initiating enforcement action to ensure that violations are addressed in a timely and appropriate manner.

Site inspection: This activity includes (1) review of compliance records, (2) proximate inspections (sampling and analysis of source material), and (3) general observations. An inspector can use photography to document compliance with an air quality regulation.

On-site monitoring: EPA has stated that "An enforceable regulation must also contain test procedures in order to determine whether sources are in compliance." Monitoring can include observation of visible plume opacity, surface testing for crust strength and moisture content, and other means for assuring that specified controls are in place.

Table 10-6 summarizes the compliance tools that are applicable for harvesting.

Table 10-6. Compliance Tools for Harvesting

Record keeping	Site inspection/monitoring
Maintain daily records to document the specific dust control options taken; maintain such records for a period of not less than three years; and make such records available to the Executive Officer upon request.	Observation of dust plumes during periods of agricultural harvesting; observation of dust plume opacity (visible emissions) exceeding a standard; observation of high winds (e.g., >25 mph).

10.7 Sample Cost-Effectiveness Calculation

This section is intended to demonstrate how to select a cost-effective control measure for agricultural harvesting. A sample cost-effectiveness calculation is presented below for a specific control measure (precision farming utilizing a GPS system) to illustrate the procedure. The sample calculation includes the entire series of steps for estimating uncontrolled emissions (with correction parameters and source extent), controlled emissions, emission reductions, control costs, and control cost-effectiveness values for PM10 and PM2.5. In selecting the most advantageous control measure for agricultural harvesting, the same procedure is used to evaluate each candidate control measure (utilizing the control measure specific control efficiency and cost data), and the control measure with the most favorable cost-effectiveness and feasibility characteristics is identified.

Sample Calculation for Agricultural Harvesting

Step 1. Determine source activity and control application parameters.

Field size (acres)	320
Crop	Cotton
Frequency of operations per year	2 (picking & stalk cutting)
Control Measure	Precision farming
Control application/frequency	Reduce overlap of passes by 8%
Economic Life of Control System (yr)	5
Control Efficiency	8%

Precision farming utilizing a GPS system has been chosen as the applied control measure. The field size, frequency of operations, and control application/frequency are assumed values for illustrative purposes. The economic life of the control is determined from industrial records. The control efficiency of 8% is based on the proportional reduction in passes to harvest the cotton and cut the stalks after harvesting the cotton (SJVAPCD, 2003).[8]

Step 2. PM10 Emission Factor.
The PM10 emission factor for harvesting cotton includes the emissions from picking the cotton plus the emissions from cutting the stalks after picking the cotton. The PM10 emission factor for each operation is 1.7 lb/acre.[2]

Step 3. Calculate Uncontrolled PM Emissions. The PM10 emission factor, EF, (given in Step 2) is multiplied by the field size and the frequency of operations (both under activity data) and then divided by 2,000 lbs to compute the annual PM10 emissions in tons per year, as follows:

Annual PM10 emissions = (EF x Field Size x Frequency of Ops) / 2,000

- Annual PM10 Emissions = (1.7 x 320 x 2) / 2,000 = 0.544 tons

Annual PM2.5 emissions = (PM2.5/PM10) x PM10 emissions
Assume PM2.5/PM10 ratio for agricultural harvesting is 0.15 (MRI, 2006).[6]
Annual PM2.5 emissions = 0.15 x PM10 emissions

- Annual PM2.5 Emissions = (0.15 x 0.544 tons) = 0.0816 tons

Step 4. Calculate Controlled PM Emissions. The uncontrolled emissions (calculated in Step 3) are multiplied by the percentage that uncontrolled emissions are reduced, as follows:

Controlled emissions = Uncontrolled emissions x (1 – Control Efficiency)

For this example, we have selected precision farming as our control measure. Based on a control efficiency estimate of 8%, the annual controlled PM emissions are calculated to be:

Annual Controlled PM10 emissions = (0.544 tons) x (1 – 0.08) = 0.500 tons
Annual Controlled PM2.5 emissions = (0.0816 tons) x (1 – 0.08) = 0.075 tons

Step 5. Determine Annual Cost to Control PM Emissions.

The Annualized Cost of control is calculated by subtracting the cost savings from reducing the overlap of harvesting passes by 8% from the annualized cost of purchasing the GPS system.

Assuming that the cost of harvesting is equivalent to that of tilling, namely $10/acre (WSU, 1998[10]), the cost savings using GPS precision farming is $512 (i.e., 0.08 x 320 acres x $10/acre x 2 harvesting passes [i.e., one pass to harvest the cotton and a second pass to cut the stalks]).

GPS systems range in cost from $200 to $5,000 and have a lifetime of approximately five years (SJVAPCD, 2003[8]). Using an estimate of $1,000 and an economic life (EL) of five years for the GPS system together with an annual interest rate (AIR) of 5%, the annualized cost of the GPS system is calculated by adding the product of the Capital Recovery Factor (CRF) and the capital costs to the annual operating and maintenance costs, which for this example are assumed to be $200 per year.

The Capital Recovery Factor (CRF) is calculated as follows:

$$CRF = AIR \times (1+AIR)^{EL} / [(1+AIR)^{EL} - 1]$$

$$CRF = 5\% \times (1+ 5\%)^{5} / [(1+ 5\%)^{5} - 1] = 0.231$$

Annualized capital cost = CRF x capital cost = 0.231 x $1,000 = $231

Annual cost of GPS system = Annualized capital costs + Annual O & M costs

Annual cost of GPS system = $231 + $200 = $431

Annualized cost of control measure = Annual cost of GPS system minus the cost savings from reducing the overlap of harvesting passes

Annualized Cost = $431 - $512 = -$81

The annualized cost is negative and represents a net savings.

Step 6. Calculate Cost-effectiveness. Cost-effectiveness is calculated by dividing the annualized cost by the emissions reduction. The emissions reduction is determined by subtracting the controlled emissions from the uncontrolled emissions:

Cost-effectiveness = Annualized Cost/ (Uncontrolled emissions – Controlled emissions)

Cost-effectiveness for PM10 emissions = -$81 / (0.544 – 0.500) = -$1,862/ton
Cost-effectiveness for PM2.5 emissions = -$81 / (0.0816 – 0.075) = -$12,412/ton

The negative cost-effectiveness values indicate cost savings.

10.8 References

1. USEPA, 2006. AP-42: Compilation of Air Pollutant Emission Factors Volume I: Stationary Point and Area Sources.
2. California Air Resources Board, 2003. Emission Inventory Procedural Manual Volume III: Methods for Assessing Area Source Emissions, Sacramento, CA, January.
3. Flocchini, R.G., James, T.A., et al., 2001. *Sources and Sinks of PM10 in the San Joaquin Valley,* Interim Report prepared for the United States Department of Agriculture Special Research Grants Program, August 10.
4. Flocchini, R.G., 2006. *Recommended PM10 Emission Factors for Almond Harvesting*, White Paper prepared for the San Joaquin Valley APCD by UC Davis, May 22.
5. MRI, 2006. *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Emission Factors*, Final Report prepared for the WRAP by Midwest Research Institute, Project No. 110397, February 1.
6. CARB, 2006. Private communication from Patrick Gaffney, CARB Emission Inventory Branch PTSD, May 2.
7. MRI, 1981. *The Role of Agricultural Practices in Fugitive Dust Emissions*, Final Report prepared for the California Air Resources Board by Midwest Research Institute, April 17.
8. SJVAPCD, 2003. *Conservation Management Practices Program for the San Joaquin Valley*, Final Report prepared by the San Joaquin Valley Air Pollution Control District, February 5.
9. URS, 2001. *Technical Support Document for Quantification of Agricultural Best Management Practices*, Final Report prepared for Maricopa County, Arizona Department of Environmental Quality, June 8.
10. WSU, 1998. *Farming with the Wind*, Washington State University College of Agriculture and Home Economics Miscellaneous Publication N.MISC0208, December.

10.9 Attachment 10-1. PM10 Emission Factors for Harvesting Crops in CA

Crop Description	Crop Profile	Assumption	PM10 Emission Factor (lb/acre)
ALMOND HULLS	Almonds	Almonds/1	40.77
ALMONDS, ALL	Almonds	Almonds/1	40.77
ANISE (FENNEL)	Lettuce	Cotton/2	1.68
APPLES, ALL	Citrus	Cotton/40	0.08
APRICOTS, ALL	Citrus	Cotton/40	0.08
ARTICHOKES	Melon	Cotton/40	0.08
ASPARAGUS, FRESH MKT	Melon	Cotton/2	1.68
ASPARAGUS, PROC	Melon	Cotton/2	1.68
ASPARAGUS, UNSPECIFIED	Melon	Cotton/2	1.68
AVOCADOS, ALL	Citrus	Cotton/40	0.08
BARLEY, FEED	Wheat	Wheat/1	5.8
BARLEY, MALTING	Wheat	Wheat/1	5.8
BARLEY, UNSPECIFIED	Wheat	Wheat/1	5.8
BEANS FRESH UNSPECIFIED	Dry Beans	Cotton/20	0.17
BEANS, BLACKEYE (PEAS)	Dry Beans	Cotton/2	1.68
BEANS, FAVA	Dry Beans	Cotton/2	1.68
BEANS, GARBANZO	Garbanzo	Cotton/2	1.68
BEANS, GREEN LIMAS	Dry Beans	Cotton/2	1.68
BEANS, LIMAS, BABY DRY	Dry Beans	Cotton/2	1.68
BEANS, LIMAS, LG. DRY	Dry Beans	Cotton/2	1.68
BEANS, PINK	Dry Beans	Cotton/2	1.68
BEANS, RED KIDNEY	Dry Beans	Cotton/2	1.68
BEANS, SNAP FR MKT	Dry Beans	Cotton/20	0.17
BEANS, SNAP PROC	Dry Beans	Cotton/20	0.17
BEANS, UNSPECIFIED SNAP	Dry Beans	Cotton/20	0.17
BEANS,UNSPEC. DRY EDIBLE	Dry Beans	Cotton/2	1.68
BEETS, GARDEN	Sugar Beets	Cotton/2	1.68
BERRIES, BLACKBERRIES	Grapes-Table	Cotton/40	0.08
BERRIES, BOYSENBERRIES	Grapes-Table	Cotton/40	0.08
BERRIES, BUSH, UNSPECIFIED	Grapes-Table	Cotton/40	0.08
BERRIES, LOGANBERRIES	Grapes-Table	Cotton/40	0.08
BERRIES, RASPBERRIES	Grapes-Table	Cotton/40	0.08
BROCCOLI, FR MKT	Vegetables	Cotton/40	0.08
BROCCOLI, PROC	Vegetables	Cotton/40	0.08
BROCCOLI, UNSPECIFIED	Vegetables	Cotton/40	0.08
BROCCOLI,FOOD SERV	Vegetables	Cotton/40	0.08
BRUSSELS SPROUTS	Melon	Cotton/40	0.08
CABBAGE, CH. & SPECIALTY	Lettuce	Cotton/40	0.08
CABBAGE, HEAD	Lettuce	Cotton/40	0.08
CARROTS, FOOD SERV	Sugar Beets	Cotton/20	0.17
CARROTS, FR MKT	Sugar Beets	Cotton/20	0.17
CARROTS, PROC	Sugar Beets	Cotton/20	0.17
CARROTS, UNSPECIFIED	Sugar Beets	Cotton/20	0.17

Crop Description	Crop Profile	Assumption	PM10 Emission Factor (lb/acre)
CAULIFLOWER, FOOD SERV	Vegetables	Cotton/40	0.08
CAULIFLOWER, FR MKT	Vegetables	Cotton/40	0.08
CAULIFLOWER, PROC	Vegetables	Cotton/40	0.08
CAULIFLOWER, UNSPECIFIED	Vegetables	Cotton/40	0.08
CELERY, FOOD SERV	Lettuce	Cotton/40	0.08
CELERY, FR MKT	Lettuce	Cotton/40	0.08
CELERY, PROC	Lettuce	Cotton/40	0.08
CELERY, UNSPECIFIED	Lettuce	Cotton/40	0.08
CHERIMOYAS	Citrus	Cotton/40	0.08
CHERRIES, SWEET	Citrus	Cotton/40	0.08
CHESTNUTS	Almonds	Almonds/10	4.08
CHIVES	Lettuce	Cotton/40	0.08
CILANTRO	Lettuce	Cotton/40	0.08
CITRUS, MISC BY-PROD	Citrus	Cotton/40	0.08
CITRUS, UNSPECIFIED	Citrus	Cotton/40	0.08
CLOVER, UNSPECIFIED SEED	Alfalfa	Alfalfa/1	0
COLLARD GREENS	Lettuce	Cotton/40	0.08
CORN FOR GRAIN	Corn	Cotton/2	1.68
CORN FOR SILAGE	Corn	Cotton/20	0.17
CORN, SWEET ALL	Corn	Cotton/40	0.08
CORN, WHITE	Corn	Cotton/40	0.08
COTTON LINT, PIMA	Cotton	Cotton/1	3.37
COTTON LINT, UNSPEC	Cotton	Cotton/1	3.37
COTTON LINT, UPLAND	Cotton	Cotton/1	3.37
COTTONSEED	Cotton	Cotton/1	3.37
CUCUMBERS	Vegetables	Cotton/40	0.08
CUCUMBERS, GREENHOUSE	No Land Prep	Zero/1	0
DATES	Citrus	Almonds/20	2.04
EGGPLANT, ALL	Vegetables	Cotton/40	0.08
ENDIVE, ALL	Lettuce	Cotton/40	0.08
ESCAROLE, ALL	Lettuce	Cotton/40	0.08
FIELD CROP BY PRODUCTS	Cotton	Cotton/20	0.17
FIELD CROPS, UNSPEC.	Corn	Cotton/20	0.17
FIGS, DRIED	Citrus	Almonds/20	2.04
FOOD GRAINS, MISC	Corn	Cotton/2	1.68
FRUITS & NUTS, UNSPEC.	Citrus	Cotton/40	0.08
GARLIC, ALL	Garlic	Cotton/2	1.68
GRAPEFRUIT, ALL	Citrus	Cotton/40	0.08
GRAPES, RAISIN	Grapes-Raisin	Cotton/20	0.17
GRAPES, TABLE	Grapes-Table	Cotton/20	0.17
GRAPES, UNSPECIFIED	Grapes-Wine	Cotton/20	0.17
GRAPES, WINE	Grapes-Wine	Cotton/20	0.17
GREENS, TURNIP & MUSTARD	Lettuce	Cotton/40	0.08
GUAVAS	Citrus	Cotton/40	0.08
HAY, ALFALFA	Alfalfa	Alfalfa/1	0
HAY, GRAIN	Alfalfa	Cotton/2	1.68

Crop Description	Crop Profile	Assumption	PM10 Emission Factor (lb/acre)
HAY, GREEN CHOP	Alfalfa	Alfalfa/1	0
HAY, OTHER UNSPECIFIED	Alfalfa	Cotton/2	1.68
HAY, SUDAN	Alfalfa	Alfalfa/1	0
HAY, WILD	Alfalfa	Cotton/2	1.68
HORSERADISH	Onions	Cotton/40	0.08
JOJOBA	Melon	Cotton/40	0.08
KALE	Lettuce	Cotton/40	0.08
KIWIFRUIT	Citrus	Cotton/40	0.08
KOHLRABI	Lettuce	Cotton/40	0.08
KUMQUATS	Citrus	Cotton/40	0.08
LEEKS	Onions	Cotton/40	0.08
LEMONS, ALL	Citrus	Cotton/40	0.08
LETTUCE, BULK SALAD PRODS.	Lettuce	Cotton/40	0.08
LETTUCE, HEAD	Lettuce	Cotton/40	0.08
LETTUCE, LEAF	Lettuce	Cotton/40	0.08
LETTUCE, ROMAINE	Lettuce	Cotton/40	0.08
LETTUCE, UNSPECIFIED	Lettuce	Cotton/40	0.08
LIMA BEANS, UNSPECIFIED	Dry Beans	Cotton/2	1.68
LIMES, ALL	Citrus	Cotton/40	0.08
MACADAMIA NUT	Almonds	Almonds/10	4.08
MELON, CANTALOUPE	Melon	Cotton/40	0.08
MELON, HONEYDEW	Melon	Cotton/40	0.08
MELON, UNSPECIFIED	Melon	Cotton/40	0.08
MELON, WATER MELONS	Melon	Cotton/40	0.08
MUSHROOMS	No Land Prep	Zero/1	0
MUSTARD	Lettuce	Cotton/40	0.08
NECTARINES	Citrus	Cotton/40	0.08
NURSERY TURF	No Land Prep	Zero/1	0
OATS FOR GRAIN	Wheat	Wheat/1	5.8
OKRA	Lettuce	Cotton/40	0.08
OLIVES	Citrus	Cotton/40	0.08
ONIONS	Onions	Cotton/2	1.68
ONIONS, GREEN & SHALLOTS	Onions	Cotton/40	0.08
ORANGES, NAVEL	Citrus	Cotton/40	0.08
ORANGES, UNSPECIFIED	Citrus	Cotton/40	0.08
ORANGES, VALENCIAS	Citrus	Cotton/40	0.08
ORCHARD BIOMASS	Almonds	Cotton/40	0.08
PARSLEY	Lettuce	Cotton/40	0.08
PASTURE, IRRIGATED	No Land Prep	Zero/1	0
PASTURE, MISC. FORAGE	No Land Prep	Zero/1	0
PASTURE, RANGE	No Land Prep	Zero/1	0
PEACHES, CLINGSTONE	Citrus	Cotton/40	0.08
PEACHES, FREESTONE	Citrus	Cotton/40	0.08
PEACHES, UNSPECIFIED	Citrus	Cotton/40	0.08
PEANUTS, ALL	Safflower	Cotton/2	1.68
PEARS, ASIAN	Citrus	Cotton/40	0.08

Crop Description	Crop Profile	Assumption	PM10 Emission Factor (lb/acre)
PEARS, BARLETT	Citrus	Cotton/40	0.08
PEARS, UNSPECIFIED	Citrus	Cotton/40	0.08
PEAS, DRY EDIBLE	Dry Beans	Cotton/20	0.17
PEAS, EDIBLE POD (SNOW)	Dry Beans	Cotton/20	0.17
PEAS, GREEN, PROCESSING	Dry Beans	Cotton/20	0.17
PEAS, GREEN, UNSPECIFIED	Dry Beans	Cotton/20	0.17
PECANS	Almonds	Almonds/10	4.08
PEPPERS, BELL	Tomatoes	Cotton/40	0.08
PEPPERS, CHILI, HOT	Tomatoes	Cotton/40	0.08
PERSIMMONS	Citrus	Cotton/40	0.08
PISTACHIOS	Almonds	Almonds/10	4.08
PLUMCOTS	Citrus	Cotton/40	0.08
PLUMS	Citrus	Cotton/40	0.08
POMEGRANATES	Citrus	Cotton/40	0.08
POTATOES SEED	Sugar Beets	Cotton/2	1.68
POTATOES, IRISH ALL	Sugar Beets	Cotton/2	1.68
PRUNES, DRIED	Citrus	Cotton/40	0.08
PUMPKINS	Melon	Cotton/20	0.17
QUINCE	Citrus	Cotton/40	0.08
RADICCHIO	Lettuce	Cotton/40	0.08
RADISHES	Sugar Beets	Cotton/40	0.08
RAPINI	Sugar Beets	Cotton/40	0.08
RHUBARB	Lettuce	Cotton/40	0.08
RICE, FOR MILLING	Rice	Cotton/2	1.68
RICE, WILD	Rice	Cotton/2	1.68
RUTABAGAS	Sugar Beets	Cotton/2	1.68
RYE FOR GRAIN	Wheat	Wheat/1	5.8
SAFFLOWER	Safflower	Wheat/1	5.8
SALAD GREENS NEC	Lettuce	Cotton/40	0.08
SEED BARLEY	Wheat	Wheat/1	5.8
SEED BEANS	Dry Beans	Cotton/2	1.68
SEED OATS	Wheat	Wheat/1	5.8
SEED PEAS	Dry Beans	Cotton/20	0.17
SEED RICE	Rice	Cotton/2	1.68
SEED RYE	Wheat	Wheat/1	5.8
SEED WHEAT	Wheat	Wheat/1	5.8
SEED, ALFALFA	Alfalfa	Alfalfa/1	0
SEED, BERMUDA GRASS	Alfalfa	Alfalfa/1	0
SEED, COTTON FOR PLANTING	Cotton	Cotton/1	3.37
SEED, GRASS, UNSPECIFIED	Alfalfa	Alfalfa/1	0
SEED, MISC FIELD CROP	Corn	Cotton/20	0.17
SEED, OTHER (NO FLOWERS)	Alfalfa	Cotton/20	0.17
SEED, SAFFLOWER, PLANTING	Safflower	Wheat/1	5.8
SEED, SUDAN GRASS	Alfalfa	Alfalfa/1	0
SEED, VEG & VINECROP	Vegetables	Cotton/20	0.17
SILAGE	Wheat	Cotton/20	0.17

Crop Description	Crop Profile	Assumption	PM10 Emission Factor (lb/acre)
SORGHUM, GRAIN	Wheat	Wheat/1	5.8
SPICES AND HERBS	Lettuce	Cotton/40	0.08
SPINACH UNSPECIFIED	Lettuce	Cotton/40	0.08
SPINACH, FOOD SERV	Lettuce	Cotton/40	0.08
SPINACH, FR MKT	Lettuce	Cotton/40	0.08
SPINACH, PROC	Lettuce	Cotton/40	0.08
SPROUTS, ALFALFA & BEAN	Lettuce	Cotton/40	0.08
SQUASH	Melon	Cotton/20	0.17
STRAW	Alfalfa	Wheat/1	5.8
STRAWBERRIES, FRESH MKT	Melon	Cotton/40	0.08
STRAWBERRIES, PROC	Melon	Cotton/40	0.08
STRAWBERRIES, UNSPECIFIED	Melon	Cotton/40	0.08
SUGAR BEETS	Sugar Beets	Cotton/2	1.68
SUNFLOWER SEED	Corn	Wheat/1	5.8
SUNFLOWER SEED, PLANTING	Corn	Wheat/1	5.8
SWEET POTATOES	Sugar Beets	Cotton/2	1.68
SWISSCHARD	Lettuce	Cotton/40	0.08
TANGELOS	Citrus	Cotton/40	0.08
TANGERINES & MANDARINS	Citrus	Cotton/40	0.08
TOMATILLO	Tomatoes	Cotton/40	0.08
TOMATOES, CHERRY	Tomatoes	Cotton/40	0.08
TOMATOES, FRESH MARKET	Tomatoes	Cotton/40	0.08
TOMATOES, GREENHOUSE	No Land Prep	Zero/1	0
TOMATOES, PROCESSING	Tomatoes	Cotton/20	0.17
TOMATOES, UNSPECIFIED	Tomatoes	Cotton/20	0.17
TURNIPS, ALL	Sugar Beets	Cotton/2	1.68
VEGETABLES, BABY	Vegetables	Cotton/40	0.08
VEGETABLES, ORIENTAL, ALL	Vegetables	Cotton/40	0.08
VEGETABLES, UNSPECIFIED	Vegetables	Cotton/20	0.17
WALNUTS, BLACK	Almonds	Almonds/1	40.77
WALNUTS, ENGLISH	Almonds	Almonds/1	40.77
WHEAT ALL	Wheat	Wheat/1	5.8