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Crop Losses from Air Pollutants: A Computer and Assessment Program and Crop and Forest Losses from Air Pollutants: An Assessment Program

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13. ABSTRACT *(Maximum 200 Words)*

The Air Resources Board-sponsored Crop Loss Assessment Program quantifies potential ozone-caused yield losses in 26 crops grown in California. Statewide yield loss estimates were made with aggregated county statistics, and at a subcounty level for the southern San Joaquin Valley. Interpolations of statewide 7-hr mean ozone levels were made for selected air basins delimited by a 2000-ft altitudinal barrier. Estimated yield losses were calculated using 2.50 pphm as a background 12-hr average concentration. In 1989 and 1990, estimated statewide yield losses were highest in bean, cotton, grape and orange (15 to 25%). Agricultural production areas in the southern San Joaquin Valley and South Coast Air Basin were projected to experience the greatest losses. Regression analyses were performed in a detailed analysis of cotton yield responses in Kern County. Using GIS techniques to plot information from grower surveys and available ozone concentration data, it was found that ozone-caused yield losses varied considerably within Kern County. Statistically significant regressions of yield vs. ozone concentration, soil characteristics and cotton variety were observed. A field survey to identify ozone injury in cotton, almond and grape was conducted at 11 sites in the Central Valley. No significant relationships between injury and yield were detected.

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CROP LOSSES FROM AIR POLLUTANTS -- A COMPUTER AND FIELD-BASED ASSESSMENT PROGRAM

and

CROP AND FOREST LOSSES FROM AIR POLLUTANTS -- AN ASSESSMENT PROGRAM

Final Report

Contract Nos. A033-174 and A933-190

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Abstract

The ARB-supported Crop Loss Assessment Program is the only source of information available that quantifies potential losses in agricultural productivity associated with ozone, in terms of yield, and is suitable for input into economic models. Using existing sources of information and Geographical Information System technology (GIS), statewide yield loss estimates were made with aggregated county statistics, and at a subcounty resolution for the southern San Joaquin Valley.

Interpolations of statewide 7-hr mean ozone concentrations were done within air basins delimited by a 2000-ft altitudinal barrier. Statewide crop loss assessments were calculated using 2.72 and 2.50 pphm ozone as background 7-hr and 12-hr seasonal means, respectively. Statewide yield losses for 26 crops were estimated using aggregated county-wide agricultural production statistics. Estimated yield losses were greatest in bean (17%), cotton (20%), grape (23%), and orange (16%). Greatest losses occurred in the southern San Joaquin Valley, and production areas in and around the South Coast Air Basin. Percent loss in most crops was comparable between 1989 and 1990.

A regression approach was employed to examine relationships between ambient concentrations of ozone and cotton yield in Kern County. Interpolated values were used in predictive yield loss equations to estimate yield gradients. In a survey of cotton growers in Kern County, information about the number of acres planted, location, cotton variety, planting date, and yield were requested. Data were geographically registered on a sectional basis using a GIS. Cotton yield losses in Kern County ranged from 14% near Buttonwillow to 22% near Arvin. Crop loss predictive models, using statistics averaged over an entire county cannot predict the amount of variability in yield loss within a county. Significant regressions of yield vs. ozone concentration, soil characteristics, and cotton variety were observed in Kern County. However, r^2 values were low.

A field survey was conducted at 11 sites to identify the extent and severity of ozone injury to cotton, almond, and grape in the Central Valley. The incidence of foliar ozone injury was greatest in the southern portion of the Central Valley for cotton, almond, and grape. Principal Component Analysis demonstrated that among the leaf conditions monitored (dead, injured,and green) the number of green leaves retained was the best indicator of the degree of injury. No significant relationships between yield from the observation plots and the presence of foliar lesions were detected.

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Disclaimer

The statements and conclusions in this report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source or use in connection with materials reported herein is not to be construed as either an actual or implied endorsement of such products.

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Recommendations

Until the inception of the California Air Resources Board's Crop Loss Assessment Program, limited efforts had been made to synthesize and apply experimental results to describe the response of crops to ozone on a regional basis. This information has not been actively disseminated to public and private interest groups although it has always been available upon request. Agriculture related air pollution information must be made easily available in an understandable and meaningful context to increase client support for ARB-funded activities and the perception that public concerns are being addressed. Additionally, recent results from the University of California, Riverside (UCR), presented herein, demonstrate that GIS technology can be successfully used to more effectively evaluate and graphically present crop loss data on a regional basis at a subcounty resolution. The continued development of a GIS data management system would strengthen the ability of administrators and researchers to access, as well as critically analyze, agriculturally relevant air quality information. Furthermore, there is also a need for developing and using multivariate methodologies by which field personnel can evaluate potential yield loss at a given locale within a county that is not represented by county aggregated yield loss.

Specific recommendations are:

1) to disseminate the information to the agricultural community through workshops and public presentations, or in conjunction with ARB-coordinated meetings;

2) to establish a GIS-based approach to estimate regional yield loss in major crops across principal agricultural production zones in California, contingent upon the location of plantings and interpolated ozone exposure statistics; and

3) to use agronomic information from Central Valley farms, in conjunction with ARB air quality statistics, to develop multivariate regression models that describe the relative contribution of ozone, in relation to other agronomic factors, on yield variability.

Glossary of Terms and Abbreviations

ARB	California Air Resources Board
ARC/INFO	Geographic Information System Software by ESRI
CCLA	California Crop Loss Assessment Program
CDFA	California Department of Food and Agriculture
Chla	Chlorophyll a
Chlb	Chlorophyll b
CST	Central Standard Time
DEM	Digital Elevation Model
DMSO	Dimethyl sulfoxide
ESRI	Environmental Systems Research Institute in Redlands, CA
ft	foot/feet
GIS	Geographic Information System
hr	hour
km	kilometer
MB	megabytes
NCLAN	National Crop Loss Assessment Network
OM	Organic Matter (in soil)
PDT	Pacific Daylight Time
ppb	parts per billion
pphm	parts per hundred-million
ppm	parts per million
r^2	Sum of squares due to regression divided by total sum of squares

SAPRC	Statewide Air Pollution Research Center
SAS	Statistical Analysis System
SCS	Soil Conservation Service
SJV	San Joaquin Valley
SJVAQS	San Joaquin Valley Air Quality Study
SoCAB	South Coast Air Basin
TIN	Triangular irregular network
TSD	Technical Support Division
UCR	University of California, Riverside
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VIP	Selection of best possible set of mesh points that describe topology
UTM	Universal Transverse Mercator

I. INTRODUCTION

A number of organized programs have assessed crop losses from ozone. These include the National Crop Loss Assessment Network (NCLAN), and research programs sponsored by the California Department of Food and Agriculture (CDFA) and the California Air Resources Board (ARB). These programs have all contributed important methodological innovations to the study of ozone-caused crop loss. All of these programs, including an ARB-supported yield loss assessment in 1989, has estimated crop loss using aggregated county-wide production statistics. While estimates on this scale are useful, they are not of a fine enough resolution to evaluate the impact of air quality on yield at a subcounty level.

The unique climate zones in California have led to the development of a diverse agricultural industry. Numerous pockets of specialized crop production exist within the state. Within the geographic extent of a single county, significant concentration gradients of oxidant air pollutants have been observed. Consequently, predictive models of crop loss based upon ozone concentration statistics derived from urban monitoring stations or averaged over the area of the whole county, may not adequately predict current or future yield losses. Using the tools available in a Geographic Information System (GIS), ozone and production statistics can be disaggregated. An automated GIS enables users to analyze the relationship between ozone and crop productivity at a spatial resolution which captures local conditions.

Regional-scale crop loss estimates can now be calculated on a one square mile gridded scale using GIS technology. The 1990 crop loss estimates, included in this report, were extended to include a pilot study of potential yield losses in Kern County. Ozone concentration gradients that exist within the study area were computed using interpolation techniques. Maps of the oxidant gradients were used to identify regions within the county where crop yields would be the most heavily impacted by poor air quality. Thus, growers in areas with high ozone exposures (often limited to several square miles) may expect to suffer greater economic loss than growers in cleaner areas of a county.

The GIS approach to crop loss both uses and extends the results of previous organized research efforts. The NCLAN, funded by the U.S. Environmental Protection Agency (USEPA), focused on standardized experimental research using open-top field chambers to generate economic crop loss models. The NCLAN research was conducted at two sites in

California, Shafter and Tracy, in addition to four sites in the Midwest and East. Researchers for NCLAN generated yield loss projections for 10 crops in the United States, with loss models for five crops (alfalfa, cotton, barley, lettuce, and tomato) based on data collected in California (Heck et al., 1982, 1983, 1984a, 1984b).

The CDFA's California Crop Loss Assessment (CCLA) Program utilizes an approach based on field surveys of ozone-caused injury symptoms. Initially, plants are grown under standardized conditions at multiple locations along an ozone concentration gradient in the Central Valley. Based upon the field research results, ozone-dose/plant-response equations are developed for the crops examined. However, estimates of monetary loss or acreage affected are not determined.

Neither the CCLA nor the NCLAN Programs attempted to integrate other published field results or farm production statistics into their crop loss equations. Furthermore, neither program attempted to validate the loss estimates on even a limited scale. Ground truthing, in the form of field surveys of commercial operations, provides assessments of injury symptoms associated with area-specific ozone levels and yield data which can be used to validate models. Ozone concentration data from the ARB's air monitoring network can be used for regression model estimates of crop yield reductions due to ozone injury on a county-by-county basis. Calculations have generally lagged by one to two years because of the time needed to compile air quality and agricultural statistics.

Previously, crop loss estimates were derived by matching ozone statistics with crop-specific predictive equations. The ozone statistics were computed from hourly ozone averages based on the ARB's network, and production statistics were obtained from the CDFA. Both were aggregated at the county level. Exposure statistics were computed using data from one to five monitoring stations judged to best represent the ozone levels within each county. Although this approach used the best available techniques, it did not have the geographic resolution required to evaluate the yield reductions and economic ramifications from a more meaningful local frame of reference.

Statewide projected yield losses associated with ozone injury, aggregated by county, are available up to and including 1988. Yield loss estimates for 1988 in the San Joaquin Valley showed that on average, cotton yields were reduced by 25% across the Valley with the greatest losses occurring in Kern County (30%). Statewide losses for all grapes were estimated to be 25%; losses in table grape yields were the greatest within this group (30%) because Thompson seedless grapes are very sensitive to ozone. Among the largest bean producing counties, losses ranged from 26% in Kern, followed by Fresno (20%), Stanislaus (13%) and San Joaquin (6%) Counties. Moderate yield reductions (6 to 15%) were estimated to occur in alfalfa, lemon, onion, potato, rice, processing tomato, and wheat. Losses in corn, lettuce, sorghum, sugar beet, and fresh market tomato were low (0 to 5%). However, variability in crop yield losses within counties may be considerable, and not apparent in analyses using county-wide data.

A number of studies indicate that leaf injury may be associated with a decrease in plant growth and yield (e.g., McCool et al., 1988; Reinert et al., 1984). Substantial foliar injury and defoliation in dry beans and alfalfa was associated with large reductions in yield (Kohut and Laurence, 1983; Oshima et al., 1976; Olszyk et al., 1986a). Thompson and Kats (1970) found that ozone injury was related to a decrease in leaf chlorophyll concentration and reduced yield in grape. Leaf injury may also be evaluated as a function of light reflectance (i.e., healthy plants reflect green, while injured plants reflect yellow), and therefore, give a general indication of potential yield loss in crops such as cotton, alfalfa, beans, and grapes. Visible lesions were absent on tomato and cotton observed to have oxidant-induced yield losses (Temple et al., 1985b; Heuss, 1982). This evidence suggests that latent injury translates into reduced yield in a number of crops. Using instruments to measure light reflectance could allow for the detection of changes imperceptible to the unaided human eye. No field applicable methodology, other than measures of reflectance, is available to quantify latent injury for purposes of predicting yield losses.

In 1990, three surveys of air pollution injury to cotton, alfalfa, grape, and almond in the San Joaquin Valley were made between June and September at 86 sites where ozone concentrations ranged from high (e.g., southeast of Bakersfield) to comparatively low (e.g., West Side Field Station) (Thompson et al., 1991). The incidence of leaf injury was greatest in the southern portion of the Valley and decreased northward for all crops surveyed. A direct correlation between predicted losses and the field assessments of injury was impossible because yield data from the observation sites were not available. Observation plots need to be established in growers' fields across the Valley, and data on yield are required to relate the incidence of ozone-caused foliar lesions to productivity.

In 1989, a comprehensive review of the literature on the effects of ozone on ponderosa and Jeffrey pine was compiled by SAPRC personnel and made available to ARB staff. At that time, a rudimentary extrapolation of ozone concentrations in forested areas of California was made based upon available ozone statistics gathered primarily from nearby urban centers (Thompson et al., 1991). Although useful, the analysis suffered from two major limitations: (1) ozone concentrations in the mountains were based on those reported from low elevation monitoring stations; and (2) the interpolation technique did not incorporate altitudinal barriers. Altitudinal barriers limit the horizontal transport of air pollutants between air basins. Adjacent localities, separated by altitudinal barriers, represent statistically separate points between which interpolations are inappropriate. Recent advances in computer technology at the SAPRC make it possible to interpolate statewide ozone statistics in specified air basins, and within buffered zones around mountainous monitoring stations. Exposure indices cannot be calculated for forested areas that are not in close proximity to monitoring stations due to the rapidly changing topography which influences air flow patterns at a scale below the resolution to the interpolation grid. However, air pollution injury to chaparral can be estimated using information in the literature, in combination with predicted ozone concentrations.

Statement of the Problem

California has some of the most severe air pollution conditions in the United States, particularly in the South Coast Air Basin. However, high levels of air pollutants are also present in the state's multi-billion dollar agricultural production areas within the Sacramento and San Joaquin Valley Air Basins. Historical evaluations of the impact of air pollution on vegetation in California have ranged from field surveys to sophisticated open-top chamber, greenhouse, and laboratory experiments. Many of these controlled studies often used ozone exposure regimes that were not representative of field conditions in agronomically important areas. Thus, the results of controlled experiments are likely to be of less value to state policymakers, agriculturists, and concerned citizens than regional tabulations of crop losses over areas with variable levels of pollution stress. Until the inception of the ARB's Crop Loss Assessment Program, limited efforts were made to synthesize and apply the research information considering the geographic locations of crops and pollutants. With the exception of the annual crop-by-county yield loss estimates computed by the SAPRC, efforts to evaluate yield losses in consideration of the variability in ozone concentrations within a county are lacking. New technologies exist for assessing crop loss at the subcounty level that do not rely on costly experimental programs; they utilize available data and yield loss models. Moreover, a visual representation of ozone concentrations interpolated across the entire state, within a selected time frame, has not been readily available. Such a presentation of ozone data from the ARB's air monitoring network is now possible with recent advances in computer technology at the SAPRC.

Thus the objectives for the two contractual periods reported herein were:

For 1991:

1. to conduct an analysis of the effects of ozone on forest trees in California using available growth models;

2. to evaluate the literature on the effects of ozone on important chaparral plant species;

3. to extend the survey of the geographic distribution of ozone-caused foliar injury to crops in the San Joaquin Valley;

4. to review published experimental results and update the inventory of predictive yield loss models; and

5. to estimate statewide yield losses based on 1989 agriculture and air quality statistics.

For 1992:

1. to establish a GIS database of crop loss related information for Kern County;

2. to relate the occurrence of foliar injury symptoms on crops with yields from observation plots established in the Central Valley;

3. to conduct a pilot study at UCR to calibrate changes in light reflectance with ozone injury in cotton;

4. to update the research and crop loss prediction model data base;

5. to estimate statewide yield losses using 1990 agriculture and air quality data; and

6. to develop a graphic representation of ozone injury symptoms across the Central Valley based on interpolated ambient ozone concentrations.

II. MATERIALS AND METHODS

A. GIS REGRESSIONS

A regression approach was employed to find relationships between ambient concentrations of ozone, which varied across the Kern County study area, and grower reported cotton yield data obtained from a survey questionnaire (Appendix). The regression analysis also included other variables which affect cotton yield (e.g., soil characteristics). The data set used in the regression was constructed using a Geographic Information System (GIS) such that the dependent variable (cotton yield) was matched by geographic location to the independent variables (ozone concentration and soil characteristics). Within the GIS, three different map layers, corresponding to cotton yields, ozone concentrations, and soil characteristics, were overlaid (the construction of these three layers is described below). The overlay procedure created a matrix of observations which was input into the Statistical Analysis System (SAS) (SAS Institute, 1985); the independent and dependent variables were listed in separate columns, and each row corresponded to a particular geographic location.

A number of regression analyses were made to assess the relationship between cotton yield and ambient ozone concentration in Kern County. One part of the analysis involved comparisons between Acala cottons (including the dominant SJ2 variety) and the Pima cotton variety grown in the area. Pima commands a much higher price because it has a longer fiber length. This comparison is of interest because previous research indicated that Pima was more sensitive to ozone than Acala SJ2. Other analyses compared yield responses where only Acala SJ2 was grown vs. yields where other Acala varieties were grown (i.e., all other Acala varieties were taken as a group). If a site was planted with both Acala SJ2 and another Acala variety, that site was classified as a site planted with "other Acala varieties."

According to the above divisions, separate regressions were done to test whether there was a simple relationship between cotton yield (bales acre^{-1}) and a linear or quadratic function of the 7-hr mean ozone concentration in August 1990. Additionally, multiple regressions were done to test the relationship between cotton yield and an array of independent variables, including linear and quadratic ozone concentration terms, available soil water, soil pH, soil salinity, soil organic matter (OM), and a measure of cotton yield potential. Cotton yield potential was provided as part of the Soil Conservation Service soil survey data. For the multiple regressions, the SAS RSQUARE procedure was employed. Values of r^2 (sum of squares due to regression divided by total sum of squares) and Mallow's C(p) were computed for all possible regressions involving one, two, three, four, or five independent variables. The units for cotton yield, 7-hr mean ozone concentration, and available soil water, were bales $acre^{-1}$, ppb, and inches in^{-1} soil profile, respectively.

B. INTERPOLATION OF 7-HOUR MEAN OZONE CONCENTRATIONS

Hourly Ozone Concentrations. Data of hourly ozone concentrations at 18 San Joaquin Valley Air Quality Study (SJVAQS) sites were provided by the ARB's Technical Support Division (TSD). The sites were: Academy, Buttonwillow, Caliente, Corcoran, Delano, Devils Den, Edison, El Paso, Friant, Mouth of Kern River Canyon, Madera, North Fork of Kings River, Raisin City, Reedley, Taft, Terrabella, Three Rocks, and Wheeler Ridge. Data from 01 August through 31 August 1990 were available from all sites except Taft (missing data for 01 August 1990). For many of the sites, data were also available for July and part of September 1990. For purposes of using the GIS to make a valley-wide map of interpolated ozone concentrations, the partial data set from July was excluded to make a map of valley-wide differences in ozone concentration with the highest resolution. Comparisons of seasonal averages from sites with more complete data sets revealed that the 7-hr means for August-only were comparable to statistics calculated using data from June through September (data not shown).

Preliminary exploration of the data set indicated that quality assurance was needed. A telephone call (on 04 September 1991) to Xo Larimer of the TSD confirmed that the data were of level I quality. Therefore, the data were screened for errors using filters to detect data that were out of range (i.e., zero and negative values or values exceeding 230 ppb), and data that displayed marked hour-to-hour discontinuities (i.e., the difference between two successive hourly observations was > 60 ppb). Considering data from only the month of August 1990, the El Paso and North Fork Kern River data sets were corrected by changing three and two errant observations to missing, respectively. The Delano data set was found to be unusable due to many zero and low values, perhaps caused by instrument error.

Statewide 7-hr Mean Ozone Concentration. For 1990, hourly ozone concentration data at the stations in the ARB network were also provided by the TSD. These data were assumed to be quality assured.

Longitude, Latitude, and Map Projections. The latitude and longitude of the monitoring stations in the SJVAQS were obtained from the TSD. Upon plotting the sites in the GIS, some erroneous coordinates were observed. The correct coordinates were obtained in a subsequent request. In a separate request, UTM coordinates for the ARB network stations were requested. Unfortunately, all coordinates were expressed as UTM zone 10, even if the actual coordinates were in zone 11. In a subsequent request, the coordinates were provided by the TSD, specifying the correct degrees, minutes, and seconds.

A series of maps showing statewide month-by-month changes in 7-hr mean ozone concentrations were plotted in the Lambert Conformal Projection with the following parameters: latitude of origin = 20.00°, first standard parallel = 33.00°, second standard parallel = 45.00°, longitude of origin = -120.00°, false easting = 2,000,000.00 meters, and false northing = 0.00 meters. The map detailing the southern part of the San Joaquin Valley for August 1990 was plotted in the State Plane Coordinate System, UTM zone 11.

Ozone Concentration Statistic. A 7-hr mean ozone concentration, calculated on a month-by-month basis, was used to compare yield responses because all previous contract work used the 7-hr mean, it is biologically relevant, and the crop loss equations from NCLAN are based on a 7-hr mean. Unlike accumulative statistics, such as the SUM06, 7-hr seasonal means are comparable even if growing seasons are of different lengths (Lee et al., 1988).

Interpolations. Although the methodology differed for constructing the statewide series vs. the SJV maps, both were made using simple interpolation techniques without any modeling or inference procedures. Interpolations were limited to geographic regions in which reasonably accurate assessments could be made. Interpolations were done within air basins delimited by a 2000-ft altitudinal barrier for both projects. The 2000-ft level outlined geographic regions which approximate the legal air basins (better delineated barriers to horizontal transport than a 3000-ft level), and is generally below the inversion layer.

Because some evidence indicated that ozone concentrations at the altitudinal base of the inversion layer may exceed concentrations at ground level on the valley floors (Miller et al., 1972a), the areas corresponding to the inversion layer base and above were excluded to avoid making unfounded extrapolations. The ozone concentrations in regions corresponding to altitudes above 2000-ft, including the mountainous areas of the state, were not interpolated because not much is known about vertical ozone gradients, and ozone concentrations in remote areas. However, it is important to state that the techniques developed are flexible and easily accommodate changes in assumptions regarding altitudinal barriers, specific ozone exposure statistics, methods of interpolation, and also can be linked to dynamic modeling routines. The techniques developed, embodied by a number of FORTRAN, C, and ARC MACRO LANGUAGE programs, stand alone as a prototype, interactive, geographic, statewide ozone concentration "browser."

Two methods of constructing the ozone concentration maps were used, one for the series of month-by-month statewide maps, another for the SJV detail map. For the statewide series of maps, the ARC/INFO TIN (triangular irregular network; ESRI, 1992) procedure was used. For the SJV map, the ARC/INFO GRID (ESRI, 1992) inverse-distance-squared-weight interpolation was used. In the beginning of the project, when work was initiated on the statewide series of maps, the latest available version of ARC/INFO was version 5, which included only surface modeling using the TIN. When surface modeling using the GRID routines became available with the release of version 6, that set of procedures was adopted for constructing the SJV map. Both procedures allowed for the specification of limiting areas outside of which no interpolation was allowed.

For the statewide series, data consisted of month-by-month 7-hr mean ozone concentrations computed for each site in the ARB network. The SJVAQS data were not included. Input to the procedure which created a TIN, included boundaries corresponding to the 2000-ft basin definitions. Interpolation was allowed within the boundaries, but was not allowed outside boundaries. High altitude island regions within interpolatable regions were also excluded from the interpolation. In order to compute an ozone concentration surface whose boundaries extended to the air basin's convolutions (caused by undulating topography), rather than a default surface whose boundaries are limited to a convex (or approximately elliptical) hull connecting the perimeter monitoring sites, the procedure required that points along the air basin boundaries be assigned values for ozone concentration. The boundaries were assigned a value of "NODATA" and the procedure estimated values for the boundaries when a certain condition was met. The condition allowed for linear interpolation of values along the boundaries if a line connecting two monitoring stations crossed the air basin boundary. Otherwise no value was estimated for the boundary, and the interpolated surface did not extend to the convoluted surface, but was limited in extent to the convex hull connecting perimeter monitoring stations. This phenomenon is apparent in the maps, where the interpolated surface extends to the boundaries of the coast in some regions, but not in others. To accommodate the TIN procedure and estimate an ozone concentration surface that extended to the air basin boundaries, the boundaries had to be approximate in nature. As described below, there was a minimum of 8-km between nodes along the boundaries.

Except for the above problem, the TIN surface is a reasonable method to graphically represent the monitoring network data. The TIN surface is constrained to pass through points of known ozone concentration. The algorithm uses the Delaunay triangulation (ESRI, 1992), which specifies that any one node (monitoring station or vertex point along the air basin boundary) is connected to its two nearest neighbors, ensuring that the triangles are as equiangular as possible. The Delaunay triangulation also ensures that the distance between any point on the surface and a node is minimal, and that the triangulation is independent of the ordering of the points in the data set. The TIN was further processed by a quintic smoothing function, substituting a smooth surface passing through the original data points, for the multi-faceted original TIN. For purposes of printing black and white hard copy, the continuous TIN surface was discretized into regions corresponding to 7-hr mean ozone concentrations of < 2 pphm, 2 to 4 pphm, 4 to 6 pphm, 6 to 8 pphm, and > 8 pphm.

Some of the ARB network monitoring sites were located outside the air basin boundary, specifically those in mountainous or remote areas; for example, Lake Gregory, Victorville, and Lake Tahoe. These points were excluded from the interpolation. A circular buffer of radius 10-km was centered at the sites, and then assigned the concentration of the site.

The 7-hr mean ozone concentration surface for the SJV in August 1990 was interpolated using the ARC/INFO GRID module's "Inverse Distance Weight" procedure

(ESRI, 1992). The data consisted of the 7-hr mean ozone concentration in August for the 17 SJVAQS study sites identified above, and the following ARB network sites found in the southern San Joaquin Valley: Bakersfield-Chester St., Edison-(Bakersfield)-1-East, Oildale-3311 Manor, Maricopa Sch-Stanislaus, Hanford, and Visalia-Church St. The procedure created a gridded coverage of a geographic region with space divided into specific-sized grid cells. For the project, the grid cells were chosen to be 1.6-km on a side (approximately 1-mile). The ozone concentration in a cell which does not contain a station is computed as the inverse-distance-square-weighted average of all cells containing stations within a specified radius of the unknown cell (i.e., 50-km for this project). A minimum of three known values was required to compute the average, and the 50-km radius was adjusted upward when needed to include the minimum number of stations. As in the TIN procedure, the interpolations were limited to areas defined by linear barrier features. However, defining complex barriers composed of many short segments would have required a prohibitive amount of CPU time. For this reason, the interpolations were done using a short barrier, which followed the air basin boundary, only long enough to separate the Caliente station (in the Tehachapi Valley) from the other stations. After the interpolation was completed within a region extending beyond the air basins (except near Caliente), cells outside the air basin were deleted from the coverage using a GIS map overlay procedure. A map defining the air basin was used as a mask or "cookie cutter" to excise outlying areas from the results.

Construction of the Air Basins. The boundaries for the air basins were constructed within the GIS based on 1:250,000 Digital Elevation Model (DEM) maps compiled and distributed by the United States Geological Survey (USGS). Most of the maps were copied from ½ inch tapes archived at the Map and Image Library, University of California, Santa Barbara. A small number of the maps were obtained from the Teale Data Center under an interagency agreement with the ARB. These maps are 1 degree on a side, and consist of elevation values spaced every 3 degree-seconds in a 1201-by-1201 dimension matrix. In terms of projected surface distances in the range of latitudes occupied by California, the spacing of elevation values would be at approximately 75 and 90-meters, along the east-west and north-south axes, respectively. Fifty-seven of these maps are required to cover the state of California, totaling approximately 600 MB (in standard format) of data. A statewide elevation map was constructed by individually projecting the DEMs to a Lambert projection (same parameters listed above), and then resampling the grids to a 250-meter grid. The resultant grids were merged into a single approximately 70 MB grid which was used for all subsequent work. Air basin boundaries were constructed from this 70 MB grid in two ways. In the first method, used for the statewide series of maps, an air basin with very few nodes was needed to compute a satisfactory TIN of statewide ozone statistics. Therefore, a 250-meter grid was resampled to 5-km, and further resampled using a VIP procedure (ESRI, 1992), to eliminate points in the grid not necessary for describing a TIN surface. The contour line at 2000-ft was then specified such that all nodes within 8-km of each other would be deleted. This low resolution air basin did not precisely follow the topology of the actual 2000-ft elevation line, because of approximations resulting from weeding nodes. In some instances, the contour line was located on the wrong side of the ARB network stations which are at less than 2000-ft, but near the actual 2000-ft contour line. For these cases, the derived air basin boundary was edited to include the station which had been arbitrarily excluded from the interpolatable region. These errors in placement of the air basin boundaries do not undercut the intent of the series of maps. As intended, the maps graphically display month-by-month ARB network data interpolated within reasonable geographical limits. For more precise work (e.g., research on concentrations and transport of pollutants and precursors from urban areas to mountain valleys), the higher resolution air basin coverages developed for the SJVAQS are more appropriate. Even higher resolution coverages, suitable for air flow modeling through mountainous areas, can be constructed from the DEM data.

When the GRID module became available, another method for constructing air basin boundaries was used for the SJV maps. The 250-meter statewide coverage was resampled to a 2-km gridded coverage. The coverage was clipped to exclude all areas outside the SJV. The clipped coverage was projected from Lambert to UTM zone 11, to be consistent with the coordinate system of the ozone data. Since the centers of the two projections are relatively close, no unreasonable errors from projection were made. The coverage was processed so that grid cells with altitudinal values on either side of 2000-ft would be grouped into one of two groups. One group represented an air basin at altitudes ≤ 2000-ft, and the other at altitudes > 2000-ft. Additional simplification, however, was required to avoid intensive computations by the interpolation procedures treatment of barrier features. The simplification was accomplished by repeated application of a majority filter with parameters tending to smooth the highly convoluted interface between the areas below and above 2000-ft. Small high altitude islands within the air basin were also eliminated from the map.

C. GROWER SURVEY

In order to conduct the proposed regional analysis of yield loss in cotton using disaggregated county statistics, the locations of fields where cotton was grown and the associated yields were required. While this information is confidential and not available from any county or state agency, Agricultural Commissioners maintain records of the growers who apply for pesticide application permits, and which crops they intend to apply the pesticide on. These records are available to the public. Mr. Ted Davis of the Kern County Agricultural Commissioner's Office, provided the names and addresses of 488 growers who in 1990, applied for pesticide application permits for cotton in Kern County. In turn, a survey (Appendix) was mailed to each grower, requesting information about the number of acres they planted, the location of their cotton acreage, the variety of cotton they planted, the planting date, and yield they obtained. One hundred forty-one growers responded, providing cotton yield, planting date, and variety information for 373 Public Land Survey sections distributed throughout the cotton producing region of Kern County. The information was entered into a computer data base and used to generate the GIS coverages needed for the estimating cotton yield losses in different production areas of Kern County. The data bases used in this task are listed in Table 1.

Table 1. Data Bases used to Generate the GIS Coverages for the Regional Analysis of Cotton Yield Loss in Kern County.

Inventory of the Data Bases Acquired for the Kern County Study and their Source:	
Public Land Survey & County Boundaries	David Sheeks California Dept. of Food & Agriculture Riverside, CA
Digital Elevation Model (DEM)	Larry Carver UC Director of the Map and Image Library Santa Barbara, CA
ARB Monitoring Station Coordinates	John Malloy California Air Resources Board Sacramento, CA
Soils Map of Kern County	Raul Ramirez U.S. Soil Conservation Service Bakersfield, CA

The data required processing before it was suitable for analysis. The aim of the analysis was to construct a data set in which yield and cotton variety data would be paired with ozone exposure data, based on geographic location. Of particular importance was the construction of a data set which would allow for comparisons between the dominant Acala variety (SJ2) and the Pima variety, which have been shown to be relatively resistant and sensitive to ozone, respectively. Many survey responses were from growers with cotton fields distributed over a large geographic area who did not itemize the varieties grown, their yields, or their planting dates on a section-by-section basis. Thus, most of the data were unusable, but some data were usable based on the format described below. There was not a one-to-one, but a many-to-one correspondence between variety-by-yield information and sections. In order to facilitate the analysis the data were restructured as follows.

Each record in the geographic data set corresponded to a unique section in the cotton growing areas. Each record included variety and yield information in four data fields. A variety field in the record was assigned as a particular variety if only that variety was grown in the section. The possible Acala varieties were SJ2, G-510, C-32, C-37, G-356, and DP6, and the only Pima variety was S6. The variety field was designated as "Mixed Acala" if a mix of Acala varieties were grown in the section, or "Mixed Pima" if a mix of Pima and Acala varieties were grown in the section. Each section record had three fields for yield: (1) yield of Pima varieties, when only Pima cotton was grown, (2) yield of Pima and Acala varieties, when Pima and Acala yields could not be separated based on ambiguous grower records, and (3) yield of Acala varieties, when only Acala cotton was grown. Yields were based on simple means within the above categories. The growers usually provided insufficient information for weighting the means on a bales $acre^{-1}$ basis.

D. SURVEY OF OZONE INJURY TO CROPS

A field survey to identify the extent and severity of ozone injury to cotton, almond, and grape in the Central Valley was conducted during August, September, and early October 1991. Eleven locales, each with three observation plots, were located in an area from Arvin, south of Bakersfield in Kern County, to Los Banos in Madera County, on both the eastern and western sides of the Valley (Figure 1 and Table 2).

Cotton observation plots were established in varietal trials conducted by Dr. R. Bassett, USDA, Shafter Research Station. Characteristic foliar ozone injury symptoms in cotton are interveinal chlorotic mottling and leaf bronzing (Olszyk, 1989a). Plantings of almond ("Nonpareil") and grapes ("Thompson seedless") in close proximity to the cotton plots were chosen for evaluation. Both Nonpareil and Thompson seedless were chosen because of their high degree of sensitivity to ozone (Musselman and McCool, 1990) and frequency of plantings. A photographic record of the development of injury symptoms throughout the season was maintained for all three crops.

For cotton, plant stands in each observation plot were thinned to a plant density of four plants $meter^{-1}$ to ensure that canopy closure did not contribute to early leaf senescence, a symptom associated with ozone injury in cotton. Plot row length was two-meters. Five representative plants were chosen for evaluation within each row. Almond groves were selected with trees that had young lateral branches at least 30-cm long. Four trees per grove were selected from different rows beginning three rows from the orchard edge. The fraction of senescent and dropped leaves was determined by a cumulative count on three branches from each of the four trees. Ozone injury consisted of leaf chlorosis, senescence and "shot hole" symptoms.

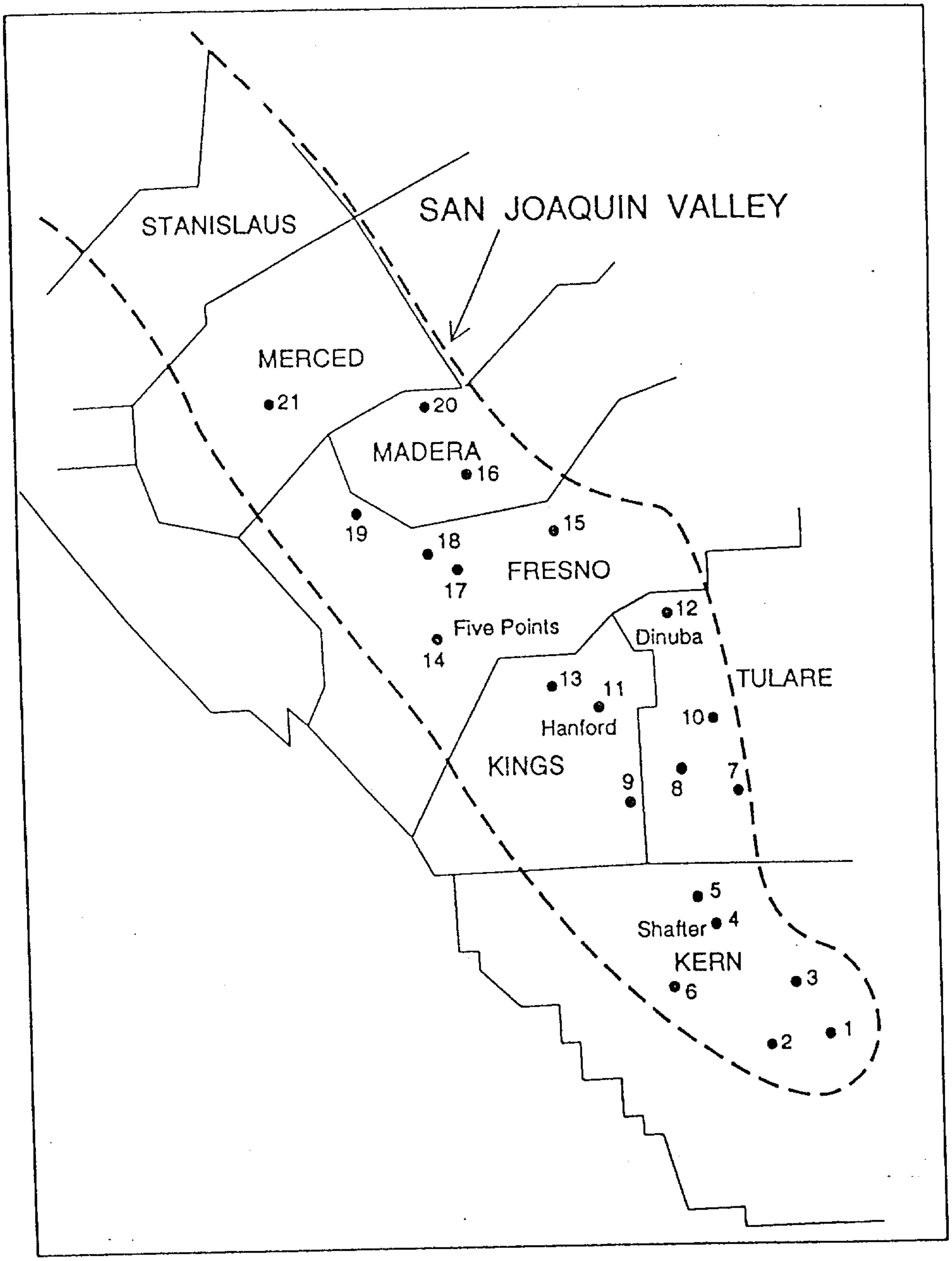


Figure 1. Location of Observation Plots for Evaluating Ozone Injury to Cotton, Almond, and Grape in the San Joaquin Valley, 1991.

Table 2. Key to the Locations of Observation Plots for Evaluating Ozone Injury to the Foliage of Cotton, Almonds, and Grapes in the San Joaquin Valley, 1991.

Location number	Name
1	Arvin
2	Buena Vista
3	Bakersfield
4	Shafter
5	Wasco
6	Buttonwillow
7	Porterville
8	Tulare
9	Waukena
10	Visalia
11	Hanford
12	Dinuba
13	Riverdale
14	Five Points
15	Fresno
16	Madera
17	San Joaquin
18	Tranquility
19	Firebaugh
20	Chowchilla
21	Los Banos

Four grape canes were selected from four different rows, starting 5-meters from the road. A count was made of leaves dropped and leaves showing ozone injury symptoms. Injury ratings per plant were expressed as a fraction of the number of leaves missing or injured over the total number of leaf nodes on the cane. Ozone injured grape leaves exhibited slight leaf stippling and accelerated senescence.

Injury evaluations were based on 0 to 10 scale, where 0 corresponded to 0% of the leaves affected (essentially all leaves green and healthy) and 10 corresponded to 100% of the leaves injured or abscissed. A rating of 2 indicated that 20% of the leaves exhibited ozone injury symptoms. A rating of 5 indicated that 50% of the leaves were affected, and so forth. The fraction of senescent and dropped leaves (bare nodes) per plant was determined by a cumulative count and rounded off to the nearest 10% increment. The range of injury present in all observation plots is presented in Tables B, C, D and E of the Appendix. All sites were visited within the three-day period during each survey.

Leaf injury ratings for the three indicator crops were expressed as follows:

$$\textit{Injury Rating} = \frac{D + I}{D + I + G}$$

Where: D = number of empty nodes where leaves have dropped off;
I = number of leaves showing ozone symptoms; and
G = number of green unaffected leaves.

Thus, a rating of one indicated that all leaves were affected by ozone as indicated by foliar lesions or premature abscission; a rating of zero indicated no visible injury. Values were determined on the main stem of a cotton plant, and on a 1-meter section of an almond or grape branch. The evaluation variables were subjected to a Principal Component Analysis to ascertain the relative importance of each factor to the final injury rating (Goldstein and Dillion, 1983). The occurrence of foliar injury symptoms was correlated with estimated yield loss for all three crops across the SJV.

The geographic locations of the observation plots were approximated using USGS Maps (1:24,000 scale). The injury ratings were then spatially registered to create a point coverage in ARC/INFO. Injury rating contours for each of the three indicator crops were developed using ARC/INFO resident triangulated interpolation procedures.

E. CROP LOSS ASSESSMENT

Potential yield losses due to ozone were estimated for 1989 and 1990 using hourly ozone data obtained from the TSD and published models describing crop response to ozone. Crop data were obtained from the Statistics Division of the CDFA (CDFA, 1990). Estimated yield losses for 26 crops were calculated using aggregated county-wide statistics. Data from nearby air quality monitoring stations, and within the same air basin as the crop production zones, were used to calculate 7-hr and 12-hr mean exposure statistics used in the yield loss models. Exposure statistics were based on the data from the months encompassing the growing season of each crop. Ozone data from 0900 to 1600 PDT, and 0800 to 2000 PDT were used for the 7-hr and 12-hr means, respectively.

Background Ozone Concentrations. Background concentrations (no yield loss) were used as a basis for estimating current yield losses. Estimated yield losses were calculated using 2.72 and 2.50 pphm ozone as the background 7-hr and 12-hr mean ozone concentrations, respectively. The 12-hr base concentration was used by NCLAN researchers (e.g., Heck et al., 1984a, 1984b), and represents relatively clean air. The 7-hr base concentration was calculated using the following equation: 7-hr base = [(12-hr base) - 0.004143] ÷ 0.919 (Thompson et al., 1991). The 0.22 pphm difference between the two background concentrations was shown to have less effect on yield loss than other factors, such as the geographic resolution used in the analysis (Heck et al., 1984a). It is noteworthy that both background concentrations represent ozone levels found in pristine environments, and are probably not attainable in any crop production zone in California. They were retained to provide consistency with past crop loss estimates for comparative purposes. Seven-hour average concentrations of ozone in the SJV may typically range from 4.5 to 5.5 pphm. Based on Olszyk et al. (1988b), 4.0 pphm was judged to be the most polluted but compliant scenario. Thus, a background level of 4.0 pphm was also used in the yield loss estimates provided to Dr. R. Howitt for analyses of economic loss (Tables F, G, and H, Appendix), in the Annual Report to the Governor and Legislature, 1991 (ARB, 1992). A 10-hr base ozone concentration of 2.59 pphm was used for potato (Pell et al., 1988). The value was calculated by linear interpolation between 2.50 and 2.72 pphm.

Yield Loss Equations. Compared to previous years, no new equations were used for the 1989 and 1990 yield loss assessments. A rigorous quality assurance check was conducted prior to calculating the 1990 losses. The exercise revealed that several equations predicted peak yields to occur at ozone concentrations greater than the background concentrations due to the quadratic nature of the model. These equations, as indicated below, were not used for the 1990 estimate. Up to eight equations were used for some crops. An explanation of the terms and percent yield loss calculations is presented in Table 3.

Several predictive equations were obtained after the analysis was complete. The time intensive nature of the analysis prohibited recalculating the losses. Noteworthy among the new models are those developed by DeJong, Williams and Retzlaff at the Kearney Agricultural Field Station in Parlier, CA, and Lee at the USEPA in Corvallis, OR. The researchers at Kearney Field Station developed a model predicting yield losses due to ozone injury in plum (Figure 2). The models by Lee utilize a SUM06 ozone exposure statistic based on all available NCLAN data. All of the models are presented in Table I (Appendix).

In years prior to 1990, estimates of yield loss were reported from models based on experimental results that indicated no yield reductions in response to ozone. In these cases, the Injury Index was calculated to be zero. In crops where no ozone associated yield reductions have been determined, Statewide Percent Losses will be zero in the Yield Loss Tables for 1990. The crops for which there have been no losses in yield observed at ozone concentrations expected to occur during the growing season are listed in Table 4.

Table 3. Description of the Terms and Procedures used to Estimate Yield Loss due to Ozone Injury on a County basis for the Entire State.

· Yield Loss Equation (Linear Example) **Yield = a + (b x Ozone Exposure)** Where Yield = the yield observed at a given level of ozone exposure; ozone exposure = 7-hr, 10-hr, or 12-hr mean ozone concentration.
· Yield Loss Index Equation (I) **I = (a + bX) ÷ (a + bX')** Where I = the loss index as a fraction of 1.00; when I = 1.00, there is no loss in yield. X = Ozone Exposure, and X' = Background Ozone Index (e.g., 2.72 and 2.50 for 7-hr and 12-hr mean concentrations, respectively).
· Percent Yield Loss Equation **Percent Loss = (1.00 - I) x 100**
· Potential Yield = (Actual Yield ÷ I) Where Actual Yield = the yield based on aggregated county production statistics provided by the CDFA.
· Statewide Potential Yield Equation **Statewide Potential Yield = (Σ Actual Yield) ÷ (Σ Potential Yield)** Where (Σ Actual Yield) = the sum of all reported yields, from all counties, for a particular crop; (Σ Potential Yield) = the sum of all potential yields.
· Statewide Percent Yield Loss Equation **Statewide Percent Yield Loss = (1.00 - Statewide Potential Yield) x 100**

Table 4. Crops where No Yield Reductions were Observed in Response to Ozone Exposure under Controlled Experimental Conditions.

Crop	Reference
Barley	Temple et al. (1985a)
Broccoli	Temple et al. (1990)
Celery	Takemoto et al. (1988)
Green pepper	Takemoto et al. (1988)
Strawberry	McCool et al. (1986)
Sugar beet	McCool et al. (1986) Brewer (1978)

Alfalfa Hay

1. I = [32.67 - (1.3902 x 12-hr)] ÷ [32.67 - (1.3902 x base-12)]

   Olszyk et al. (1986a).

2. I = [100 - (9.258 x 10^{-3} x Σ 10 pphm)] x 0.01

   McCool et al. (1986).

   where Σ 10 pphm = [Σ_{max} (0_g (observed hourly - 10))];
   days, hours

   the sum of hourly values >10 pphm over the entire season.

3. I = [118.96 - (4.088 x 12 hr)] ÷ [118.96 - (4.088 x base 12)]

   Brewer (1982).

4. I = [3,160 - base year - (109.63 x 12-hr)] ÷ [3,160 - base year - (109.63 x base-12)]

   Equation adapted from Temple et al. (1988) which considered ozone, water stress, and year. The loss estimates assumed that all alfalfa was grown under well-watered conditions, thereby omitting the water stress term. Base year = 21.

Alfalfa Seed

Alfalfa hay predictive equation 4 was used.

Barley

No yield reductions in barley that were associated with ozone injury have been reported (e.g., Temple et al., 1985a).

Beans - Dry

1. $I = [100 - (0.024 \times \Sigma\ 10\ \text{pphm})] \times 0.01$

   McCool et al. (1986).

2. $I = [2{,}878 \times e^{-(7\text{-hr} \div 12.0)^{1.171}}] \div [2{,}878 \times e^{-(\text{base-7} \div 12.0)^{1.171}}]$

   Heck et al. (1984a).

   Equations 3 through 6 were four different cultivars of dry bean which were exposed to three concentrations of ozone at UC Riverside, 1987 (personal communication; P. Temple, UC Riverside).

3. $I = [25.2 + (20.147 \times 12\text{-hr}) - (1.8011 \times (12\text{-hr})^2)] \div [25.2 + (20.147 \times \text{base-12}) - (1.8011 \times (\text{base-12})^2)]$.

   Ozone response equation for bean cultivar 'Linden Red Kidney'.

   Equation 3 was not used for the 1990 yield loss estimates because the equation predicts a yield increase in response to an ozone exposure of a 5.5 pphm 12-hr mean. Although there is some evidence that low level exposure to ozone may result in a small growth stimulation (personal communication, D. Grantz, Kearney Experiment Station), presumably due to improved water-use-efficiency from the ozone associated stomatal closure, it is unlikely that a sensitive species such as bean would continue to display such a response at a relatively high ozone exposure.

4. $I = [163.6 - (9.787 \times 12\text{-hr})] \div [163.6 - (9.787 \times \text{base-12})]$

   Ozone response equation for bean cultivar 'Sal Small White'.

5. $I = [165.8 - (13.57 \times 12\text{-hr})] \div [165.8 - (13.57 \times \text{base-12})]$

   Ozone response equation for bean cultivar 'Sutter Pink'.

6. $I = [167.6 - (13.98 \times 12\text{-hr})] \div [167.6 - (13.98 \times \text{base-12})]$

   Ozone response equation for bean cultivar 'Yolano Pink'.

Broccoli

1. $I = [2,199 + (187.58 \times 12\text{-hr})] \div [2,199 + (187.58 \times \text{base-12})]$

Temple et al. (1990).

Equation 1 was not used to estimate yield loss for 1990 because the equation predicts an incremental linear increase in yield in response to increasing ozone concentrations. Such a relationship is biologically unlikely.

Cantaloupes

1. $I = [35.8 - (2.808 \times 7\text{-hr}] \div [35.8 - (2.808 \times \text{base-7})]$

The equation was calculated from data shown in Snyder et al. (1988). Data were for muskmelon and not specifically for cantaloupes, honeydew melons, or watermelons. The equation, however, was used for those species as it is the only one available. Ozone concentrations were calculated for 0900-1600 CST from figures in the paper and yield data came from the text. Ozone concentrations and yields during the study, respectively in 1986, were 1.35 pphm and 31.3 kg/chamber for charcoal-filtered air; and 3.65 pphm and 24.9 kg for nonfiltered air. Ozone concentrations and yields, respectively in 1987, were 3.2 pphm and 28.9 kg for charcoal-filtered air; and 4.4 pphm and 22.6 kg for nonfiltered air. A linear regression equation was calculated from these for ozone concentration (x) and yield (y) data points.

Corn - Field

1. $I = [11,618.5 \times e^{-(7\text{-hr} \div 16.0)^{3.709}}] \div [11,618.5 \times e^{-(\text{base-7} \div 16.0)^{3.709}}]$

Kress and Miller (1985a).

Corn - Silage

1. $I = [11,618.5 \times e^{-(7\text{-hr} \div 16.0)^{3.709}}] \div [11,618.5 \times e^{-(\text{base-7} \div 16.0)^{3.709}}]$

Kress and Miller (1985a).

The entire plant is harvested for silage, unlike field corn where only the grain is the marketable product. This equation was developed from field corn research, therefore, it would not reflect the changes in leaf mass associated with ozone exposure.

Corn-Sweet

1. $I = [315.02 - (12\text{-hr} \times 8.2988)] \div [315.02 - (\text{base-12} \times 8.2988)]$

   Thompson et al. (1976).

Cotton

1. $I = [367 \times e^{-(7\text{-hr} \div 11.1)^{2.71}}] \div [367 \times e^{-(\text{base-7} \div 11.1)^{2.71}}]$

   Heagle et al. (1986).

2. $I = [0.8462 + (.049 \times 7\text{-hr})] \div [0.8462 + (.049 \times \text{base-7})]$

   Brewer (1985).

3. $I = [2{,}059 - (82 \times 7\text{-hr})] \div [2{,}059 - (82 \times \text{base-7})]$

   Temple et al. (1985b).

4. $I = [1{,}988 - (1545.32 \times (7\text{-hr})^2)] \div [1{,}988 - (1545.32 \times (\text{base-7})^2)]$

   Temple et al. (1985b).

5. $I = [32.3 - (2.025 \times 12\text{-hr})] \div [32.3 - (2.025 \times \text{base-12})]$

   Ozone response equation for cotton variety 'C1'..

   Temple (1990c).

6. $I = [38.6 - (2.663 \times 12\text{-hr})] \div [38.6 - (2.663 \times \text{base-12})]$

   Ozone response equation for cotton variety 'GC 510'.

   Temple (1990c).

7. $I = [25.4 + (8.833 \times 12\text{-hr}) - (1.0528 \times (12\text{-hr})^2)] \div [25.4 + (8.833 \times \text{base-12}) - (1.0528 \times (\text{base-12})^2)]$

   Ozone response equation for cotton variety 'SJ2'.

   Temple (1990c).

   This equation was not used for the 1990 projections because it predicts a yield increase up to a 12-hr mean ozone concentration of 4.4 pphm.

8. $I = [32.6 + (3.535 \times 12\text{-hr}) - (0.6721 \times (12\text{-hr})^2)] \div [32.6 + (3.535 \times \text{base-12}) - (0.6721 \times (\text{base-12})^2)]$

   Ozone response equation for cotton variety 'SS2086'.

   Temple (1990c).

Grain Sorghum

1. $I = [8{,}149 \times e^{-(7\text{-hr} \div 31.7)^{2.952}}] \div [8{,}149 \times e^{-(\text{base-7} \div 31.7)^{2.952}}]$

Kress and Miller (1985b).

Grapes

1. $I = [9{,}315 - (647 \times 12\text{-hr})] \div [9{,}315 - (647 \times \text{base-12})]$

Thompson and Kats (1970).

2. $I = [1.121 - (0.0663 \times 12\text{-hr})] \div [1.121 - (0.0663 \times \text{base-12})]$

Brewer (1983).

Lemons

1. $I = \{-[0.5004 + (0.6224 \times 12\text{-hr})] \div [0.5004 + (0.6224 \times \text{base-12})] + 1] \times -0.5\} + 1$

After Thompson and Taylor (1969) assuming that lemon trees cycled between "on" and "off" years comparable to oranges. Ozone was assumed to have no effect on lemons during "off" years. The ozone data were for two years before the harvest year.

Lettuce

1. $I = 0$

Olszyk et al. (1986b).

2. $I = [100 - (5.19 \times 10^{-2} \times \Sigma\ 10\ \text{pphm})] \times 0.01$

McCool et al. (1986).

3. $I = [3{,}187 \times e^{-(7\text{-hr} \div 12.2)^{8.837}}] \div [3{,}187 \times e^{-(\text{base-7} \div 12.2)^{8.837}}]$

Temple et al. (1986).

4. $I = 0$

Personal communication (P. M. McCool, UC Riverside). Equations 1 and 4 were not used for the 1990 projections.

Onions

1. $I = [11.1 - (0.881 \times 12\text{-hr})] \div [11.1 - (0.881 \times \text{base-12})]$

McCool et al. (1986).

2. $I = [5{,}034 - (109.41 \times \text{12-hr})] \div [5{,}034 - (109.41 \times \text{base-12})]$

Temple et al. (1990).

Oranges

1. $I = [53.7 - (\text{12-hr} \times 2.611)] \div [53.7 - (\text{base-12} \times 2.611)]$

Olszyk (1989b).

2. $I = [178.0 - (\text{12-hr} \times 19.1280)] \div [178.0 - (\text{base-12} \times 19.1280)]$

Thompson and Taylor (1969). Equation 2 was not used for the 1990 yield loss projections because the range of output (20-90% loss) was unrealistic based upon observed yields in county of contrasting air quality (i.e., San Bernardino and San Luis Obispo).

3. $I = \{-[53.7 - (\text{12-hr} \times 2.611)] \div [53.7 - (\text{base-12} \times 2.611)] + 1] \times -0.5\} + 1$

Olszyk et al. (1990b). Ozone exposure was based upon the air quality data from the two years preceding the harvest.

Potatoes

1. $I = [11{,}736 - (390 \times \text{10-hr})] \div [11{,}736 - (390 \times \text{base-10})]$

Pell et al. (1988). The equation predicts harvestable tuber weight using ozone statistics from 1000-2000 hours EDT.

2. $I = [5{,}848 - (347.6 \times \text{10-hr})] \div [5{,}848 - (347.6 \times \text{base-10})]$

Pell et al. (1988).

Rice

1. $I = [1.0851 \times e^{-(\text{7-hr} \times 0.0275)}] \div [1.0851 \times e^{-(\text{base-7} \times 0.0275)}]$

Kats et al. (1985).

2. $I = [1.0687 - (0.024 \times \text{7-hr})] \div [1.0687 - (0.024 \times \text{base-7})]$

Linear regression fitted to original data from Kats et al. (1985).

3. $I = [e^{-(\text{7-hr} \div 20.16)^{2.474}}] \div [e^{-(\text{base-7} \div 20.16)^{2.474}}]$

Weibull function fitted to original data from Kats et al. (1985).

Spinach

1. $I = [100 - (4.006 \times 10^{-2} \times \Sigma\ 10\ pphm)] \times 0.01$

   McCool et al. (1986).

2. $I = [1.199 - (7\text{-hr} \times 0.0625)] \div [1.199 - (\text{base-7} \times 0.0625)]$

   Heagle et al. (1979). No production statistics were available from CDFA for yield loss estimates.

Sugar Beets

1. $I = [64.7 - (2.58 \times 12\text{-hr})] \div [64.7 - (2.58 \times \text{base-12})]$

   McCool et al. (1986) for red table beets.

Tomatoes - Fresh Market

1. $I = [100 - (2.32 \times 10^{-2} \times \Sigma\ 10\ pphm)] \times 0.01$

   McCool et al. (1986).

Tomatoes - Processing

1. $I = [100 - 2.28 \times 10^{-2} \times \Sigma\ 10\ pphm)] \times 0.01$

   McCool et al. (1986).

   Equation 1 was not used in 1989 projections.

2. $I = [32.9 \times e^{-(7\text{-hr} \div 14.2)^{3.807}}] \div [32.9 \times e^{-(\text{base-7} \div 14.2)^{3.807}}]$

   Heck et al. (1984b).

   Equations 4 through 7 were for four different cultivars of tomatoes which were exposed to three concentrations of ozone at Riverside in the summer of 1987 (P. Temple, UC Riverside, personal communication). The ozone data for all four cultivars were collected in Pacific Daylight Time (PDT), therefore a separate analysis had to be conducted using PDT hourly ozone data for the sites where tomatoes are grown.

3. $I = [731 - (43.844 \times 12\text{-hr})] \div \text{Base T}$

Equation 3 was not used in 1990 projections because results were inconsistent with observed ozone concentration gradients. Equation requires the yield at 4.31 pphm ozone (Base T) as input which is not available from all tomato production zones within the state.

4. $I = [9{,}055 - (323.67 \times 12\text{-hr})] \div [9{,}055 - (323.67 \times \text{base-}12)]$

Ozone response equation for tomato variety 'FM785'.

Temple (1990b).

5. $I = [6{,}119 + (1{,}269.1 \times 12\text{-hr}) - (135.6707 \times 12\ \text{hr})^2] \div [6{,}119 + (1{,}269.1 \times \text{base-}12) - (135.6707 \times \text{base } 12)^2]$

Ozone response equation for tomato variety 'Hybrid 31'.

Temple (1990b).

Equation 5 was not used for 1990 projections because results indicate a yield stimulation up a 12-hr mean of 7.2 pphm, an ozone exposure higher than any observed in the state.

6. $I = [6{,}315 - (210.7 \times 12\text{-hr})] \div [6{,}315 - (210.7 \times \text{base-}12)]$

Ozone response equation for variety 'UC204C'.

Temple (1990b).

7. $I = [8{,}590 - (412.8 \times 12\text{-hr})] \div [8{,}590 - (412.8 \times \text{base-}12)]$

Ozone response equation for variety 'E6203'.

Temple (1990b).

Turnip

1. $I = [155.5 - (10.26 \times 12\text{-hr})] \div [155.5 - (10.26 \times \text{base-}12)]$

McCool et al. (1986).

Production statistics are not available from the CDFA for turnip.

Wheat

1. $I = 0$

Olszyk et al. (1986b).

Equation 1 was not used for the 1990 projections.

2. $I = [5{,}295 \times e\text{-}(7\text{-hr} \div 14.5)^{3.326}] \div [5{,}295 \times e^{-(\text{base-}7 \div 14.5)^{3.326}}]$

Kress et al. (1985).

3. $I = [7{,}857 \times e^{-(7\text{-hr} \div 5.3)^{1.000}}] \div [7{,}857 \times e^{-(\text{base-}7 \div 5.3)^{1.000}}]$

Heck et al. (1984b).

Calculation of Ozone Exposure-Crop Loss Percentages. Where possible, crops restricted to particular regions within counties were matched with ozone data from stations in those regions. For example, crops grown in the Coachella Valley of Riverside County were matched to nearby stations, and not matched to the station in the municipality of Riverside. But for most cases, one ozone value for an entire county was used, which may represent the average concentration over several sites where the crop was grown. Concentrations of ozone used to estimate crop loss in the west sides of Fresno and Kings counties were lower than concentrations used in the east side of the same counties. Ozone concentrations were based on air monitoring data for Five Points (west side) and the Fresno area (east side) as discussed in the 1989 vegetation loss report. Fresno and Kings counties were not divided for the 1990 crop loss projections.

F. PILOT STUDY TO CALIBRATE LEAF SENESCENCE WITH CHANGES IN LIGHT REFLECTANCE BY THE LEAF SURFACE

Ten replicates each of Acala and Pima cotton were planted on May 13, 1991 in two open-top chambers and exposed to either charcoal-filtered or ambient air. Six seeds each were sown in 10-gallon pots containing UC II soil mix (Matkin and Chandler, 1957), enriched with 200-g of slow release fertilizer (Osmocote®, Sierra Chemical Co., Mt. View, CA). Plants were thinned to three plants per pot two weeks after germination and later to one plant per pot at first flower. Ozone concentrations in both chambers were continually monitored with a UV chemiluminescent ozone analyzer. Seven-hour mean ozone concentrations were 8.1 pphm and 2.5 pphm for the ambient and charcoal-filtered chambers, respectively.

Light reflectance by the leaves was measured weekly from first flower (July 15, 1991) through first boll opening (September 13, 1991) with a chromometer (Minolta, Model No. SL-200) on the same four leaves from each plant for the duration of the experiment.

Reflectance was measured in four leaves along the main stem, which spanned a range of ages, and subsamples were taken for chlorophyll analysis. Four 1-cm leaf disks were taken, immediately placed on dry ice, and kept frozen until the time of analysis. Chlorophyll was extracted by placing the leaf samples in 50 ml of dimethylsulfoxide (DMSO) and incubated at 60 C for 7-hr. Chlorophyll-a, chlorophyll-b, and carotenoid contents were determined using a spectrophotometer (HP Model No. 8452A, Hewlett-Packard, Palo Alto, CA).

G. RESPONSE TO OZONE -- REVIEW OF THE RECENT LITERATURE

The extensive body of published information pertaining to the effects of air pollution, particularly ozone, on the growth and physiology of crop plants has been continually reviewed during the ARB-sponsored Crop Loss Assessment Program. Experimental results and dose response functions of importance to California agriculture have been incorporated into the program to ensure that the best available information is used for statewide and regional yield loss estimates. During the preceding contractual period, computer searches encompassing over 100 scientific journals were conducted at regular intervals. Recent literature was reviewed and presented in three general categories: whole-plant response, physiological mechanisms, and yield loss equations. Experiments that expand current knowledge were preferentially addressed. Papers reporting crop responses previously elucidated are not discussed unless the accompanying analysis is unique or is used to develop yield loss equations useful to the project.

Whole Plant Response. The most notable area of research in the last three years is the response of fruit and nut trees to high levels of ozone. Information on these crops is scarce because of the logistics of exposing mature, or yet-to-bear trees, over extended periods of time. As reported earlier for citrus by Olszyk et al. (1988a), two years of exposure are needed to elicit a growth response because the injury is associated with the period of floral primordium initiation, which occurs nearly a year in advance of harvest. Retzlaff et al. (1992) found that leaf net CO_2 assimilation rate decreased linearly with increasing 12-hr mean ozone concentrations in almond, plum, apricot, prune, pear and apple after 3½ months of fumigation. Cherry, peach and nectarine were relatively tolerant to ozone exposure. In a companion study, the same authors (Retzlaff et al., 1992) found that among the dominant varieties of almond grown in the Central Valley, Nonpareil was the most sensitive to ozone injury, among the Mission, Butte, Carmel, and Sonora varieties. Ozone injury was associated with reduced photosynthesis, reduced trunk and foliage growth and premature leaf senescence. McCool and Musselman (1990) studied nonbearing seedlings and observed a similar growth response of Nonpareil to ozone, but apricot and peach were relatively insensitive to ozone treatments. During the last two years, ARB-funded research by DeJong et al. (unpublished data provided by W. Retzlaff in a personal communication) at the Kearney Field Station revealed that ambient levels of ozone in the Central Valley significantly reduce yields in plum, as compared to charcoal-filtered air (Figure 2). The three treatment ozone levels were charcoal-filtered air, ambient ozone, and 1.9 x ambient ozone, as 12-hr averages. A linear reduction in yield in response to ozone was observed in both 1991 and 1992. Ambient levels of ozone reduced yields by approximately 18% as compared to charcoal-filtered air over the two-year period. If the exposure chambers were removed, it is not known whether the yields of the high and low ozone-treated trees would equilibrate with those of ambient trees (Olszyk et al., 1990a). The additional information would provide convincing evidence to skeptical growers that current levels of ozone do in fact reduce yields in plum. Valencia orange exhibited a 31% yield reduction when exposed to a 12-hr mean ozone concentration of 0.075 ppm for four consecutive years (Olszyk et al., 1990b). The yield reduction was associated with fewer fruits per tree, as fruit quality and size were not affected.

Eissenstat et al. (1991a, 1991b) found that grapefruit exposed to 120 ppb ozone (12-hr mean) for eight months exhibited a significant reduction in freeze resistance. The negative effects of ozone were ameliorated by environmental conditions conducive to slow vegetative growth. It is noteworthy that hard freezes, such as the one experimentally reproduced in this study, seldom occur in the citrus growing regions of the Central Valley.

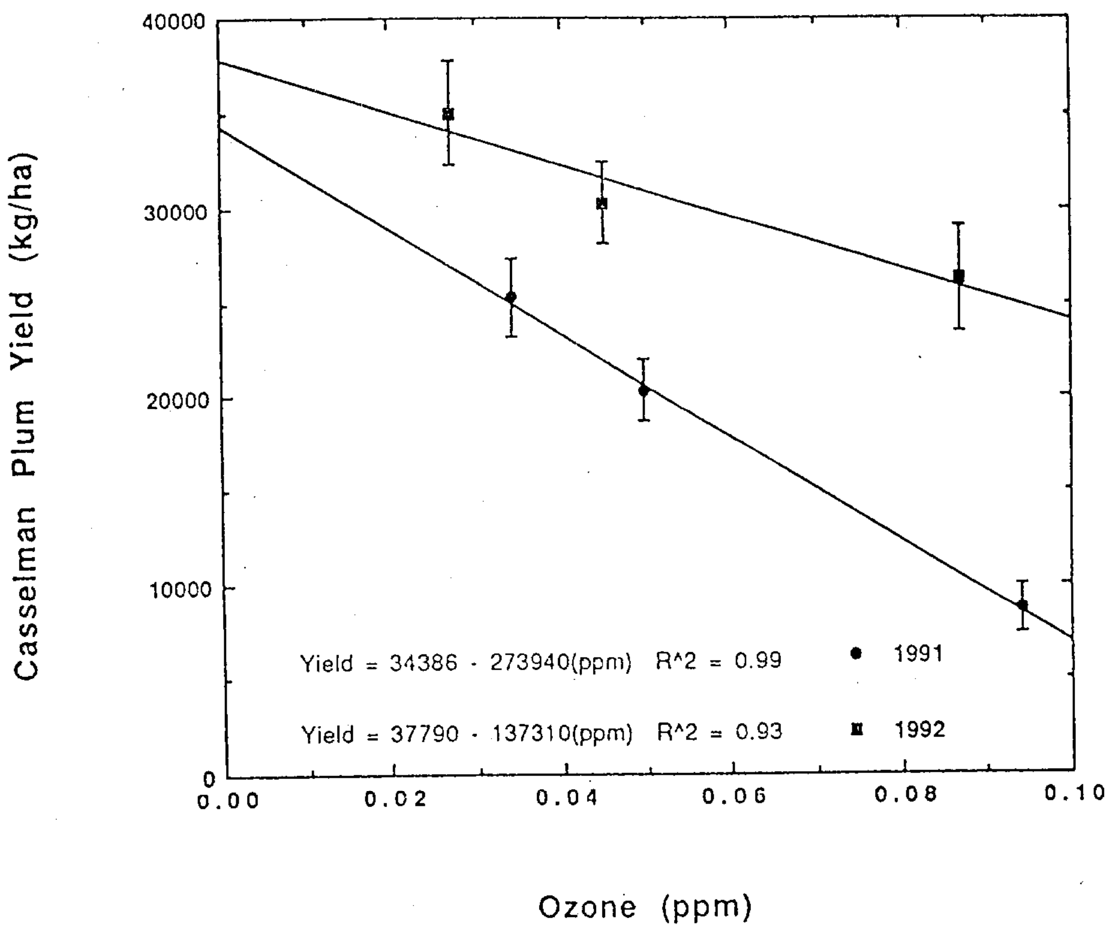


Figure 2. Yield of Casselman Plum in Response to Ozone at Three Different 12-hr Average Concentrations in 1991 and 1992 (Data provided by Dr. W. Retzlaff, University of California, Kearney Field Station).

No yie'd losses were observed in four cultivars each of lettuce, broccoli, and onion when exposed to ambient and 1.5 x ambient ozone in the winter growing season in southern California (Temple et al., 1990). Ozone injury on the outer leaves was severe, but yields were unaffected. Such cosmetic injuries may adversely affect marketability under some circumstances. These results show that, in general, the ozone concentrations in winter and spring are probably below the injury threshold for these crops. Ambient summer ozone concentrations in Riverside had no significant effect on the yield of a number of tomato cultivars (Temple, 1990b). However, 1.5 x ambient ozone (12-hr mean concentration = 109 ppb) reduced yield between 17 and 54% depending on the cultivar. The sensitivity of tomato to ozone was greatest in the morning and decreased over the remainder of the day (Goodyear and Ormrod, 1991). If it is shown that a diurnal pattern of ozone sensitivity exists in many crop species, exposure indices for yield loss estimates should include a weighting function to emphasize the time of day when air pollution is the most injurious.

Potatoes, grown to maturity according to standard agronomic practices, exhibited a substantial reduction in tuber yield when foliar ozone injury exceeded 20 to 40% (Clarke et al., 1990). Ozone injury was significantly mitigated by soil drench treatments of EDU (*N*-[2-(2-oxo-1-imidazolidinyl) ethyl]-*N'* phenylurea), an antioxidant. EDU was advanced as a potential means of evaluating the impact of ambient ozone on agricultural crops without open-top exposure chambers. A similar response to EDU did not occur, however, in soybean where no differences were detected in the plants grown at ambient concentrations of ozone with and without EDU (Brennan et al., 1990).

Kasana (1991) exposed chickpea, mung, and trefoil to 0 and 120 ppb ozone during a six-week period and found that these legumes were more vulnerable to ozone injury in the early stages of exponential growth. Leaves which were nearly fully expanded, root growth, and reproduction were significantly disturbed by ozone treatment. Results imply that it is not merely the intensity of the ozone episode that is crucial, but the timing of exposure in relation to the phenological and physiological stages of development. Reproduction was also observed to be particularly sensitive to ozone stress in dry bean (Mebrahtu et al., 1991). These researchers observed seeds-per-pod and pods-per-plant components of yield to be the most sensitive to ozone treatment. Mersie et al. (1990) reported similar findings, however, the degree of reproductive perturbation was extremely variable among the 410 genotypes screened for ozone sensitivity. Grain yield decreased with increasing seasonal mean ozone concentration as a result of the reduced weight of individual grains and in the number of grains-per-head (Fuhrer et al., 1992). Exposure of tomato to a 7-hr mean ozone concentration of 0.24 ppm at the vegetative stage had no affect on yield or fruit quality, but the same treatment at flowering progressively reduced the fresh weight of fruit (Tenga et al., 1990).

Recent experimental evidence has indicated that physiological and biochemical traits determine the susceptibility of plants to air pollution injury (e.g., Manderscheid et al., 1991). These processes include changes in stomatal behavior, which influence plant/water relations, and alterations in carbon and nitrogen metabolism and partitioning. The degree to which crop productivity is impacted depends on the growth stage of the plant, the rate and amount of ozone entry, and the plant's physiological capacity to detoxify, repair damage, and metabolically compensate for ozone and its oxidative derivatives (Guzy and Heath, 1993).

Disturbances in photosynthesis and carbon assimilation may influence plant development, and pollutants can affect the ability of both the stomata and other parts of the epidermal layer to regulate gas exchange (Wolfenden and Mansfield, 1991). Episodes of high ozone concentrations occur throughout the summer growing season in many areas of California. The effects on plant productivity in relation to the timing of the episodes is not well understood. Miller et al. (1991) found that photosynthesis during the pod fill stage in soybean was most correlated with ozone associated yield reductions, as compared to correlations measured during other stages of development. Ozone exposure during earlier stages of development contributed to yield suppression because of the irreversible injury to leaves and concomitant diminution of growth potential. Ambient levels of ozone in the Central Valley reduced photosynthesis in grape between 5 and 13% (Roper and Williams, 1989). The authors attributed the decreased photosynthesis to a reduction in both stomatal and mesophyll conductances to carbon dioxide. Smith et al. (1990) also reported an increase in leaf diffusive resistance (resistance is the inverse of conductance). Light utilization efficiency at the leaf level was not altered by ozone exposure (Loadley et al., 1990). Light interception, however, was reduced by 30% in the 0.3 ppm-treated plants, as compared to the 0.10 ppm treatment. This was attributed to premature senescence and the associated loss in leaf area. One can infer that photosynthesis was unaffected by ozone treatment during the course of the growing season because light utilization efficiency was unchanged. In contrast, Toyama et al. (1989) found the thylakoid membranes of the chloroplasts (site of carbon dioxide fixation) to be disrupted before any other ozone injury symptoms developed in rice. Aben et al. (1990) concluded that ozone could directly affect stomatal function, as well as photosynthesis in faba bean during pod fill, but neither were significantly influenced by ozone during vegetative growth. Increased stomatal resistance and the consequential decrease in intercellular carbon dioxide at very high concentrations of ozone (0.64 ppm) for 3-hr resulted from stomatal dysfunction due to changes in cell wall properties, and not changes in mesophyll photosynthesis (Moldau et al., 1990). Leaf net carbon dioxide assimilation rate decreased linearly with increasing 12-hr mean ozone concentrations in almond, plum, apricot, prune, pear, and apple cultivars, while stomatal conductance demonstrated a similar trend in all fruits except prune and pear (Retzlaff et al., (1991). Adaros et al. (1990) postulated that ozone related yield reductions resulted from shifts in carbon partitioning to metabolic maintenance of stressed leaves, and away from developing fruit. Although injured by ozone during reproductive phases of growth, seed yield was not affected in soybean if the younger ozone-tolerant leaves remained functional (Smith et al., 1990). Aben et al. (1990) observed ozone exposure was associated with a decrease in stomatal conductance during both the vegetative and reproductive growth stages of faba bean, while photosynthesis was affected only during pod fill.

Physiological and Biochemical Mechanisms. Plant growth and yield are the end-product of a series of physiological processes. It was proposed that ozone accelerated cellular aging of membranes and structural processes in a manner parallel to senescence (Price et al., 1990). The complexity of the numerous interactive processes associated with ozone toxicity has been the focus of several studies of plant responses to ozone exposure during the contractual period.

An increase in the pool size of free amino acids, particularly glycine and serine, was observed after common bean was exposed to ozone (Bender et al., 1990). The increased allocation of fixed carbon into glycine and serine indicated that the rate of photorespiration was elevated under ozone exposure. This assumption was supported by previous studies where the increase of glutamine synthetase activity was associated with long-term ozone fumigation (Bender et al., 1990), because the activity of this enzyme is thought to be predominantly involved in the reassimilation of photorespiratory ammonia. Another group of amino compounds, polyamines, increase during ozone treatment (Rowland-Bramford et al., 1989), and when plants are supplied with supplemental polyamines, visible symptoms of ozone injury were reduced (Bors et al., 1989). Mehlhorn et al. (1991) postulated that the protective effect of a polyamine against ozone may occur through its effect on ethylene biosynthesis. Sensitivity to ozone was reduced if ethylene biosynthesis was experimentally reduced. Manderscheid et al. (1991) reported that polyamines act to stabilize membrane integrity during ozone stress by scavenging of ozone-derived oxygen radicals.

It can be argued that premature leaf senescence associated with ozone injury results from oxygen free radicals disrupting nitrogen metabolism and cell membrane integrity, which leads to secondary symptoms such as the breakdown of chloroplast DNA (Agrawal and Agrawal, 1990). Castillo and Heath (1990) concluded that common bean exposed to a triangular wave of ozone exhibited visible injury and lost the capacity to extrude cellular calcium and thereby maintain ionic homeostasis within the cell. Toyama et al. (1989) also noted a loss of membrane integrity in rice following ozone exposure. Visible injury by ozone was accompanied by a decrease in leaf chlorophyll (Smith et al., 1990). The same authors found that nitrate reductase activity was reduced by ozone treatment.

The enzyme nitrate reductase reduces nitrogen from the phytotoxic form of NO_3^- to NH_3, which is readily convertible into amino acids and proteins. Agrawal and Agrawal (1990) demonstrated that the appearance of ozone-caused foliar lesions coincided with a decrease in nitrate reductase activity in faba bean. There was a subsequent reduction in amino acid and protein content in the leaf, due to an apparent lack of NH_3 for normal metabolic processes. Nitrate reductase activity and nitrogen content of soybean leaves was reduced in a similar fashion by ozone injury (Smith et al., 1990). Reduced glutathione has often been implicated as a defense against ozone toxicity because it scavenges free oxygen radicals in plant cells (Price et al., 1990; Guzy and Heath, 1993). As a result of neutralizing the oxidant, glutathione is oxidized, and potentially restored to a reduced state by the enzyme glutathione reductase. Disrupted nitrogen metabolism could result in the loss of capacity to scavenge free oxygen radicals produced in response to ozone injury. Bender et al. (1990) pointed out that an increase in free radical scavenging enzymes can occur in the absence of visible injury symptoms and measurable yield reductions.

H. DOMINANT BRUSH SPECIES AT RISK FROM OZONE -- LITERATURE REVIEW

Digital data bases were searched for information regarding ozone effects on brush species from genera commonly found in ponderosa pine and associated chaparral ecosystems, including *Rhamnus, Adenostoma, Fremontia, Artemisia, Rhus, Ribes, Ceanothus, Arctostaphylos, Quercus,* and *Eriogonum*; common and scientific names were referenced. No research was found addressing the ozone susceptibility of dominant understory species in the ponderosa pine ecosystem. Limited research addresses the ozone susceptibility of woody perennials in chaparral zones (Stolte, 1984).

Chaparral species are of interest because they underpin the viability of watersheds with value for habitat, forage, and recreation (Munz and Keck, 1968). Furthermore, the altitudinal range of the chaparral often corresponds to heights of inversion bases and concentrations of ozone which commonly exceed those in the valley below and the higher elevations above (ARB, 1990; Miller et al., 1972b).

In the most complete study to date of the effects of ozone on dominant species in the chaparral, Stolte (1984) conducted controlled fumigations and field surveys of mature and seedling plants of *Ceanothus leucodermis, Arctostaphylos glauca, Adenostoma fasciculatum,* and *Quercus dumosa*. The results of Stolte (1984) suggested that ambient ozone may significantly affect the density and composition of chaparral during periods of post-fire regeneration in areas subject to ozone stress because of the differential effects of ozone on chaparral species. His results may also apply to predicting the ozone susceptibility of closely related species of *Ceanothus* (California lilac), *Arctostaphylos* (manzanita), and evergreen *Quercus* (oaks and scrub oaks), which are found in the ponderosa pine ecosystem. Another observation which could prove useful in predicting the ozone susceptibility of untested species was the very strong negative correlation between susceptibility to ozone and leaf sclerophylly (lignin enriched cell walls), as supported by Ledbetter et al. (1959). If additional assessments of understory and chaparral species are to be made, species without sclerophylly could be focused on in order to most effectively use limited resources. A final observation useful for extrapolation to other species was that sensitivity of the plants varied with the season: plants fumigated in February or March were less sensitive than similar plants fumigated in late-March or April. It is reasonable to assume that chaparral plants would be most sensitive to ozone episodes during their periods of peak physiological activity, for most of the species late-March to May is when soil water is available and temperatures are rising. However, for very deep rooted species like *Ceanothus*, which do not typically exhibit summer drought dormancy, the period of ozone susceptibility may extend well into the summer. Thus, except for species like *Ceanothus*, many of the chaparral plants would escape ozone stress through dormancy during the months of highest ozone concentrations.

The effects of ozone on these species were characterized by Stolte (1984) with respect to visible injury, but no measurements of ozone effects on photosynthesis, other metabolic functions, or growth were made. The study was also limited by reliance on fumigation regimes which do not match ozone exposures encountered under ambient conditions. Although the plants were kept in an open lathhouse, low light conditions could have altered leaf morphology and led to an unrealistic O_3 response. Most experiments assayed plants fumigated once for 6-hr at concentrations ranging from 0.5 to 2.5 ppm; only a few experiments tested seedlings with a single 6-hr fumigation of either 0.1, 0.2, or 0.3 ppm.

The most sensitive species assayed by Stolte (1984) was *C. leucodermis*. Twelve other species of *Ceanothus*, in the section Euceanothus (Wells, 1969), which are morphologically similar to *C. leucodermis*, are expected to respond similarly. Eight-week-old seedling plants manifested light chlorotic stippling in response to controlled ozone fumigations of 0.1 ppm for 6-hr, a dose that could be replicated or exceeded under ambient conditions in many chaparral zones of California. Furthermore, field observations of seedlings of the same species in the Strawberry Creek area of the San Bernardino Mountains in April 1981 found significant ozone injury. Ambient hourly ozone maxima for the 16-days preceding the observation ranged from 0.12 to 0.22 ppm.

Chamise (*A. fasiculatum*) was also observed to be sensitive to levels of ozone expected under ambient conditions. Eight-week-old seedlings showed visible damage when exposed to 0.2 ppm, but not 0.1 ppm ozone for 6-hr. Manzanita and scrub oak species showed visible damage only after 6-hr fumigations exceeding 0.5 ppm ozone.

The differential susceptibility of the two groups of plants could result in changes in chaparral composition and density following the period of regeneration after fire. The first year of growth after a fire, determines which species will dominate the chaparral (Horton and Kraebel, 1955; Countryman and Philpot, 1970; Keeley and Keeley, 1981). The sensitive chamise and *Ceanothus* species depend upon the establishment of a deep taproot to survive the critical first year. Ozone episodes in March through April during the period of intense growth could negatively impact the ability of these plants to become established. A competitive advantage may accrue to species such as the slower growing manzanita and scrub oak, which apparently are resistant to ambient levels of ozone.

Ceanothus species fix nitrogen, and in so doing provide essential resources for forest and chaparral ecosystems. A decrease in the number of *Ceanothus* shrubs could have a systemic effect on ecosystem productivity, which would not necessarily be offset by an increase in the number of non-fixing species. If ozone injury decreases nodule formation in *Ceanothus*, as it does in soybean (Tingey and Blum, 1973), pools of available nitrogen in the ecosystem may decrease.

III. RESULTS AND DISCUSSION

A. STATEWIDE INTERPOLATIONS

The twelve maps (i.e., one for each month in 1990), which show statewide 7-hr mean ozone concentrations at the ARB network sites and points in between where interpolation was possible, demonstrate the extreme seasonal variability in air quality within and between the major air basins of California (Figures 3 to 14). In January (Figure 3), mean ozone concentrations of all interpolatable regions were between 0 and 4 pphm, except at four locations at elevations near the inversion layer base. In northern California, ozone was measurably higher in the Lake Tahoe region compared to valley areas. Ozone levels in the Los Padres National Forest (near Santa Barbara), Phelan (in western San Bernardino County), and Alpine-Victoria (in the hills east of the San Diego metropolitan area) were also higher than in adjacent areas. The limits of the interpolation are apparent on the eastern edge of the Imperial and Coachella Valleys (Figure 3). The geographical extent of interpolation is determined by the location of the monitoring stations and the availability of air quality data from that site. In other words, the region of interpolation is defined by the distribution of air monitoring stations with data for a given time period.

Ozone concentrations increased around most metropolitan areas in February 1990 (Figure 4). Interestingly, air quality began deteriorating in the Fresno, southern San Joaquin Valley and San Diego areas before the area surrounding San Bernardino and Riverside, which characteristically experiences some of the highest ozone levels in the state. The lack of data for February from Shasta and Siskiyou Counties prohibited interpolation of mean ozone concentrations in the northern portion of the Sacramento Valley.

In March, higher ozone concentrations were observed in the majority of the San Joaquin and South Coast Air Basins (SoCAB; Figure 5). The area around Alpine, west of San Diego, continued to report some of the highest ozone concentrations in the state during March and April 1990 (Figure 6). The transport of air pollution from the valley floor to the mountains surrounding the SoCAB was apparent during April when the Lake Gregory station in the San Bernardino mountains reported mean ozone values of 6 to 8 pphm. A similar statewide distribution of air quality trends was observed in May, except the influence of the Bakersfield

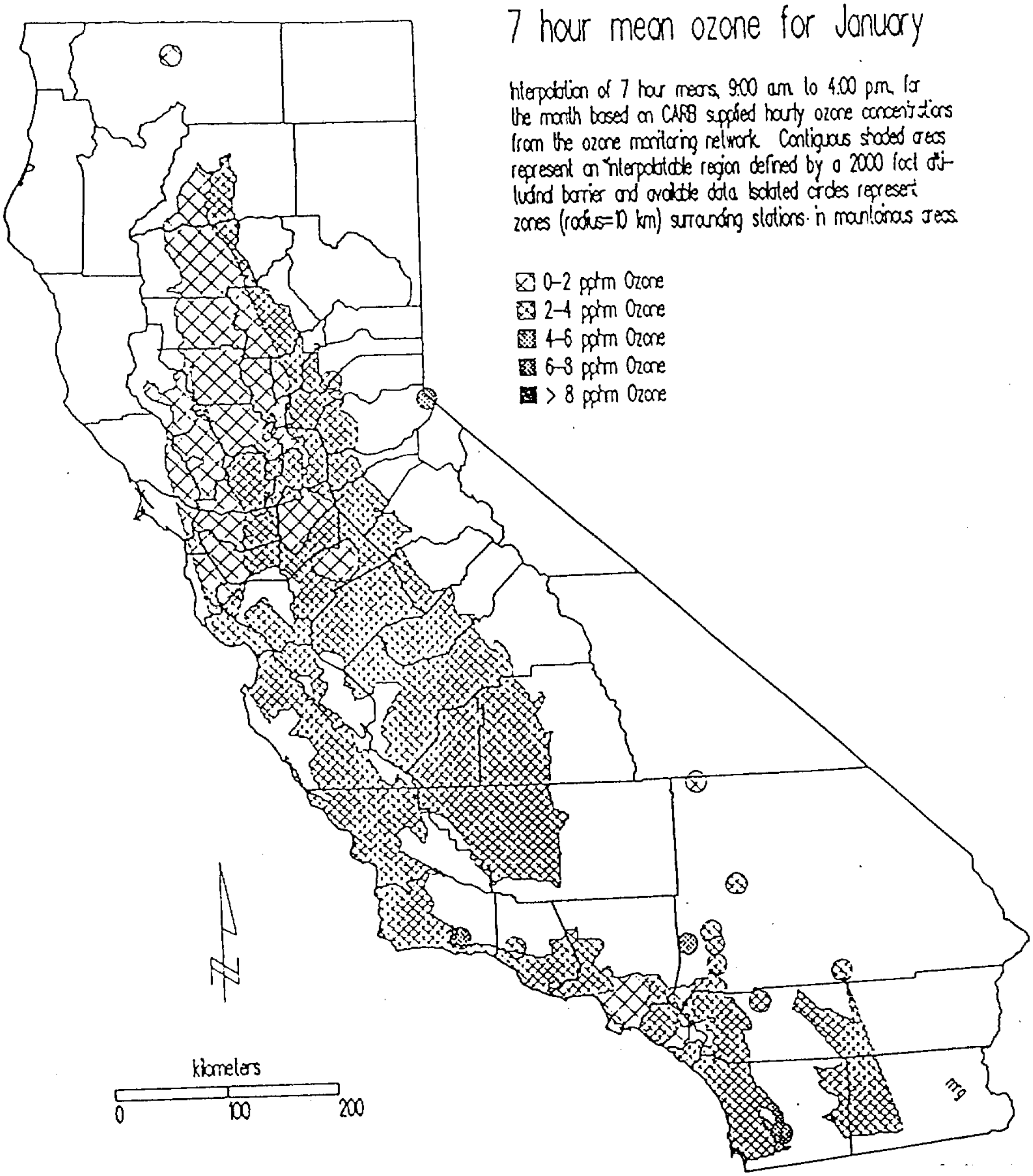


Figure 3. Statewide 7-hr Mean Ozone Concentration: January 1990.

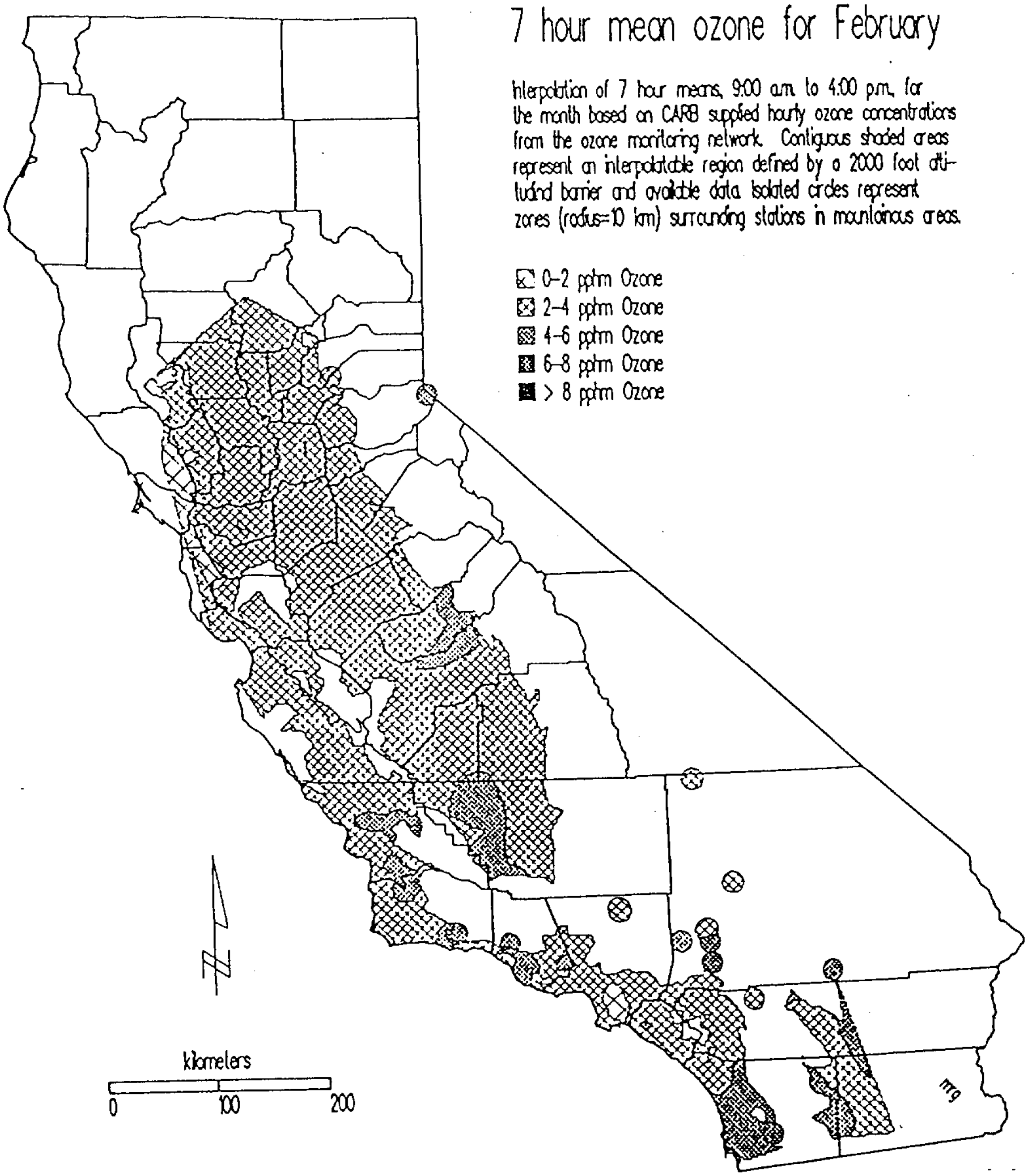


Figure 4. Statewide 7-hr Mean Ozone Concentration: February 1990.

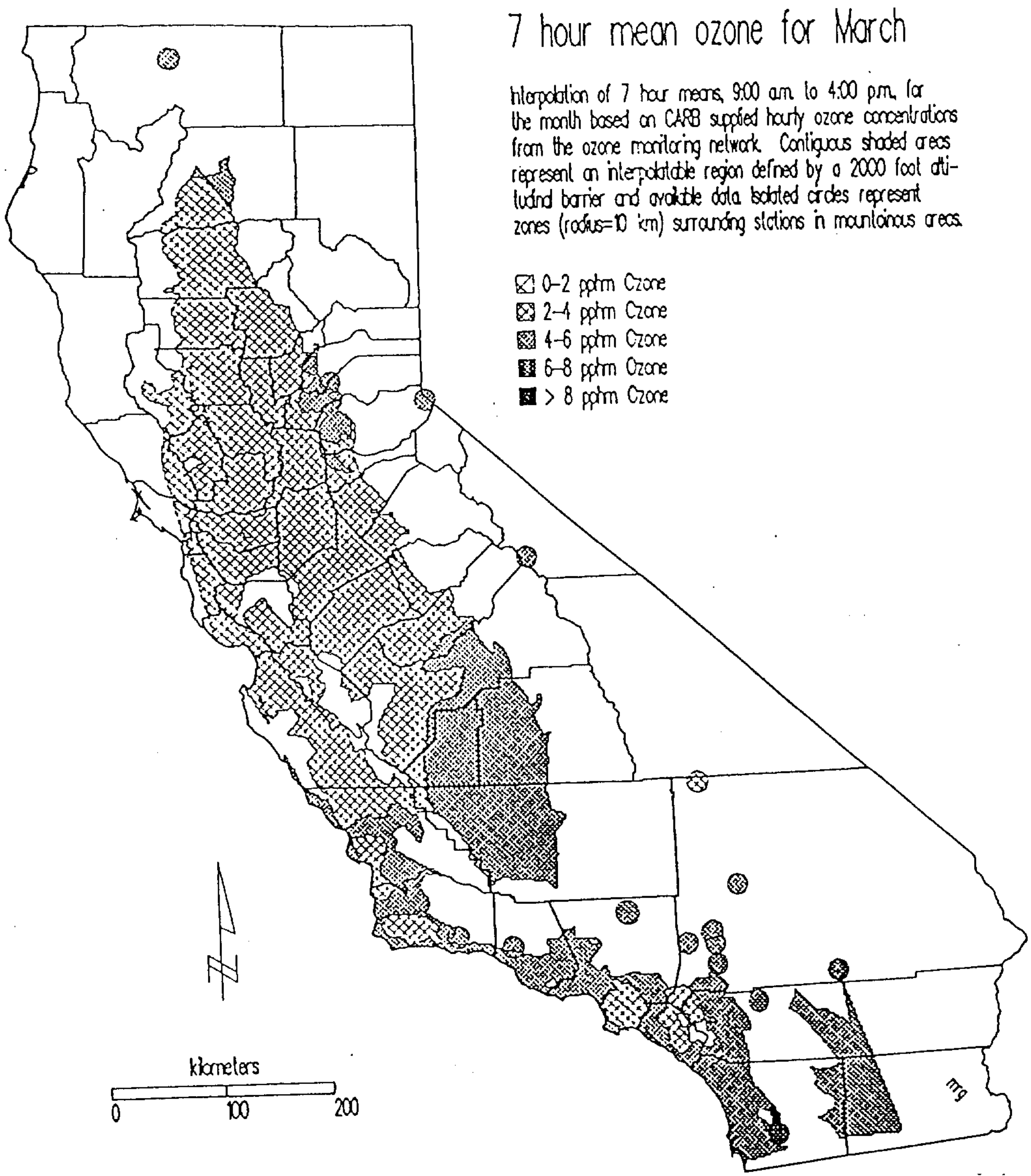


Figure 5. Statewide 7-hr Mean Ozone Concentration: March 1990.

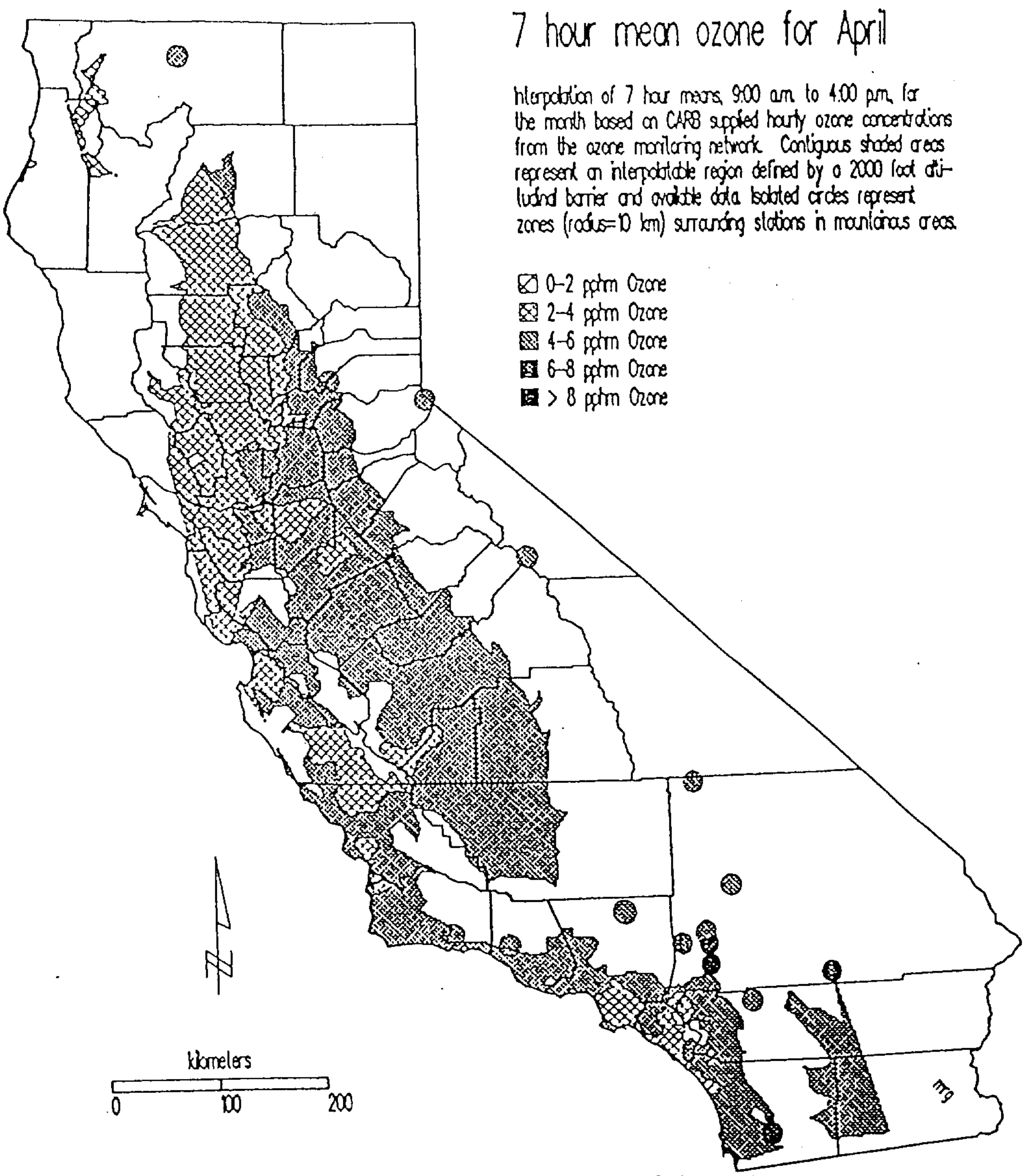


Figure 6. Statewide 7-hr Mean Ozone Concentration: April 1990.

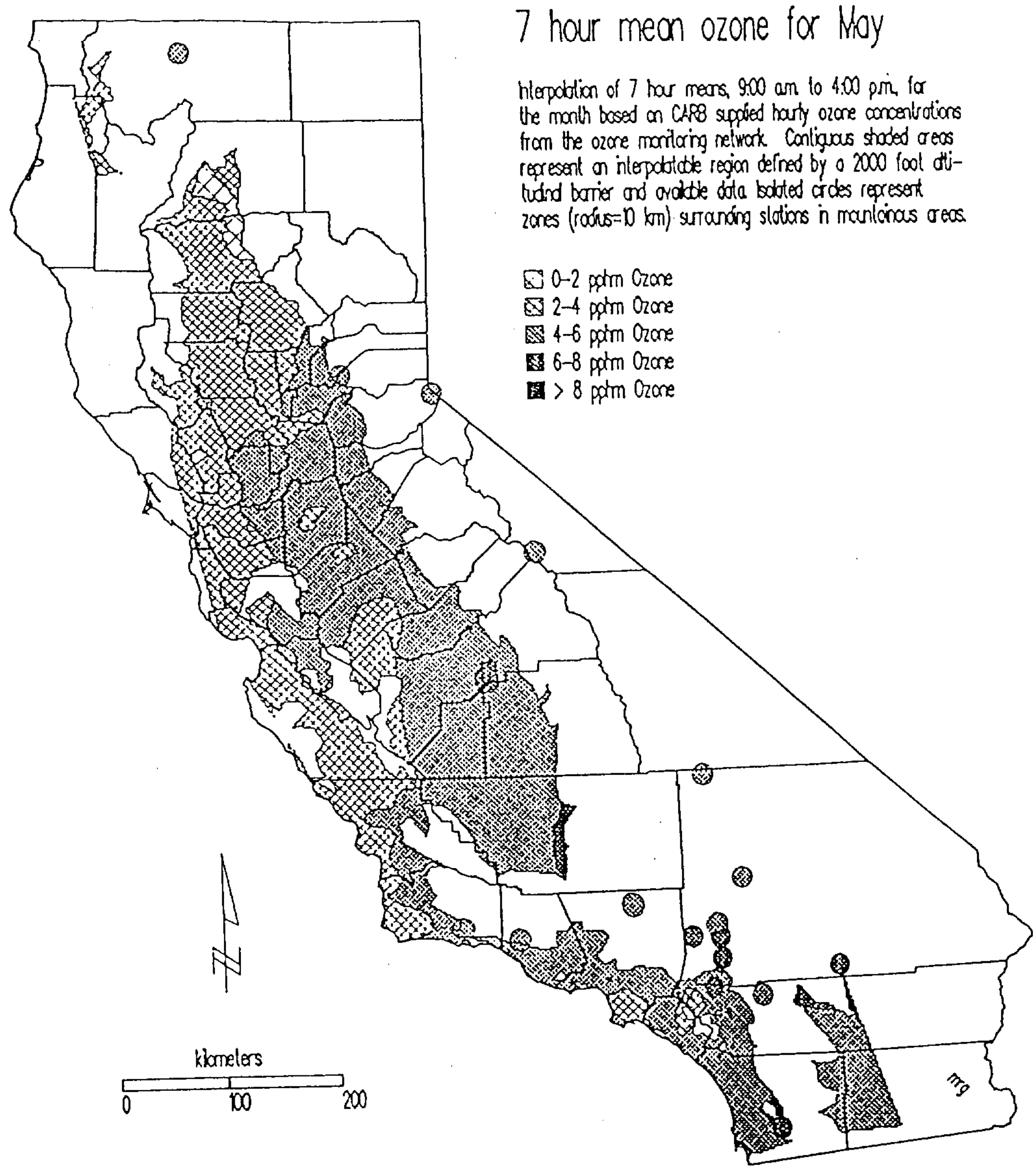


Figure 7. Statewide 7-hr Mean Ozone Concentration: May 1990.

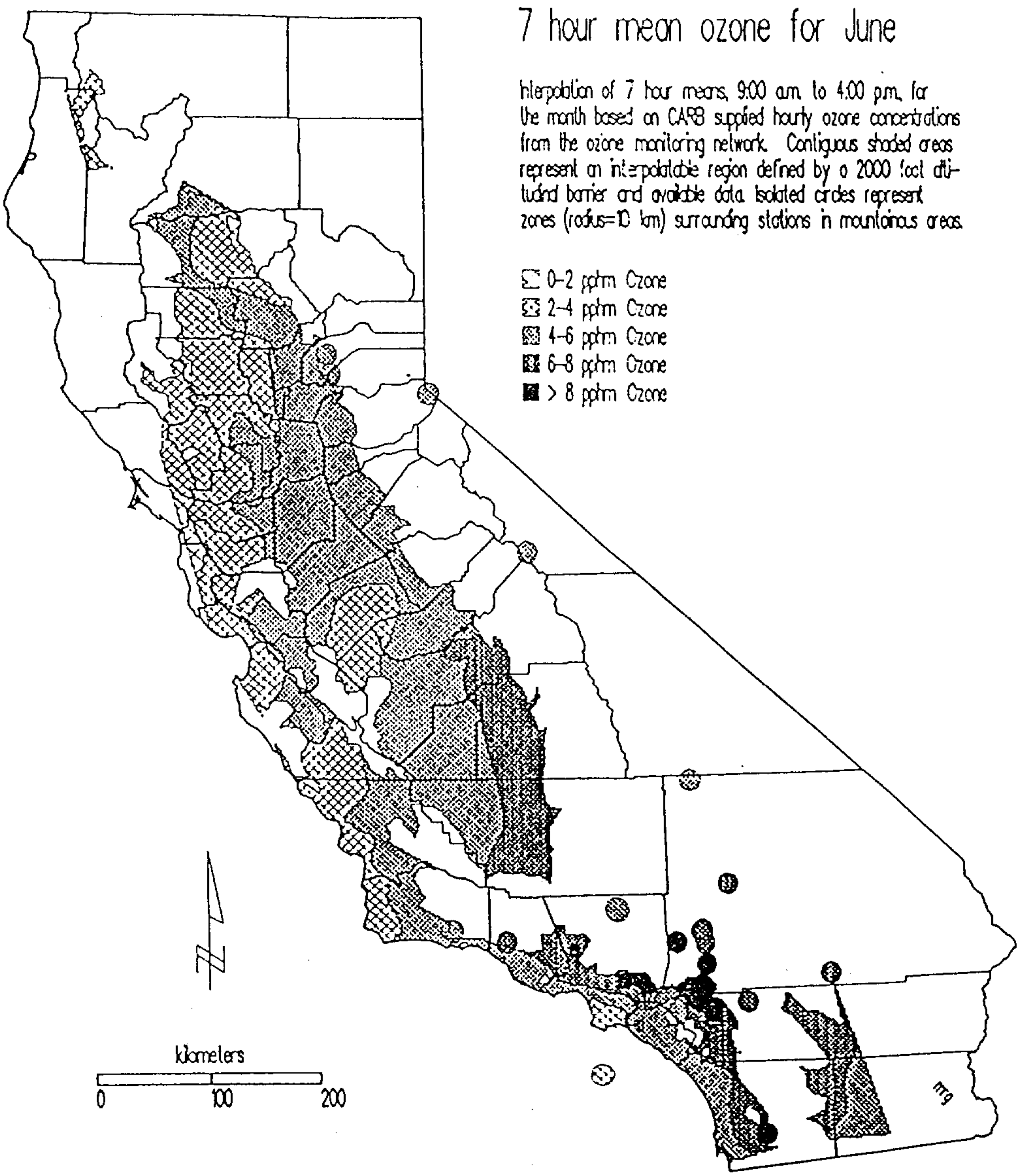


Figure 8. Statewide 7-hr Mean Ozone Concentration: June 1990.

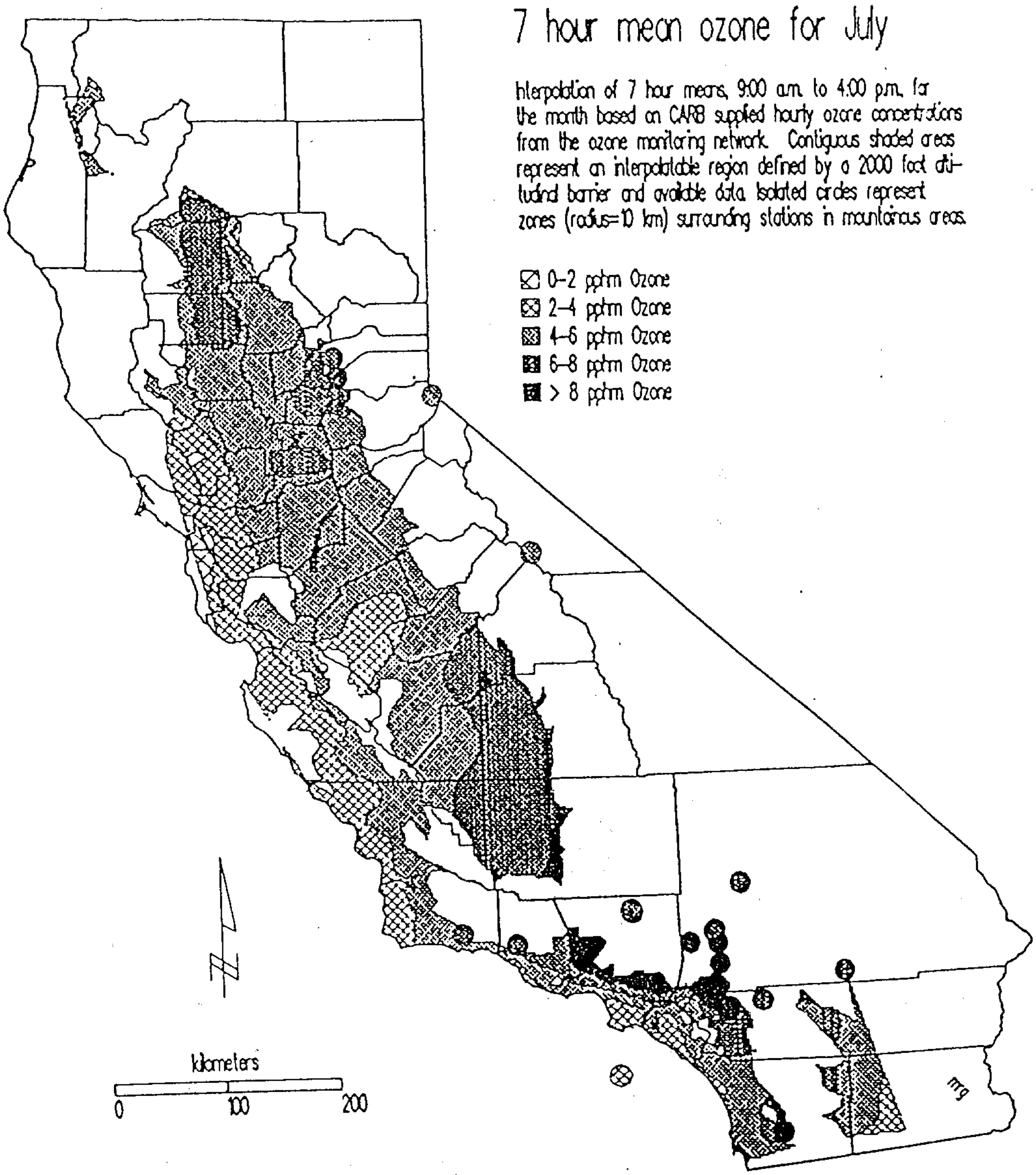


Figure 9. Statewide 7-hr Mean Ozone Concentration: July 1990.

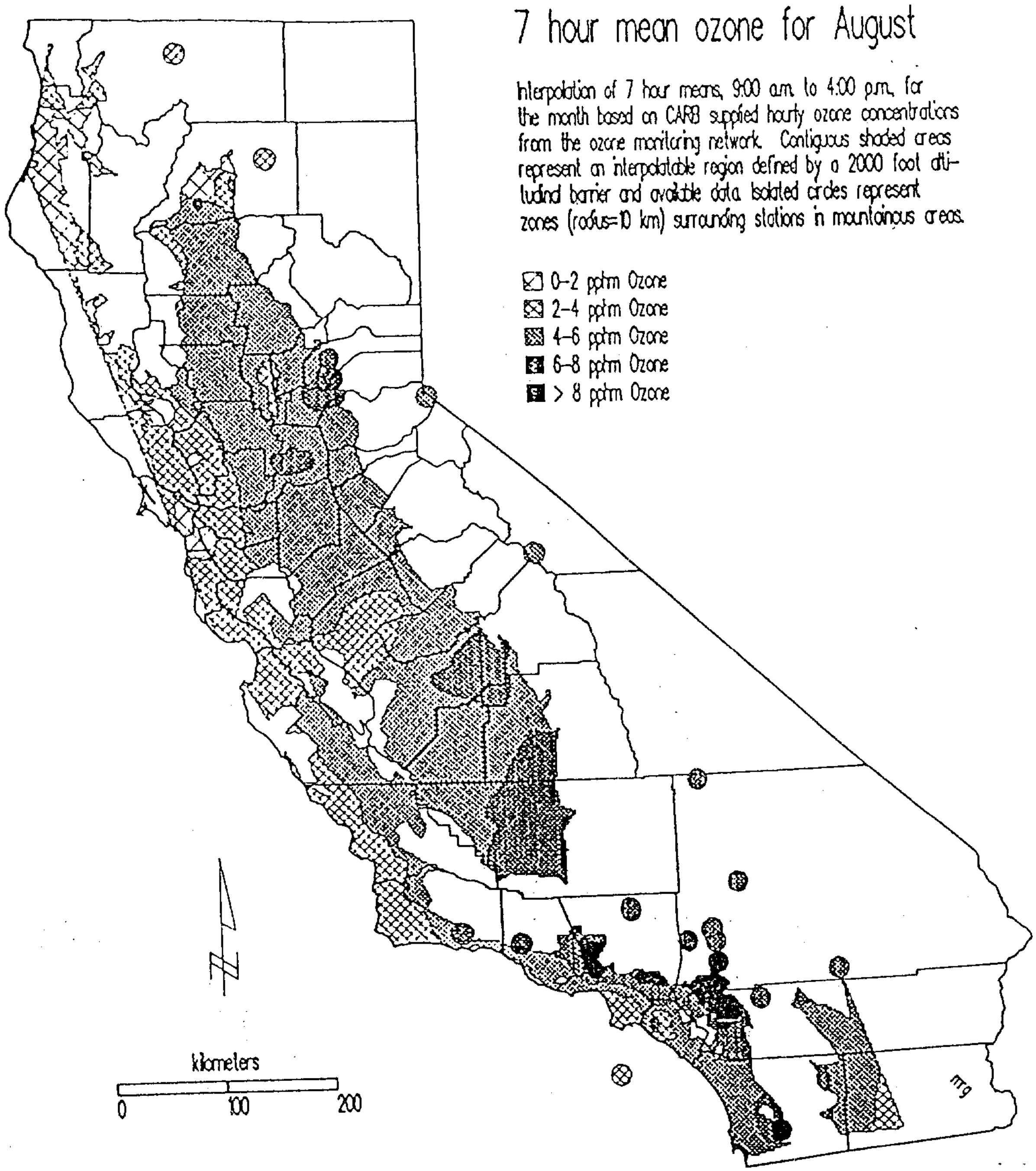


Figure 10. Statewide 7-hr Mean Ozone Concentration: August 1990.

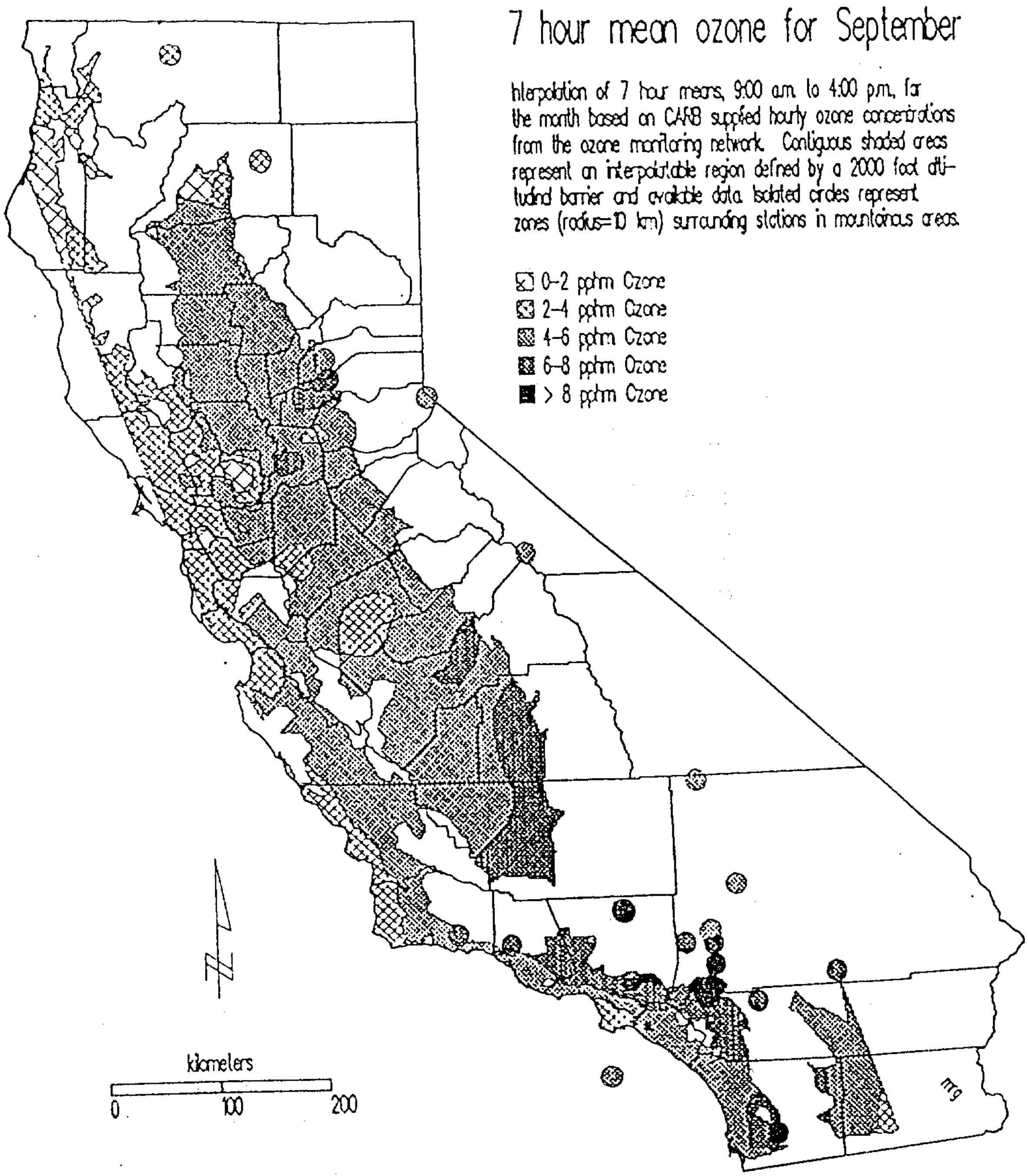


Figure 11. Statewide 7-hr Mean Ozone Concentration: September 1990.

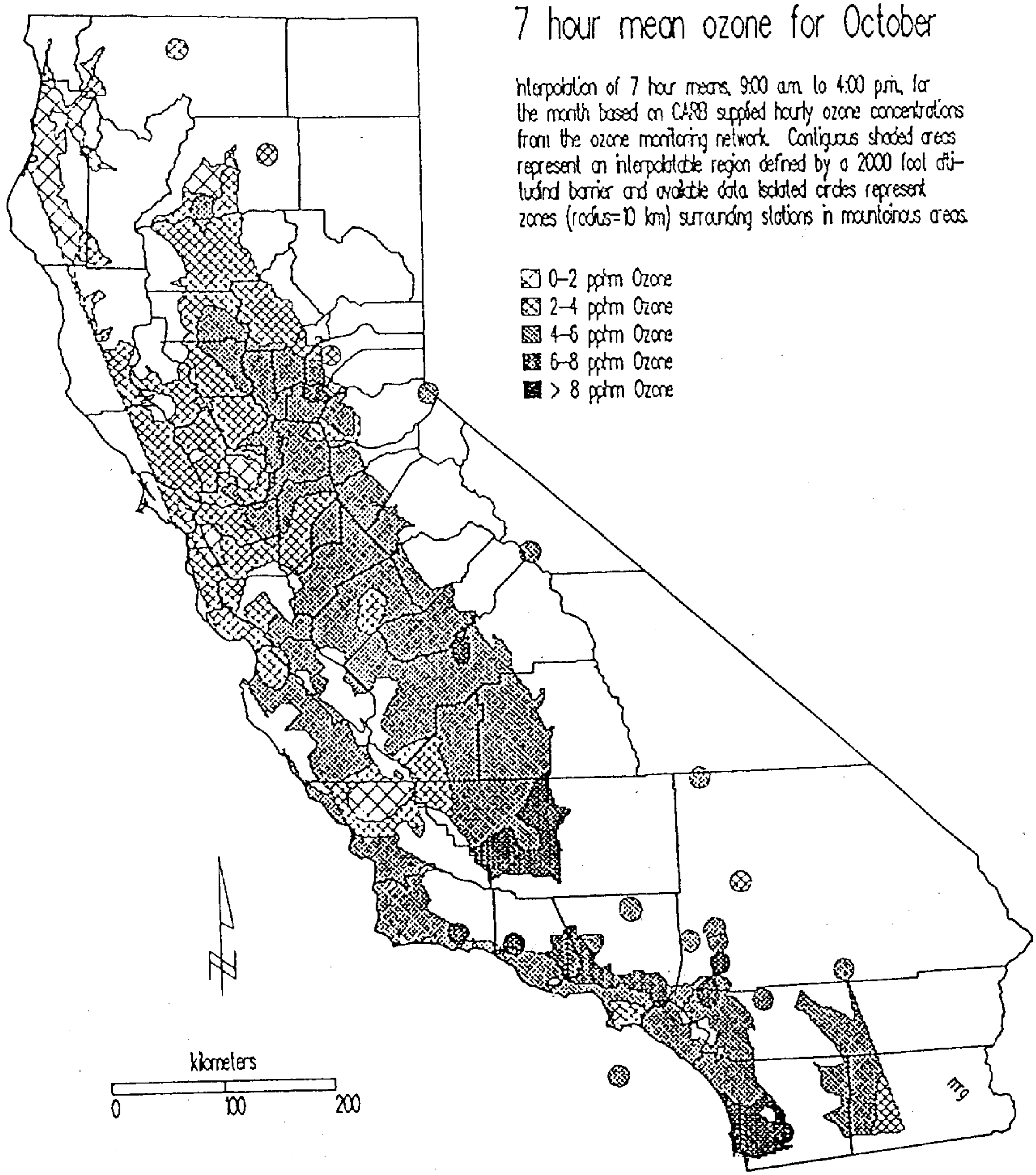


Figure 12. Statewide 7-hr Mean Ozone Concentration: October 1990.

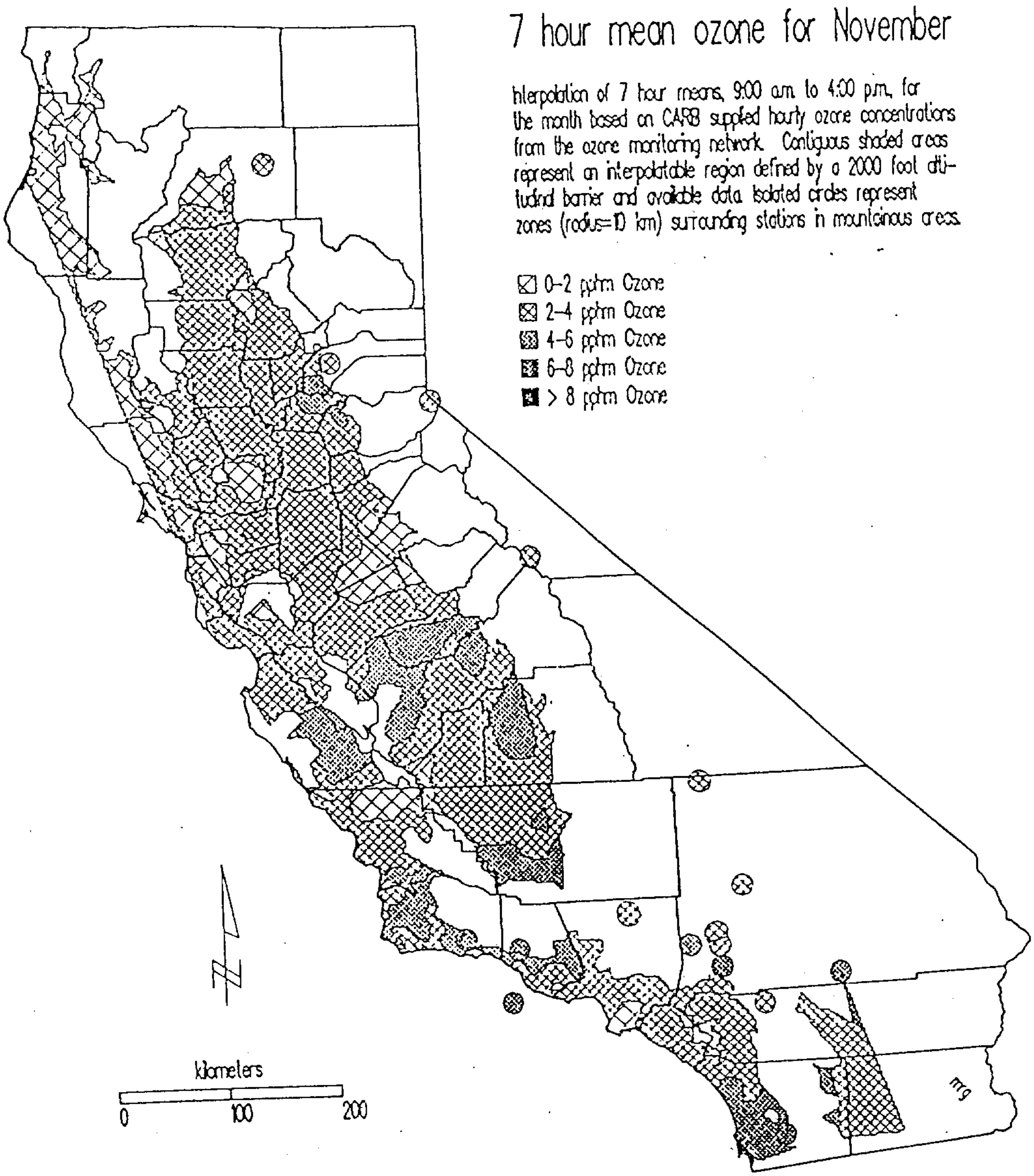


Figure 13. Statewide 7-hr Mean Ozone Concentration: November 1990.

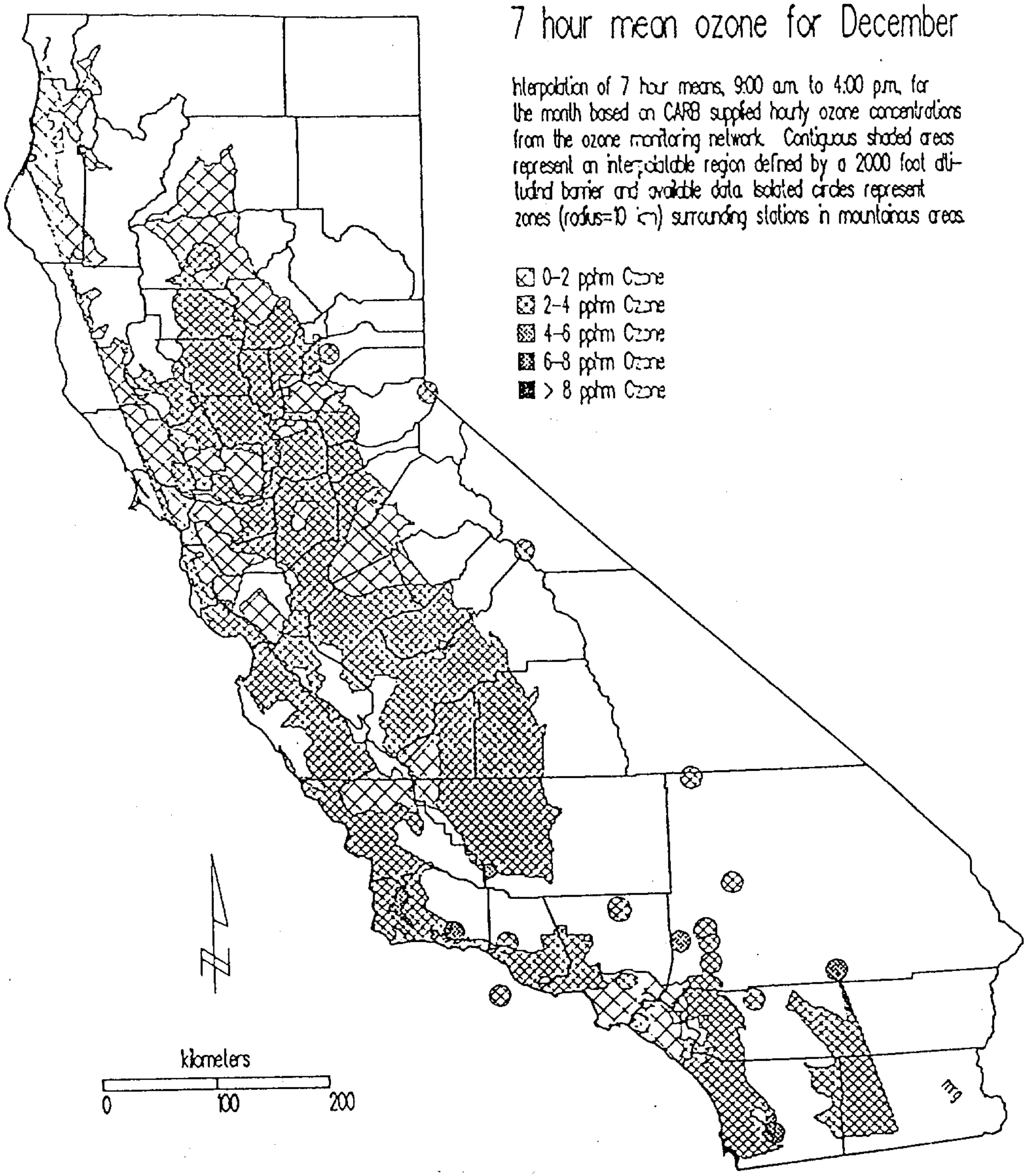


Figure 14. Statewide 7-hr Mean Ozone Concentration: December 1990.

and Fresno metropolitan areas on regional air quality became apparent (Figure 7). Otherwise, statewide ozone levels in March and April were comparable.

The months of April through October saw much of the monitored area affected by 7-hr means in excess of 4 pphm. The only exceptions were some coastal areas in Los Angeles, Orange, Ventura, and Santa Barbara Counties, and also western Fresno and Merced Counties, and the region north of Monterey County, west of the Central Valley.

A substantial increase in ozone concentrations during June, as compared to previous months (Figure 8), coincided with the occurrence of higher temperatures and the development of an inversion layer over valleys in the southern portion of the state. Mean ozone concentrations jumped from around 4 pphm to > 8 pphm in the eastern SoCAB. On the eastern side of the San Joaquin Valley, from south of Bakersfield north to Fresno, 7-hr means were at levels known to significantly reduce yields in some crops under experimental conditions (cf. NCLAN). Ozone levels in the Alpine area remained high, while in the coastal areas from Point Conception north to Point Reyes, ozone concentrations were relatively constant during the first six months of the year.

Air quality in the communities adjacent to and in the mountains surrounding the SoCAB was at its worst during July 1990, with the 7-hr mean ozone concentration exceeding 8 pphm over a large area of the basin (Figure 9). Moreover, ozone concentrations in Bakersfield and Fresno were comparable to those observed in parts of the SoCAB. In agricultural areas south of these metropolitan areas, ozone levels were > 8 pphm in July, when a large portion of the major crops are in or approaching reproductive stages of development. The areas surrounding Sacramento were also readily identifiable as an island of higher ozone concentration. The area of intense ozone exposures shrank in August (Figure 10) relative to ozone levels in July. Only the areas that experience consistently poor air quality during the summer, such as Glendora, Riverside, Lake Gregory, Bakersfield and Alpine reported concentrations > 8 pphm in August. Statewide air quality in September (Figure 11) was comparable to that observed in August.

The decrease in daytime temperatures and the breakup of the inversion layer over the major air basins in California resulted in an improvement of air quality at all reporting stations during October (Figure 12). Mean ozone concentrations across the state during October, November (Figure 13) and December (Figure 14) were comparable to those reported in March, February, and January, respectively, of the same year.

A number of observations comparing sites with elevations in excess of 2000-ft, near the base of the inversion layer, with nearby sites at lower elevation, demonstrated vertical differences in ozone concentration (i.e., sites at higher altitude experience significantly greater ozone doses than lower elevation sites). Distinct differences in ozone exposure were seen between sites near the inversion base vs. nearby lower altitude sites: Lake Gregory vs. San Bernardino-Fourth Street, Alpine-Victoria vs. El Cajon, and Los Padres National Forest vs. Santa Barbara. Not only does the monthly 7-hr mean highlight the phenomenon, but comparisons of other statistics, including the number of annual occurrences of hourly maximum ozone concentrations > 9, 12 and 20 pphm are also similar. The importance of assessing the effects of elevated ozone concentrations on natural resources at and above the inversion layer is discussed further in the section in this report on the effects of ozone on important woody perennials in ponderosa pine and chaparral ecosystems.

B. SAN JOAQUIN VALLEY AIR QUALITY STUDY

Qualitatively, for the same region, the interpolation of 7-hr mean ozone concentration statistics is comparable across the maps. In both maps, higher ozone concentrations were found on the eastern sides of Kern and Fresno Counties, with the highest valley-wide concentration near Arvin. However, the San Joaquin Valley map depicts valley-wide ozone concentration differences at higher resolution, emphasizing the contributions of the seventeen SJVAQS monitoring stations to the overall pattern of ozone distribution (Figure 15). Perhaps the most striking feature found in the SJV, but not the statewide map, is a region of higher ozone concentration in western Kings County, centered around the Terrabella station. It is not known whether or not the data from this station are biased. Other features of the SJV map, different from the statewide map, include the higher ozone area near Arvin and the shape of the high ozone area east of Fresno.

Mean 7-hr Ozone Levels in the San Joaquin Valley: August 1990

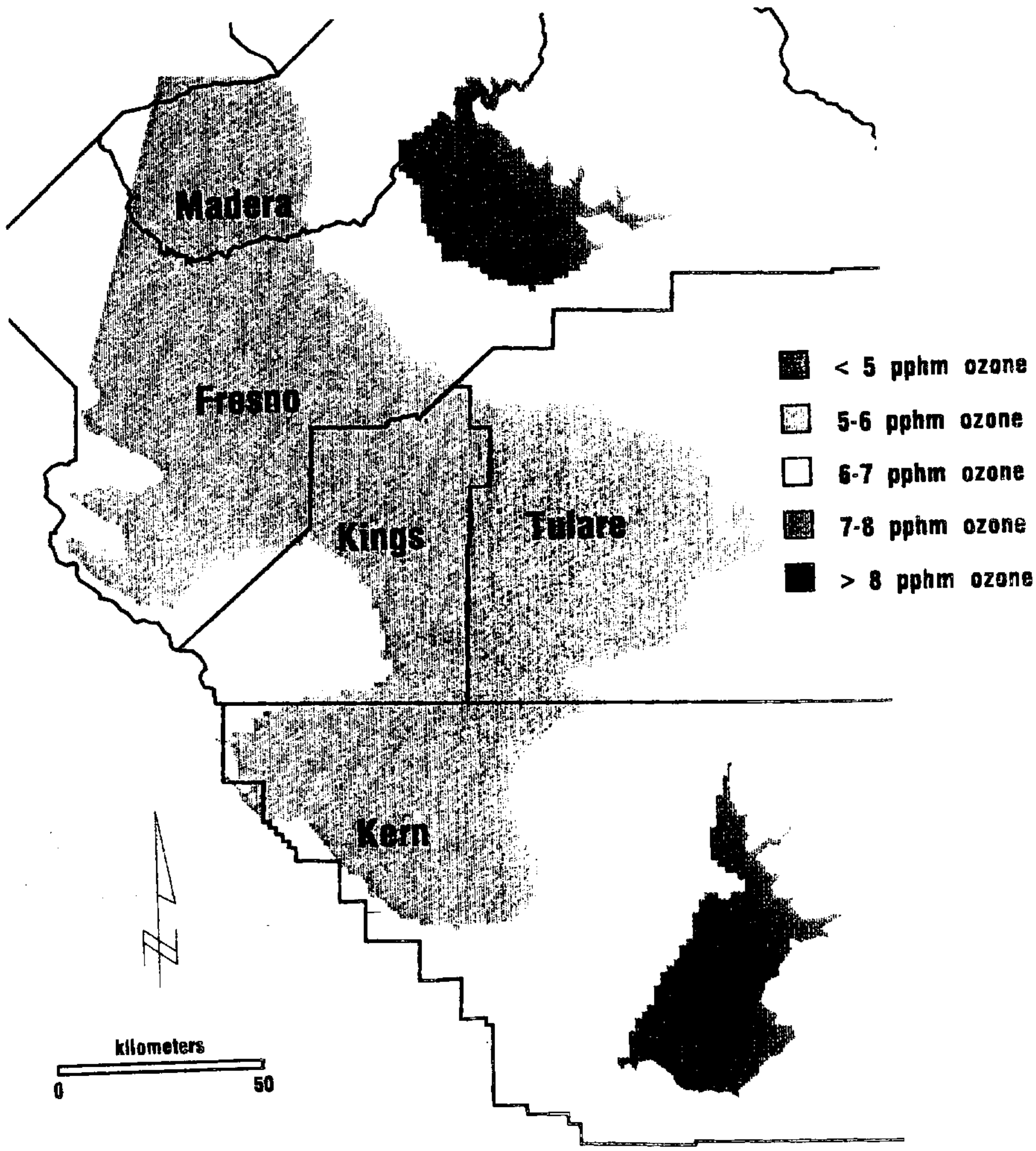


Figure 15. An Inverse-distance-squared Interpolation Based on Ozone Data from the San Joaquin Valley Air Quality Study and ARB Monitoring Stations within a Region Defined by a 2000-ft Altitudinal Barrier (Stations within 50-km of a Location were Used to Interpolate Ozone Concentration at the Location).

C. COMPARISON OF INTERPOLATION TECHNIQUES AND RECOMMENDATIONS FOR FUTURE WORK

Limitations of the Interpolation Method. Both techniques make comparable maps, but there is a caveat for users of the TIN associated with extending the interpolated region beyond the default convex hull to match the convoluted boundaries and islands of the air basins. Because the method will not extend the interpolation to the boundary unless nodes along the boundary have values for the ozone statistic, the analyst must assign either a value of "NODATA" or a reasonable value for the ozone statistic. Usually NODATA will be assigned because nothing is known about the ozone statistics associated with the boundaries of the basin. The method will use linear interpolation to estimate a value to replace the NODATA value, and extend the TIN to the boundary, if a line can be drawn across the boundary which connects two monitoring stations. If the NODATA value is not replaced, the TIN will not extend to that node. However, in exceptional cases, NODATA values can be replaced by unrealistic values, resulting from an interpolation between two unrelated monitoring stations, separated by a physical barrier. Except for the above, TIN surfaces provide reliable interpolations of ozone concentrations at locations without monitoring stations. Nonetheless, analysts should carefully examine the interpolations they perform.

The inverse distance weighting method is easier to adjust so that the interpolated surface extends to an air basin boundary. Thus, the analyst can preclude the possibility of interpolating between two unassociated stations.

D. YIELD LOSS ESTIMATES

Statewide estimated yield losses for 22 crops in 1989 and 1990 were determined by comparing actual yields to those projected to occur at a background ozone concentration (Tables 5 and 6). Background 12-hr and 7-hr average ozone levels were either 2.50 or 2.72 pphm, respectively. These background concentrations are based on the results of the NCLAN Program. Whether the 12-hr or 7-hr mean was used for comparison depends upon the crop-specific projection model as discussed in Materials and Methods. Yield in tons represents the actual harvested yield. Potential yield can be calculated by adjusting the actual yield by the percent loss. Losses for each commodity by county are presented in expanded form in Tables F and G in the Appendix.

In 1989, estimated statewide, weighted-average yield losses for alfalfa ranged from 0.8 to 7.1% for models 2 and 1, respectively (Table 5). The apparently small impact of ozone on statewide alfalfa yield is not entirely unexpected since it is periodically harvested during the growing season. Therefore, the foliage is exposed to ambient ozone for relatively short periods of time during vegetative stages of development. The highest losses were estimated to occur in production areas with high ambient ozone, such as Los Angeles (14%), Kern (13%), and San Bernardino (12%) Counties using model 1 (Table J, Appendix). Alfalfa grown for seed, however, is not harvested for hay and the leaves would experience a greater ozone exposure, as evidenced by the slightly greater predicted loss. The losses were estimated using models developed for alfalfa hay, where the foliage was periodically harvested, and therefore may be an underestimate.

Yield loss in dry bean ranged from 1.6 to 20.1% in 1989. Among the major bean producing counties, losses were greatest in Kern (21%), Merced (17%), and Fresno (16%) Counties using model 4 (Table J, Appendix). Orange County experienced the greatest losses (26%), where a relatively few number of acres were planted in bean, and therefore constituted a small fraction of the total production statewide. Cantaloupe yield was estimated to be reduced by 30% statewide, and the highest losses were expected to occur in Fresno County (40%). Notably, the predictive model used for cantaloupe was derived from data describing the response of muskmelon to ozone, and should be viewed as only an indicator of potential loss. Sweet corn yields were reduced by an estimated 4.5% in 1989.

Weighted-average yield loss in cotton was 17% in 1989 (Table 5), with a range from 9.1 to 32.3% for models 8 and 4, respectively. Yields in the Imperial Valley in Imperial County and the Coachella Valley in Riverside County (4.0% loss) were the least affected by ozone (Table J, Appendix). In contrast, yields reductions were estimated to be as much as 20% in Tulare County and 18% in Kern County using model 3. These are predicted losses based on aggregated county-wide statistics, and the losses are not necessarily distributed uniformly across the individual counties. The geographic distribution of ozone and associated cotton yield variability within Kern County is discussed in greater detail below.

Table 5. Statewide Predicted Yield Losses Associated with Ozone in 1989.

Crop	Yield (tons)	Predictive Model (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Mean
		% Loss								
Alfalfa hay	7,609,302	7.1	0.8	5.6	5.6					4.8
Alfalfa seed	24,071	11.6	1.2	9.1	9.2					9.8
Bean -- dry	187,151	1.6	20.1	3.0*	9.1	13.7	14.1			10.3
Cantaloupe	767,611	29.8								29.8
Corn -- sweet	72,927	4.5								4.5
Cotton	703,243	21.7	16.8	18.1	32.3	17.4	19.5	0*	9.1	16.9
Grape -- all	5,263,135	18.7	15.3							17.0
Grape -- raisin	2,412,405	22.2	18.3							20.3
Grape -- table	523,952	24.6	20.1							22.4
Grape -- wine	2,322,113	14.2	11.5							12.9
Lemon	645,370	8.9								8.9
Lettuce	3,071,223	0*	1.1	0	0*					0.3
Onion	718,044	28.5	6.3							17.4
Orange	2,099,955	22.7	63.5*	11.3						32.5
Potato	860,235	10.9	21.9							16.4
Rice	1,764,534	5.5	4.9	2.1						4.2
Silage	6,072,072	2.6								2.6
Sorghum grain	27,943	0.7								0.7
Sugar beet	5,433,055	0*	0*	7.2						2.4
Tomato -- fresh	574,655	0.9								0.9
Tomato -- processing	8,313,484	0.8	2.6	3.9*	5.9	0.1*	5.4	8.3		3.9
Wheat	2,034,691	0*	0.6	14.5						5.3

* Predictive models omitted from the 1990 projections.

Overall, grape yields were reduced by 17% statewide. Potential losses in Fresno County (19%) were the highest, whereas the grape yields in Napa Valley and Lake County were unaffected (Table J, Appendix). The same predictive equations were used for all types of grapes. The variability in average yield losses among the different types of grape reflected different ambient ozone concentrations in a particular growing region. Yields in lemon were reduced by 9%, while orange yields may have been reduced by as much as 33% statewide. The large difference was attributable to the results of model 2, which predicted a 64% yield reduction at ambient ozone concentrations (Table 5). The model was subsequently omitted from the yield loss computer program because results were not consistent with field observations or comparisons of actual yields between two production areas with contrasting air qualities.

Potato yields were reduced by 16% on average across the state. Losses ranged from 1% in Humboldt County to 17% in Riverside County using model 1 (Table J, Appendix). Rice yields were relatively unaffected (4.2% on average), a function of the good air quality in the northern portion of the Sacramento Valley. Indications of the relative tolerance of a particular crop to ozone is evidenced by a consistency in actual yields across production zones with different air pollution exposure levels during the growing season. Relatively minor losses were observed in silage, sorghum, sugar beet, fresh and processing tomatoes, and wheat, with average losses of 2.6%, 0.7%, 2.4%, 0.9%, 3.9% and 5.3%, respectively.

Estimated yield losses in 1990 (Table 6) were slightly higher for all crops as compared to estimated losses in 1989 (Table 5), with the exception of orange. Yield losses in orange were estimated to be less in 1990 (16%) than in 1989 (33%), due to the omission of model 2 referenced above. Highest estimated yield losses occurred in cantaloupe, cotton, all grapes, raisin grapes, and table grapes with 30%, 20%, 23%, 26%, and 27%, respectively. Losses were the greatest in the counties of the San Joaquin Valley and in those regions in and around the SoCAB (Table K, Appendix). Yield losses between 10 and 20% were predicted for bean, wine grapes, onion, orange, and potato. Reductions of < 10% were expected to have occurred in alfalfa hay and seed, sweet corn, lemon, lettuce, rice, silage, grain sorghum, sugar beets, fresh and processing tomatoes, and wheat.

Table 6. Statewide Predicted Yield Losses Associated with Ozone in 1990

Crop	Yield (tons)	Predictive Model								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Mean
		% Loss								
Alfalfa hay	8,331,747	11.2	0.4	8.8	8.9					7.3
Alfalfa seed	21,126	13.5	0.4	10.6	10.7					8.8
Bean -- dry	206,619	1.0	18.2	*	16.6	24.9	25.6			17.3
Cantaloupe	645,507	30.2								30.2
Corn -- sweet	71,522	4.8								4.8
Cotton	746,792	17.0	14.5	15.3	26.0	24.1	27.1	*	18.3	20.3
Grape -- all	5,126,254	25.2	20.7							23.0
Grape -- raisin	2,244,654	28.5	23.6							26.1
Grape -- table	569,558	30.0	24.7							27.4
Grape -- wine	2,307,020	20.9	17.1							19.0
Lemon	611,653	8.9								8.9
Lettuce	3,127,133	*	0.7	0	*					0.4
Onion	922,776	16.9	3.8							10.4
Orange	2,654,211	21.0	*	10.4						15.7
Potato	850,343	9.3	18.1							13.7
Rice	1,598,308	4.4	3.9	1.6						3.3
Silage	7,154,431	1.8								1.8
Sorghum grain	17,674	0.6								0.6
Sugar beet	4,650,366	*	*	6.1						6.1
Tomato -- fresh	633,079	0.5								0.5
Tomato -- processing	9,892,405	0.8	2.2	*	8.8	*	8.1	12.3		6.5
Wheat	1,737,047	*	0.6	13.2						6.9

* Predictive models omitted from the 1990 projections.

E. SCENARIOS

Actual yields of 22 crops were compared to potential yields under different air quality scenarios in 1990 (Table 7). The actual yield, and selected yield projections under ambient vs. other seasonal mean ozone concentration levels were calculated using disaggregated yield data used to determine the values in Table 6. For example, in the 4.0 vs. 2.50/2.72 scenario, values represent estimated yields if the seasonal mean ozone concentration in all production areas for a crop was ≤ 4.0 pphm for the 7-hr mean (or 3.7 pphm for the 12-hr mean), and maximum yield occurred under clean air with an ozone concentration of 2.50/2.72 pphm. In counties where actual ozone levels did not exceed 4.0 pphm (or 3.7 pphm), the seasonal mean ozone concentration was not adjusted, and actual crop yields and projected yields under the Ambient vs. 2.50/2/72 scenario were equal. In the counties where seasonal mean ozone levels were adjusted downward to the mean scenario criteria, estimated yields were slightly greater than actual yields. For example, the yield of alfalfa hay in Amador County may have been as great as 1,173 tons if the 12-hr seasonal mean was 2.50 pphm as compared to 1,024 tons at the actual ozone level of 5.6 pphm (Table G, Appendix). In comparison, if the seasonal mean ozone level was 4.0 pphm, yield would have increased to 1,076 tons (about 5% higher), relative to the yield under ambient ozone (1,024 tons). This same relative relationship between yields under different ozone scenarios was consistent across counties and crops. The estimated yield increases and the associated dollar value added to statewide agricultural receipts under the 4.0 vs 2.50/2.72 scenario would be realized if efforts to improve air quality targeted only those areas with seasonal mean ozone concentrations > 4.0 pphm. Air quality in the remaining areas would be deemed acceptable in terms of agricultural production.

Some researchers (e.g., Lefohn et al., 1990) have expressed concern as to the use of 2.50 or 2.72 pphm ozone as a representative measure of natural background concentrations in many agricultural areas. Lefohn et al. (1990) calculated seasonal 7-hr mean ozone concentrations for several remote, "clean" areas of North America, where air quality was not heavily influenced by urban activities, and found the range to be 3.5 and 4.5 pphm. Consequently, predictive yield loss models, based upon a comparison of yield responses under ambient ozone vs. 2.50 or 2.72 pphm, may result in an overestimation of potential yield losses. The NCLAN data base may suffer limitations of this kind, resulting from the use of a low background ozone concentration

Table 7. Comparison of the Actual Yields of 22 Crops under Ambient Ozone in 1990 to Three Seasonal Mean Scenarios (SM).

SM equals 2.50 or 2.72 pphm, 12-hr and 7-hr seasonal mean, respectively, depending on the crop-specific projection model.

Crop, 1990	County	Actual Yield	---------------- Scenario ----------------		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Alfalfa Hay	Alameda	11,059	11,508	11,508	11,059
Alfalfa Hay	Amador	1,024	1,076	1,173	1,116
Alfalfa Hay	Butte	21,461	22,555	23,073	21,955
Alfalfa Hay	Colusa	76,500	80,398	82,247	78,259
Alfalfa Hay	Contra Costa	19,500	20,206	20,206	19,500
Alfalfa Hay	Fresno	714,000	750,386	829,360	789,144
Alfalfa Hay	Glenn	111,118	116,781	119,466	113,673
Alfalfa Hay	Humboldt	840	861	861	840
Alfalfa Hay	Imperial	1,874,050	1,969,555	1,976,388	1,880,552
Alfalfa Hay	Inyo	24,660	25,917	28,576	27,190
Alfalfa Hay	Kern	875,000	919,591	1,044,412	993,768
Alfalfa Hay	Kings	307,586	323,261	342,051	325,465
Alfalfa Hay	Lake	1,500	1,537	1,537	1,500
Alfalfa Hay	Lassen	156,300	164,265	173,337	164,932
Alfalfa Hay	Los Angeles	53,400	56,121	67,221	63,962
Alfalfa Hay	Madera	239,440	251,642	272,130	258,934
Alfalfa Hay	Merced	538,800	566,258	584,452	556,112
Alfalfa Hay	Modoc	118,250	124,276	131,139	124,781
Alfalfa Hay	Mono	38,500	40,462	43,110	41,020
Alfalfa Hay	Monterey	17,300	17,357	17,357	17,300
Alfalfa Hay	Plumas	17,545	18,439	18,863	17,948

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Alfalfa Hay	Riverside	404,451	425,063	426,537	405,854
Alfalfa Hay	Sacramento	55,300	58,118	63,355	60,283
Alfalfa Hay	San Benito	19,520	20,515	20,649	19,648
Alfalfa Hay	San Bernardino	127,000	133,472	139,568	132,800
Alfalfa Hay	San Joaquin	428,000	449,812	454,725	432,675
Alfalfa Hay	San Luis Obispo	22,680	23,401	23,401	22,680
Alfalfa Hay	Santa Barbara	27,877	29,298	29,374	27,949
Alfalfa Hay	Santa Clara	5,600	5,885	5,924	5,637
Alfalfa Hay	Shasta	65,000	68,312	72,085	68,590
Alfalfa Hay	Sierra	1,743	1,832	2,086	1,985
Alfalfa Hay	Siskiyou	372,735	391,730	413,363	393,319
Alfalfa Hay	Solano	99,360	102,737	102,737	99,360
Alfalfa Hay	Stanislaus	264,000	277,454	286,369	272,483
Alfalfa Hay	Sutter	33,099	34,786	35,586	33,860
Alfalfa Hay	Tehama	28,600	30,058	30,749	29,257
Alfalfa Hay	Trinity	300	308	308	300
Alfalfa Hay	Tulare	945,000	993,159	1,094,013	1,040,964
Alfalfa Hay	Yolo	208,080	218,864	223,713	212,865
Alfalfa Hay	Yuba	5,569	5,853	5,987	5,697
Alfalfa Seed	Fresno	11,654	12,248	13,537	12,880
Alfalfa Seed	Glenn	107	112	115	109
Alfalfa Seed	Imperial	2,843	2,988	2,998	2,853

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Alfalfa Seed	Kings	6,353	6,677	7,065	6,723
Alfalfa Seed	Lassen	169	178	188	179
Bean -- Dry	Butte	4,606	5,155	5,498	4,913
Beans -- Dry	Colusa	9,880	11,056	11,792	10,538
Beans -- Dry	Fresno	13,900	15,555	20,417	18,244
Beans -- Dry	Glenn	5,383	6,024	6,425	5,741
Beans -- Dry	Kern	15,100	16,899	24,181	21,607
Beans -- Dry	Kings	2,037	2,280	2,611	2,333
Beans -- Dry	Madera	4,180	4,678	6,040	5,397
Beans -- Dry	Merced	5,200	5,820	6,539	5,843
Beans -- Dry	Monterey	2,260	2,260	2,260	2,260
Beans -- Dry	Orange	536	600	1,224	1,093
Beans -- Dry	Riverside	231	259	305	272
Beans -- Dry	Sacramento	1,450	1,623	1,896	1,694
Beans -- Dry	San Joaquin	38,920	43,555	45,129	40,326
Beans -- Dry	San Mateo	75	75	75	75
Beans -- Dry	Santa Barbara	3,558	3,982	4,003	3,577
Beans -- Dry	Santa Clara	1,062	1,189	1,201	1,073
Beans -- Dry	Solano	14,625	15,825	15,825	14,625
Beans -- Dry	Stanislaus	39,150	43,812	48,823	43,627
Beans -- Dry	Sutter	15,104	16,903	18,028	16,109
Beans -- Dry	Tehama	885	990	1,056	944

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario: 4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Beans -- Dry	Tulare	16,000	17,905	23,306	20,826
Beans -- Dry	Ventura	9,061	10,140	12,515	11,183
Beans -- Dry	Yolo	3,416	3,823	4,115	3,677
Cantaloupe	Fresno	351,000	402,350	553,565	482,916
Cantaloupe	Imperial	145,428	163,710	163,710	145,428
Cantaloupe	Kern	31,800	36,452	54,063	47,163
Cantaloupe	Kings	15,563	17,840	21,384	18,655
Cantaloupe	Merced	55,530	63,654	70,772	61,740
Cantaloupe	Orange	28	32	33	29
Cantaloupe	Riverside	30,347	34,787	41,754	36,425
Cantaloupe	San Bernardino	211	242	310	270
Cantaloupe	Stanislaus	15,600	17,882	19,632	17,127
Corn -- Grain & Seed	Amador	581	584	594	591
Corn -- Grain & Seed	Butte	3,423	3,438	3,445	3,430
Corn -- Grain & Seed	Colusa	12,180	12,234	12,258	12,204
Corn -- Grain & Seed	Contra Costa	15,400	15,469	15,507	15,438
Corn -- Grain & Seed	Fresno	17,000	17,076	17,520	17,442
Corn -- Grain & Seed	Glenn	28,340	28,466	28,529	28,403
Corn -- Grain & Seed	Kern	24,600	24,710	25,520	25,406
Corn -- Grain & Seed	Lassen	175	176	178	177
Corn -- Grain & Seed	Madera	35,942	36,102	36,740	36,577

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario: 4.0 vs. 2.50/2.72	Scenario: Ambient vs. 2.50/2.72	Scenario: Ambient vs. 4.0
Corn -- Grain & Seed	Merced	48,800	49,018	49,253	49,034
Corn -- Grain & Seed	Sacramento	105,300	105,769	107,751	107,273
Corn -- Grain & Seed	San Joaquin	185,000	185,825	186,041	185,215
Corn -- Grain & Seed	Solano	124,016	124,328	124,328	124,016
Corn -- Grain & Seed	Stanislaus	6,120	6,147	6,177	6,150
Corn -- Grain & Seed	Sutter	7,898	7,933	7,951	7,916
Corn -- Grain & Seed	Tehama	4,680	4,701	4,711	4,690
Corn -- Grain & Seed	Tulare	41,000	41,183	42,034	41,847
Corn -- Grain & Seed	Yolo	73,050	73,376	73,617	73,290
Corn -- Grain & Seed	Yuba	3,740	3,757	3,765	3,748
Corn -- Sweet	Contra Costa	5,090	5,215	5,215	5,090
Corn -- Sweet	Humboldt	48	48	48	48
Corn -- Sweet	Kings	6,034	6,242	6,533	6,315
Corn -- Sweet	Los Angeles	3,233	3,344	3,565	3,447
Corn -- Sweet	Orange	2,842	2,904	2,904	2,842
Corn -- Sweet	Riverside	34,943	36,146	36,508	35,293
Corn -- Sweet	Sacramento	1,600	1,655	1,751	1,693
Corn -- Sweet	San Bernardino	1,093	1,131	1,179	1,139
Corn -- Sweet	San Diego	1,800	1,860	1,860	1,800
Corn -- Sweet	Santa Clara	7,425	7,681	7,703	7,446
Corn -- Sweet	Sutter	557	574	574	557
Corn -- Sweet	Ventura	6,857	7,093	7,252	7,011

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Cotton	Fresno	251,000	268,037	322,162	301,684
Cotton	Imperial	7,914	8,385	8,385	7,914
Cotton	Kern	188,000	200,761	256,652	240,339
Cotton	Kings	140,771	150,326	164,119	153,687
Cotton	Madera	25,771	27,520	32,319	30,265
Cotton	Merced	44,500	47,521	50,705	47,482
Cotton	Riverside	9,388	9,947	9,947	9,388
Cotton	Tulare	79,448	84,841	100,912	94,498
Grape -- All	Alameda	3,435	3,705	3,705	3,435
Grape -- All	Amador	5,643	6,205	7,404	6,733
Grape -- All	Calaveras	360	396	405	368
Grape -- All	Contra Costa	2,130	2,279	2,279	2,130
Grape -- All	El Dorado	2,645	2,909	3,824	3,477
Grape -- All	Fresno	1,964,950	2,160,765	2,644,960	2,415,269
Grape -- All	Kern	619,085	680,779	888,862	808,311
Grape -- All	Kings	33,159	36,464	40,856	37,153
Grape -- All	Lake	7,900	8,268	8,268	7,900
Grape -- All	Madera	706,749	777,179	934,785	850,072
Grape -- All	Mariposa	94	103	113	103
Grape -- All	Mendocino	39,779	39,840	39,840	39,779
Grape -- All	Merced	132,712	145,938	159,134	144,712
Grape -- All	Monterey	100,076	100,694	100,694	100,076

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario 4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Grape -- All	Napa	114,304	119,247	119,247	114,304
Grape -- All	Nevada	527	580	762	693
Grape -- All	Placer	247	272	325	295
Grape -- All	Riverside	100,881	110,934	121,302	110,309
Grape -- All	Sacramento	37,200	40,907	48,804	44,381
Grape -- All	San Benito	6,570	7,225	7,318	6,655
Grape -- All	San Bernardino	4,114	4,524	4,947	4,498
Grape -- All	San Diego	400	440	486	442
Grape -- All	San Joaquin	353,500	388,728	397,123	361,134
Grape -- All	San Luis Obispo	35,942	38,138	38,138	35,942
Grape -- All	Santa Barbara	30,729	33,791	33,964	30,886
Grape -- All	Santa Clara	3,875	4,262	4,290	3,901
Grape -- All	Santa Cruz	240	250	250	240
Grape -- All	Solano	7,702	8,206	8,206	7,702
Grape -- All	Sonoma	111,921	112,093	112,093	111,921
Grape -- All	Stanislaus	168,000	184,742	201,448	183,192
Grape -- All	Tulare	523,480	575,647	702,434	638,777
Grape -- All	Yolo	7,905	8,693	9,093	8,269
Grape -- Raisin	Fresno	1,541,000	1,694,567	2,082,920	1,894,159
Grape -- Raisin	Kern	208,085	228,822	298,762	271,687
Grape -- Raisin	Kings	19,202	21,116	23,659	21,515
Grape -- Raisin	Madera	220,000	241,924	290,984	264,614

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario: 4.0 vs. 2.50/2.72	Scenario: Ambient vs. 2.50/2.72	Scenario: Ambient vs. 4.0
Grape -- Raisin	Merced	9,812	10,790	11,766	10,700
Grape -- Raisin	San Bernardino	25	28	30	27
Grape -- Raisin	Tulare	246,530	271,098	330,808	300,828
Grape -- Table	Fresno	77,200	84,894	104,349	94,892
Grape -- Table	Kern	160,000	175,945	229,723	208,904
Grape -- Table	Kings	4,247	4,671	5,233	4,758
Grape -- Table	Madera	38,717	42,576	51,209	46,568
Grape -- Table	Riverside	93,806	103,154	136,199	123,856
Grape -- Table	San Bernardino	2,288	2,516	2,751	2,502
Grape -- Table	San Joaquin	17,500	19,244	19,660	17,878
Grape -- Table	Tulare	175,800	193,319	235,898	214,520
Grape -- Wine	Alameda	3,435	3,705	3,705	3,435
Grape -- Wine	Amador	5,643	6,205	7,404	6,733
Grape -- Wine	Calaveras	360	396	405	368
Grape -- Wine	Fresno	346,750	381,305	468,691	426,216
Grape -- Wine	Kern	251,000	276,013	360,378	327,719
Grape -- Wine	Kings	9,710	10,678	11,964	10,879
Grape -- Wine	Lake	7,900	8,268	8,268	7,900
Grape -- Wine	Madera	448,032	492,681	592,592	538,889
Grape -- Wine	Mariposa	94	103	116	106
Grape -- Wine	Mendocino	39,779	39,840	39,840	39,779

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Grape -- Wine	Merced	122,900	135,148	147,369	134,013
Grape -- Wine	Monterey	100,076	100,694	100,694	100,076
Grape -- Wine	Napa	114,304	119,247	119,247	114,304
Grape -- Wine	Nevada	527	580	762	693
Grape -- Wine	Riverside	7,075	7,780	8,507	7,736
Grape -- Wine	Sacramento	37,200	40,907	48,804	44,381
Grape -- Wine	San Benito	6,570	7,225	7,318	6,655
Grape -- Wine	San Bernardino	1,801	1,981	2,166	1,969
Grape -- Wine	San Diego	400	440	486	442
Grape -- Wine	San Joaquin	336,000	369,484	377,463	343,256
Grape -- Wine	San Luis Obispo	35,942	38,138	38,138	35,942
Grape -- Wine	Santa Barbara	30,729	33,791	33,964	30,886
Grape -- Wine	Santa Clara	3,875	4,262	4,290	3,901
Grape -- Wine	Santa Cruz	240	250	250	240
Grape -- Wine	Solano	7,702	8,206	8,206	7,702
Grape -- Wine	Sonoma	111,921	112,093	112,903	111,921
Grape -- Wine	Stanislaus	168,000	184,742	201,448	183,192
Grape -- Wine	Tulare	101,150	111,230	135,729	123,428
Grape -- Wine	Yolo	7,905	8,693	9,093	8,269
Lemon	Fresno	11,360	11,999	12,641	11,968
Lemon	Imperial	9,632	10,174	10,409	9,854
Lemon	Kern	32,000	33,800	35,849	33,940

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario: 4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Lemon	Orange	10,942	11,558	11,819	11,189
Lemon	Riverside	69,422	73,328	75,022	71,026
Lemon	San Bernardino	1,361	1,438	1,545	1,462
Lemon	San Diego	47,900	50,595	52,350	49,562
Lemon	San Luis Obispo	14,797	15,630	15,780	14,939
Lemon	Santa Barbara	18,517	19,559	19,847	18,790
Lemon	Tulare	38,800	40,983	42,996	40,706
Lemon	Ventura	356,922	377,003	392,894	371,967
Lettuce	Fresno	282,600	282,614	282,750	282,736
Lettuce	Imperial	427,856	427,860	427,860	427,856
Lettuce	Kern	146,300	146,307	146,392	146,385
Lettuce	Monterey	1,414,307	1,414,323	1,414,323	1,414,307
Lettuce	Orange	11,249	11,249	11,249	11,249
Lettuce	Riverside	212,850	212,851	212,851	212,850
Lettuce	Sacramento	250	250	250	250
Lettuce	San Benito	67,671	67,674	67,678	67,675
Lettuce	San Bernardino	534	534	534	534
Lettuce	San Luis Obispo	205,830	205,832	205,832	205,830
Lettuce	Santa Barbara	154,474	154,481	154,481	154,474
Lettuce	Santa Clara	15,825	15,826	15,826	15,825
Lettuce	Santa Cruz	104,347	104,348	104,348	104,347
Lettuce	Stanislaus	3,740	3,740	3,740	3,740

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Lettuce	Ventura	79,300	79,304	79,311	79,307
Onion	Contra Costa	277	289	289	277
Onion	Fresno	379,400	409,785	422,979	391,616
Onion	Imperial	207,152	218,149	218,149	207,152
Onion	Kern	156,500	169,034	194,130	179,735
Onion	Los Angeles	38,800	41,908	51,090	47,302
Onion	Modoc	29,942	31,809	31,809	29,942
Onion	Monterey	5,905	5,938	5,938	5,905
Onion	Orange	463	469	469	463
Onion	Riverside	20,795	22,429	22,429	20,795
Onion	San Benito	20,317	21,944	22,022	20,389
Onion	San Bernardino	111	114	114	111
Onion	San Joaquin	31,800	32,215	32,215	31,800
Onion	Santa Clara	4,550	4,741	4,741	4,550
Onion	Siskiyou	10,164	10,798	10,798	10,164
Onion	Stanislaus	16,600	17,612	17,612	16,600
Orange	Butte	684	755	743	673
Orange	Fresno	310,800	343,267	372,576	337,337
Orange	Imperial	5,607	6,193	6,132	5,552
Orange	Kern	255,500	282,190	317,253	287,246
Orange	Madera	52,215	57,997	60,896	55,137

Table 7 Continued)

Crop, 1990	County	Actual Yield	---------------- Scenario ----------------		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Orange	Orange	77,485	85,579	84,656	76,649
Orange	Riverside	256,895	283,731	321,975	291,521
Orange	San Bernardino	66,116	73,023	90,740	82,158
Orange	San Diego	141,200	155,950	158,694	143,684
Orange	San Luis Obispo	1,101	1,216	1,175	1,064
Orange	Tulare	1,291,000	1,425,861	1,519,954	1,376,193
Orange	Ventura	195,311	215,714	226,270	204,869
Rice	Butte	372,408	382,179	383,736	373,925
Rice	Colusa	334,628	343,408	344,807	335,991
Rice	Fresno	19,800	20,319	21,391	20,844
Rice	Glenn	244,177	250,584	251,604	245,171
Rice	Kern	1,850	1,898	2,035	1,983
Rice	Merced	19,700	20,217	20,579	20,053
Rice	Placer	48,200	49,465	51,384	50,070
Rice	Sacramento	39,340	40,372	42,153	41,076
Rice	San Joaquin	19,800	20,319	20,420	19,898
Rice	Stanislaus	9,040	9,277	9,443	9,202
Rice	Sutter	271,631	278,759	279,894	272,737
Rice	Tehama	3,900	4,002	4,019	3,916
Rice	Yolo	97,000	99,545	100,807	98,229
Rice	Yuba	116,834	119,900	120,388	117,310

Table 7 (Continued)

Crop, 1990	County	Actual Yield	---------------- Scenario ----------------		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Silage	Contra Costa	10,500	10,536	10,536	10,500
Silage	Fresno	293,000	294,306	302,476	301,134
Silage	Glenn	72,000	72,321	72,490	72,168
Silage	Humboldt	1,136	1,136	1,136	1,136
Silage	Kern	281,000	282,253	293,563	292,260
Silage	Kings	308,265	309,639	312,532	311,145
Silage	Madera	129,200	129,776	132,747	132,158
Silage	Marin	25,239	25,239	25,239	25,239
Silage	Merced	1,511,000	1,517,737	1,527,448	1,520,668
Silage	Riverside	17,302	17,379	17,815	17,736
Silage	Sacramento	187,000	187,834	191,716	190,865
Silage	San Bernardino	40,300	40,480	41,745	41,559
Silage	San Diego	1,365	1,371	1,388	1,382
Silage	San Joaquin	782,000	785,487	787,111	783,617
Silage	Santa Barbara	23,518	23,623	23,637	23,532
Silage	Siskiyou	7,950	7,985	8,074	8,039
Silage	Sonoma	58,871	58,888	58,888	58,871
Silage	Stanislaus	1,294,000	1,299,769	1,308,086	1,302,280
Silage	Sutter	70,000	70,312	70,477	70,164
Silage	Tehama	9,425	9,467	9,489	9,447
Silage	Tulare	2,010,000	2,018,962	2,069,202	2,060,017
Silage	Yuba	21,360	21,455	21,505	21,410

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario: 4.0 vs. 2.50/2.72	Scenario: Ambient vs. 2.50/2.72	Scenario: Ambient vs. 4.0
Sorghum -- Grain	Glenn	3,680	3,686	3,687	3,681
Sorghum -- Grain	Kern	1,820	1,823	1,841	1,838
Sorghum -- Grain	Merced	184	184	185	185
Sorghum -- Grain	San Joaquin	462	463	463	462
Sorghum -- Grain	Solano	367	367	367	367
Sorghum -- Grain	Sutter	2,005	2,008	2,016	2,013
Sorghum -- Grain	Tulare	8,100	8,112	8,162	8,150
Sorghum -- Grain	Yolo	1,056	1,058	1,059	1,057
Sugar Beet	Butte	59,597	61,252	61,252	59,597
Sugar Beet	Colusa	174,800	179,654	179,654	174,800
Sugar Beet	Fresno	512,000	540,235	591,061	560,170
Sugar Beet	Glenn	238,702	245,330	245,330	238,702
Sugar Beet	Imperial	1,013,555	1,052,238	1,052,238	1,013,555
Sugar Beet	Kern	358,000	377,742	393,560	372,991
Sugar Beet	Kings	19,282	20,345	21,448	20,327
Sugar Beet	Madera	37,200	39,251	42,531	40,309
Sugar Beet	Merced	365,000	385,129	399,311	378,441
Sugar Beet	Modoc	13,639	14,391	15,067	14,280
Sugar Beet	Monterey	108,000	108,771	108,771	108,000
Sugar Beet	Sacramento	132,000	136,598	136,598	132,000
Sugar Beet	San Benito	34,503	36,406	36,611	34,697
Sugar Beet	San Joaquin	696,000	734,382	735,069	696,651

Table 7 (Continued)

Crop, 1990	County	Actual Yield	------------ Scenario ------------		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Sugar Beet	Santa Clara	28,084	29,009	29,009	28,084
Sugar Beet	Solano	393,104	405,126	405,126	393,104
Sugar Beet	Stanislaus	72,800	76,815	79,643	75,780
Sugar Beet	Sutter	131,590	135,244	135,244	131,590
Sugar Beet	Tehama	3,360	3,545	3,637	3,447
Sugar Beet	Tulare	119,000	125,562	136,955	129,798
Sugar Beet	Yolo	140,150	144,833	144,833	140,150
Tomato -- Processing	Colusa	683,200	711,988	724,131	694,853
Tomato -- Processing	Contra Costa	130,000	133,941	133,941	130,000
Tomato -- Processing	Fresno	3,692,000	3,847,568	4,187,042	4,017,748
Tomato -- Processing	Imperial	334,900	348,980	351,065	336,901
Tomato -- Processing	Kern	170,000	177,163	197,358	189,378
Tomato -- Processing	Kings	90,090	93,886	98,084	94,118
Tomato -- Processing	Merced	240,000	250,113	258,382	247,935
Tomato -- Processing	Monterey	90,000	90,570	90,570	90,000
Tomato -- Processing	Orange	7,400	7,701	7,704	7,403
Tomato -- Processing	Riverside	28,281	29,470	29,646	28,450
Tomato -- Processing	Sacramento	219,000	228,228	245,586	235,656
Tomato -- Processing	San Benito	128,413	133,824	135,048	129,588
Tomato -- Processing	San Joaquin	871,000	907,701	913,581	876,643
Tomato -- Processing	Santa Barbara	13,598	13,961	13,961	13,598
Tomato -- Processing	Santa Clara	60,800	63,362	63,788	61,209

Table 7 (Continued)

Crop, 1990	County	Actual Yield	---------------- Scenario ----------------		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Tomato -- Processing	Solano	615,731	633,008	633,008	615,731
Tomato -- Processing	Stanislaus	365,000	380,380	388,500	372,792
Tomato -- Processing	Sutter	439,992	458,531	466,352	447,497
Tomato -- Processing	Yolo	1,713,000	1,785,180	1,812,566	1,739,279
Wheat	Amador	328	366	366	328
Wheat	Butte	30,680	31,193	31,193	30,680
Wheat	Colusa	95,040	95,040	95,040	95,040
Wheat	Contra Costa	6,220	6,220	6,220	6,220
Wheat	Fresno	152,241	173,798	175,734	153,937
Wheat	Glenn	73,769	73,769	73,769	73,769
Wheat	Imperial	167,375	179,745	179,745	167,375
Wheat	Kern	90,400	103,201	110,731	96,996
Wheat	Kings	156,323	178,458	179,846	157,539
Wheat	Lake	210	210	210	210
Wheat	Lassen	1,000	1,142	1,189	1,042
Wheat	Madera	72,020	79,495	79,495	72,020
Wheat	Merced	39,300	39,801	39,801	39,300
Wheat	Modoc	5,283	6,031	6,280	5,501
Wheat	Monterey	1,460	1,530	1,530	1,460
Wheat	Riverside	21,597	24,655	25,126	22,009
Wheat	Sacramento	88,092	90,188	90,188	88,092
Wheat	San Benito	7,200	7,999	7,999	7,200

Table 7 (Continued)

Crop, 1990	County	Actual Yield	Scenario		
			4.0 vs. 2.50/2.72	Ambient vs. 2.50/2.72	Ambient vs. 4.0
Wheat	San Joaquin	173,000	173,000	173,000	173,000
Wheat	San Luis Obispo	2,915	3,008	3,008	2,915
Wheat	Santa Barbara	562	623	623	562
Wheat	Santa Clara	8,000	8,888	8,888	8,000
Wheat	Shasta	3,655	3,688	3,688	3,655
Wheat	Siskiyou	29,328	33,481	33,555	29,393
Wheat	Solano	109,656	109,656	109,656	109,656
Wheat	Stanislaus	18,900	19,583	19,583	18,900
Wheat	Sutter	44,390	44,780	44,780	44,390
Wheat	Tehama	11,300	11,400	11,400	11,300
Wheat	Tulare	158,800	181,285	185,995	162,926
Wheat	Yolo	163,676	171,310	171,310	163,676
Wheat	Yuba	4,327	4,365	4,365	4,327

as a basis for predicting agricultural losses (Lefohn et al., 1989). Estimated yield losses of crops using an injury index in which actual yields were compared to yields projected under a seasonal background ozone concentration of 4.0 pphm are presented in the Ambient vs. 4.0 scenario in Table 7. Alfalfa hay yield in Amador County was estimated to be 1,116 tons as compared to the observed yield of 1,024 tons. Under this scenario, ambient ozone caused a yield reduction of about 8%. In contrast, using a background concentration of 2.50 pphm was associated with a potential loss of about 13%. The potential economic consequences of a different percent yield loss varies among crops depending on price elasticity and other marketing factors (Howitt et al., 1984). The actual economic losses due to ozone under the 4.0 pphm background scenario have not been calculated with the CARM program developed by R. Howitt, University of California, Davis. Yields under the Ambient vs 4.0 scenario equal the actual yields in areas where the ambient ozone concentrations were ≤ 4.0 pphm (Table K, Appendix), such as for alfalfa hay in Humboldt County (Table 7). Otherwise the Ambient vs 4.0 scenario provided yield estimates generally greater than the actual yields, but less than those expected to occur vs. seasonal means of 2.50/2.72 pphm.

F. FIELD SURVEY

The incidence of ozone injury to Acala cotton leaves (Table 8 and Figure 16) was greatest at locations in the southern end of the San Joaquin Valley (e.g., Location 1, Arvin) and decreased northward (Location 21, Los Banos). An injury index derived by dividing the sum of dead and injured leaves (D + I) by the total number of leaves on the main stem (D + I + G) revealed that green leaves (G) constituted a smaller portion of the total leaves at the southern sites than at the northern locations. Plants with no green leaves have injury values close to 1.00, while plants with a minimal amount of ozone injury have values approaching 0.00. For example, the injury index for cotton in the Arvin area was 0.78, and only 0.41 in the relatively cleaner Los Banos location.

Principal Component Analysis demonstrated that of the three leaf conditions monitored (D, I and G), the weighted contribution of green leaves had the greatest effect on the value of the injury index. The number of green leaves was found to be the best indicator of injury present. Ozone injury, calculated by a linear weighted function, produced values ranging from 10.36 in the Arvin area, to 3.85 near Firebaugh.

Table 8. Ozone Injury in Acala SJ2 Cotton at 11 Sites in the San Joaquin Valley, 1991*.

Site No.	D	I	G	Injury+	WI^
1	10.4	5.2	4.8	0.78	10.36
4	9.4	4.4	7.0	0.66	8.54
5	6.8	5.6	9.8	0.57	6.95
7	11.4	3.6	5.8	0.70	9.22
8	8.8	0.6	10.4	0.47	4.82
11	7.8	1.8	10.4	0.48	5.17
14	5.8	2.2	10.6	0.42	4.71
16	8.6	1.4	10.0	0.50	5.36
19	6.2	1.8	12.2	0.39	3.85
20	8.4	2.0	11.2	0.52	5.95
21	6.8	1.8	11.4	0.41	4.42

* Values represent the mean of five plants where D, I, and G are dropped leaves, injured leaves, and green leaves, respectively. Larger values reflect greater ozone injury.

\+ Injury = [(D + I) ÷ (D + I + G)]. Values in the Table are from the original data, and may vary from the value calculated using D, I, and G in the Table due to rounding.

^ Weighted Injury (WI) = {10 + [0.12(D) + 0.4(I) - 0.63(G)]}; values represent the amount of ozone injury based upon the relative contribution of each component to observed variability.

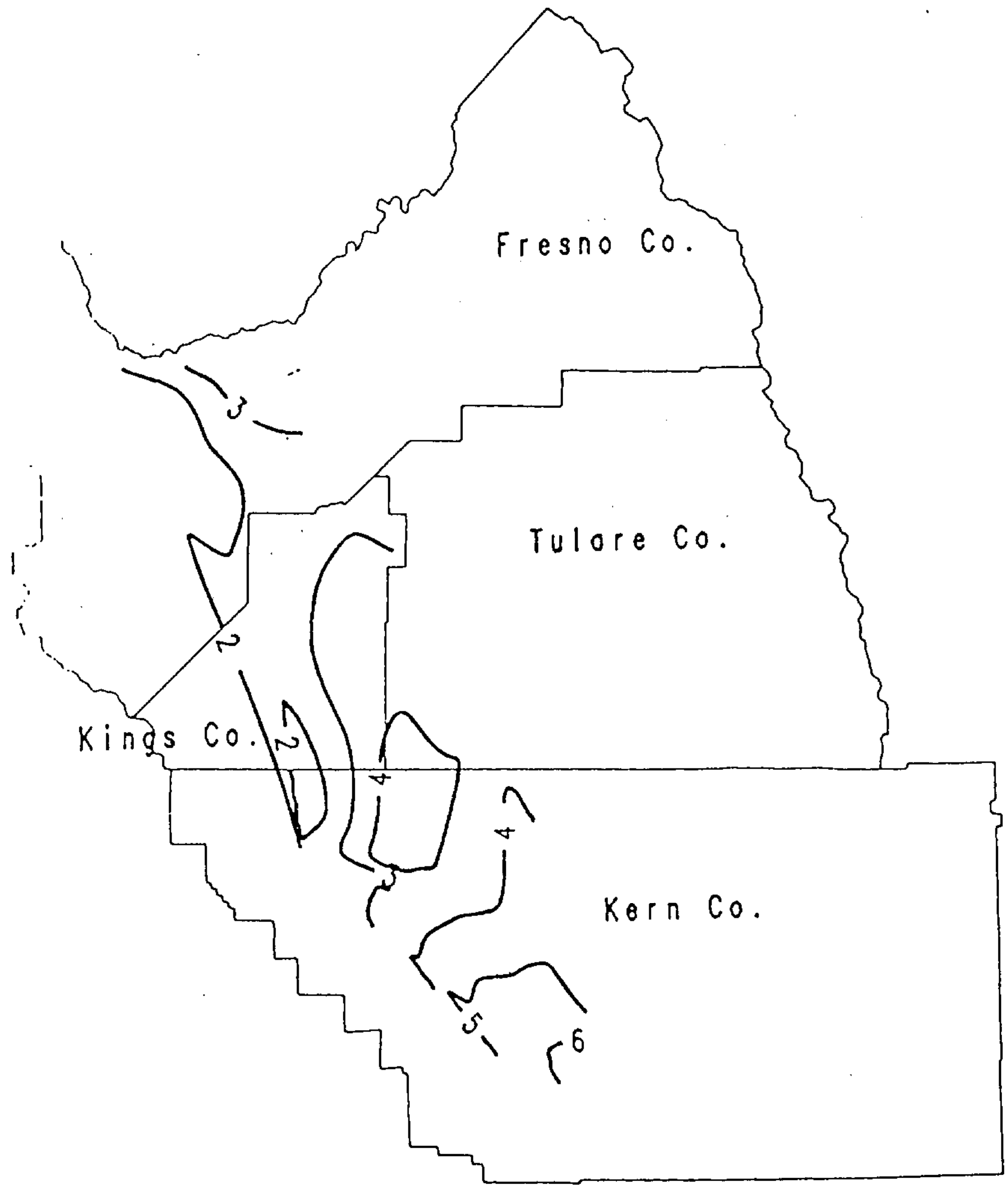


Figure 16. Foliar Injury in Cotton, 1990.

Ozone injury in Pima cotton (Table 9) using either the quotient or the linear weighting method was greatest in the southern portion of the Valley and decreased in a northerly fashion along the observed ambient ozone gradient (Figure 9). Ozone injury to Pima was greater than that observed in Acala at all comparable locations. This was reflected in the fewer number of green leaves, relative to the dead and injured leaves, on the main stem of plants in the southern locations. Pima cotton was observed to be more sensitive to ozone injury than Acala cotton under controlled conditions when subjected to summer ambient ozone concentrations in Riverside (personal communication, D. Grantz, Kearney Agricultural Field Station, Parlier, CA).

In July 1990, seasonal mean ozone concentrations south of Bakersfield were comparable to those observed in Riverside during the same period (Figure 9). Continued urbanization of the southern Valley may lead to ozone concentrations which would make planting Pima in this area a nonprofitable endeavor due to the ozone associated yield suppression.

In general, leaf injury in Nonpareil almonds was highest in the southern portion of the Valley and decreased in a northerly fashion (Table 10). The one exception was the slight amount of injury at location 1, where the degree of injury was comparable to that present at the more northerly locations (e.g., locations 10 and 11). The apparent ozone stress was evidenced by a greater number of dropped leaves per branch in the southern end of the valley. The degree of injury present in almond was slight-to-moderate, as compared to cotton. Although the number of injured leaves showed a similar geographical trend, it was not as consistent as that for dropped leaves. It is not known whether almond leaves abscise readily following injury by ozone. Principal Component Analysis could not be applied to the almond injury data because of the large number of green leaves (G) relative to the number of dropped (D) and injured (I) leaves. The injury rating arrived at with Principal Component Analysis was dominated by the green leaf component. Consequently, the injury rating was closely associated, in a positive fashion, with the number of green leaves and internode density on the sample branch.

The intensity of injury symptoms in Thompson seedless grape was greatest in the Arvin area at in the southern end of the San Joaquin Valley (Table 11). As was the case in cotton and almonds, the symptoms decreased in a northerly fashion. Only slight indications of ozone injury were detected at the northernmost sites in Fresno and Madera counties. The degree injury in grape was comparable to that in almond; the range of severity was slight-to-moderate, and considerably less severe than in cotton.

Table 9. Ozone Injury in Pima S6 Cotton at 10 Sites in the San Joaquin Valley, 1991*.

Site No.	D	I	G	Injury+	WI^
1	11.2	6.2	4.2	0.80	11.24
2	6.4	11.0	4.4	0.78	12.32
3	6.0	6.4	9.0	0.58	7.67
4	8.8	5.6	7.0	0.67	8.95
6	6.6	3.4	11.2	0.47	5.16
7	8.4	2.8	9.2	0.55	6.40
9	6.8	5.0	8.8	0.57	7.33
14	6.0	1.2	13.0	0.35	3.08
17	6.0	2.4	11.8	0.41	4.31
18	6.8	0	15.8	0.30	0.95

* Values represent the mean of five plants, where D, I, and G are dropped leaves, injured leaves, and green leaves, respectively. Larger values reflect greater ozone injury.

\+ Injury = [(D + I) ÷ (D + I + G)]. Injury values are from the original data, and may vary from injury values calculated using D, I, and G in the Table due to rounding errors.

^ Weighted injury (WI) = {10 + [0.12(D) + 0.41(I) - 0.63(G)]; values represent the amount of ozone injury based upon the relative contribution of each component to observed variability.

Table 10. Ozone Injury in Nonpareil Almonds at 11 Sites in the San Joaquin Valley, 1991*.

Site No.	D	I	G	Injury+
1	8.8	6.4	110.2	0.12
2	22.2	16.0	107.6	0.25
3	20.8	9.2	112.2	0.21
5	10.4	7.2	103.8	0.15
7	12.4	16.0	112.6	0.20
10	5.2	5.6	91.4	0.11
11	6.0	4.8	92.0	0.10
13	3.8	1.4	79.6	0.03
14	2.8	0.4	101.6	0.06
15	1.8	0.2	65.6	0.06
16	7.2	2.2	145.0	0.03

* Values represent the mean of five plants where D, I, and G are dropped leaves, injured leaves, and green leaves, respectively. Larger values reflect greater ozone injury.

\+ Injury = $[(D + I) \div (D + I + G)]$. Injury values are from the original data, and may vary from injury values calculated using D, I, and G in the Table due to rounding errors.

Table 11. Ozone Injury in Thompson Seedless Grape at 12 Sites in the San Joaquin Valley, 1991*.

Site No.	D	I	G	Injury+
1	22.4	19.4	162.4	0.20
2	23.8	24.0	159.8	0.23
3	11.8	6.6	130.0	0.12
5	10.8	6.6	141.2	0.11
7	13.0	12.0	144.0	0.14
8	10.8	8.4	104.4	0.16
8	9.2	4.0	89.0	0.13
12	14.4	9.2	106.0	0.18
13	4.8	3.2	145.0	0.05
14	8.8	4.2	147.9	0.10
15	8.6	6.4	123.2	0.09
16	4.6	4.6	92.2	0.11

* Values represent the mean of five plants, where D, I, and G are dropped leaves, injured leaves, and green leaves, respectively. Larger values reflect greater ozone injury.

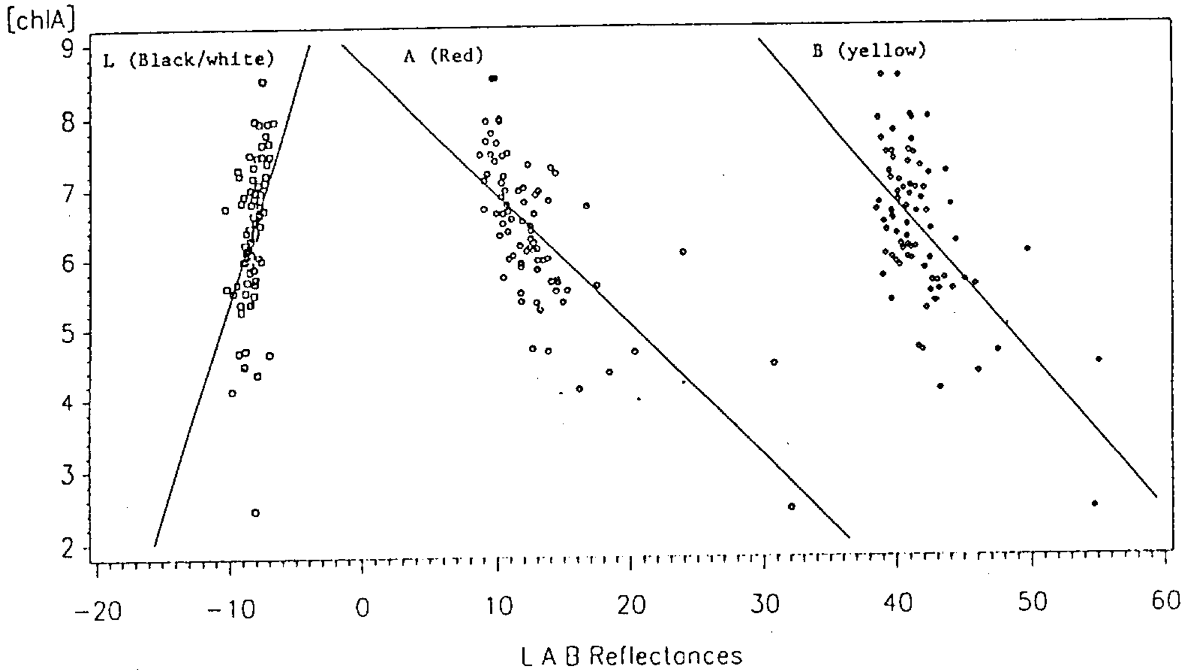
\+ Injury = [(D + I) ÷ (D + I + G)]. Injury values are from the original data, and may vary from the values calculated using D, I, and G in the Table due to rounding.

G. COTTON LEAF REFLECTANCE IN RESPONSE TO OZONE EXPOSURES

The most common method used to assess the amount of plant injury caused by air pollution involves making a visual estimation of how much of the total leaf surface area of the plant is chlorotic or necrotic. Thus, rendering this type of injury rating is inherently biased due to the arbitrary decisions made by the observer. An observer's perception may vary between experiments and among plants within an experiment (Tenga and Ormrod, 1990). To standardize the assessment method, the light spectrum reflected from the leaf surface was measured.

For the reflectance scale, L (black-white) is the lightness variable, and A (green-red) and B (blue-yellow) are the chromaticity coordinates. Negative values represent the presence of black, green, or blue reflected light, and positive values represent white, red or yellow light. Increasing absolute values for reflectance correspond to increasing intensities of the color scale. For example, more negative A values denote more green light, and more positive A values denote more red light. Zero values represent no color or gray on each of the color band scales.

Reflectance and leaf chlorophyll content pooled across genotype and air quality treatment revealed a significant correlation of chlorophyll a (Chla) and all three of the measured spectral components (Figure 17). Neither chlorophyll b (Chlb) or carotenoid content were correlated with reflectance values (Figures 18 and 19). Ozone stress leads to a breakdown of chloroplasts within the mesophyll cells, and consequently a loss of chlorophyll (Knudson et al., 1977). Degradation of Chla associated with ozone stress would result in red light being absorbed less efficiently by the leaf and an increase in the reflectance of red light (Figure 17). As a leaf exhibits an increasing degree of ozone injury, it will become chlorotic and eventually necrotic as injured cells die. An increase in the amount of yellow (negative B value), with an associated decrease in Chla, quantitatively represents the observed changes in leaf health often reported in qualitative surveys of ozone injury under controlled experimental conditions. Knudson et al. (1977) demonstrated the relationship between visible leaf injury and chlorophyll content (Figure 20). These results were the first to provide useful means of quantifying and standardizing injury lesions, and required tissue sampling and laboratory analysis. The linear relationship between Chla and light reflectance in the present study indicated that direct measurements in the field may substitute for laboratory analysis of tissue samples, as a means of quantifying ozone injury in crop plants such as cotton. It remains undetermined whether reflectance measurements associated with visible and nonvisible lesions can be directly related to yield.



◇ = L: [ChlA] = −0.22∗L + 15.41; R2 = 0.38
□ = A: [ChlA] = 0.60∗A + 11.42; R2 = 0.18
o = B: [ChlA] = −0.18∗B + 8.71; R2 = .0.49

Figure 17. Correlation of Cotton Leaf Chlorophyll-a Level and Three Components of Spectral Reflectance (L, A, and B).

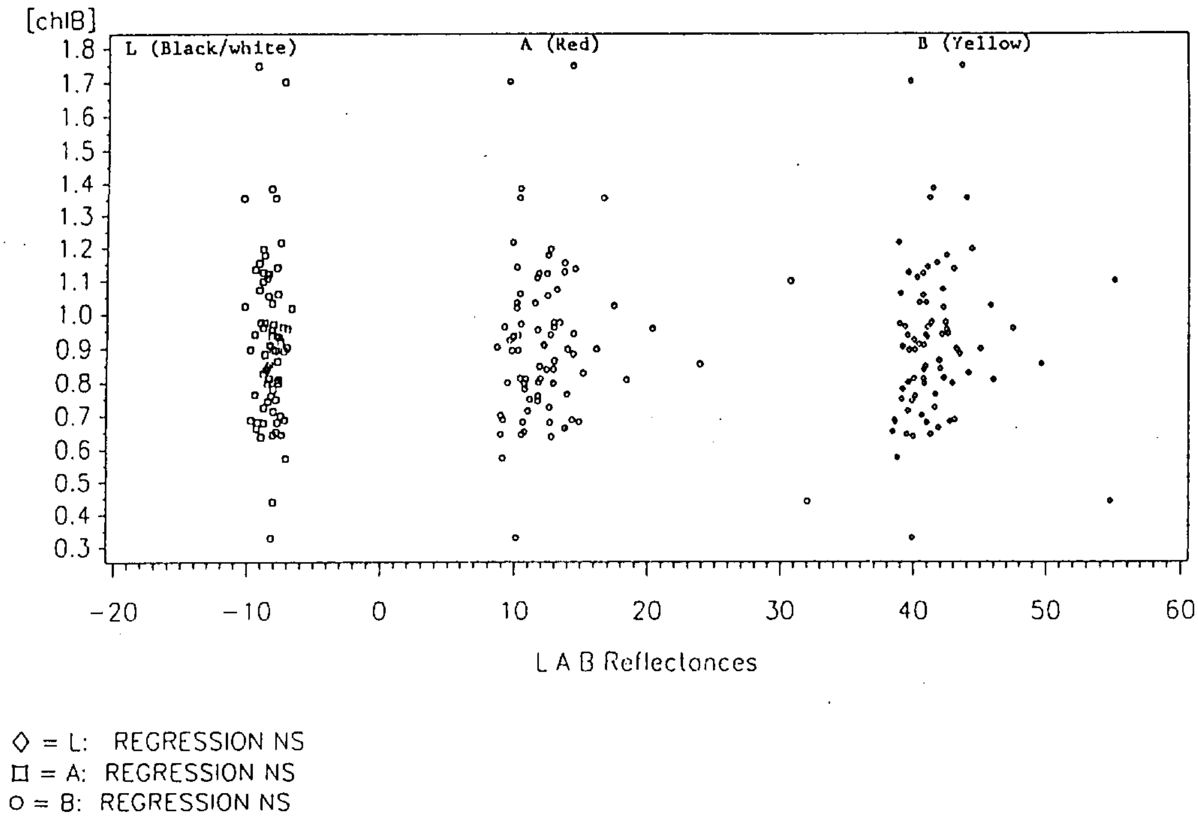
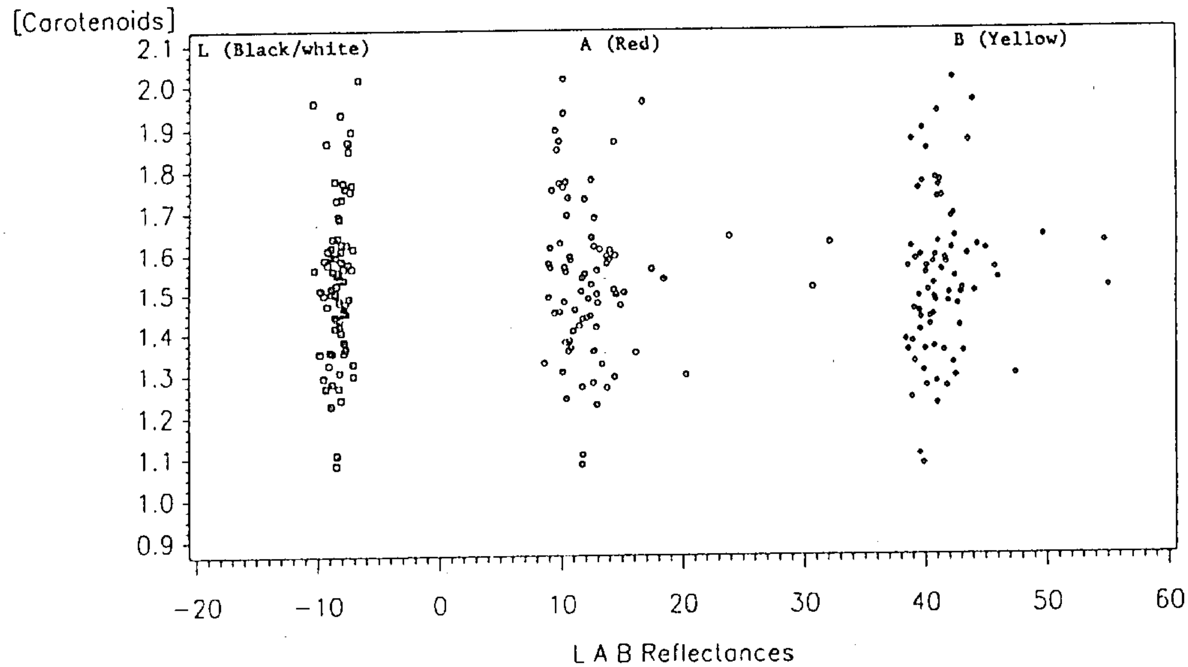


Figure 18. Correlation of Cotton Leaf Chlorophyll-b Level and Three Components of Spectral Reflectance Components (L, A, and B).



◇ = L: REGRESSION NS
⌑ = A: REGRESSION NS
○ = B: REGRESSION NS

Figure 19. Correlation of Cotton Leaf Carotenoid Level and Three Components of Spectral Reflectance (L, A, and B).

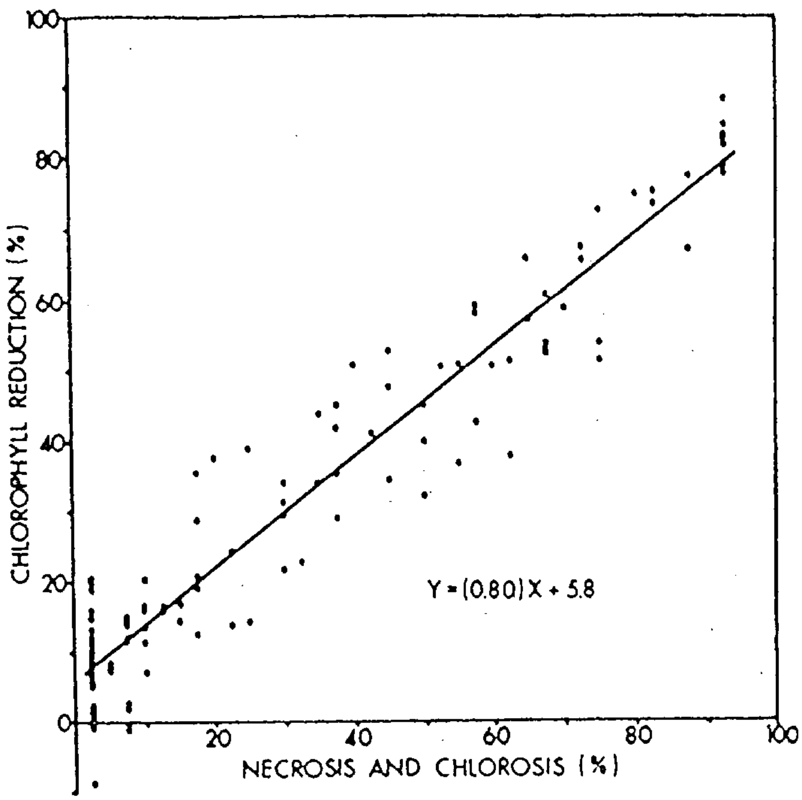


Figure 20. Correlation of Percent Chlorophyll Reduction with Necrosis and Chlorosis in Pinto Bean Leaves Fumigated with Different Ozone Concentrations ($r = 0.92$, $n = 116$, and $s_{y\,x\,1} = 7.20$; cf. Knudson et al., 1977).

H. KERN COUNTY REGIONAL ASSESSMENT OF OZONE INJURY TO COTTON

Regressions of Yield on Ozone Exposure Statistic. Significant regressions of yield (bales $acre^{-1}$) and the 7-hr mean ozone concentration in August (ppb) were computed for some subgroups of data (Table 12). If the requirements for significance are relaxed somewhat, all regressions were significant. However, the proportion of the total variability in yield accounted for by the regressions is small, ranging from 2 to 16%. In other words, other unidentified factors account for 84 to 98% of the variability in yield. Some of the soil factors identified by Kerby (1990) were available from the soils map of western Kern County (Figure 21 and Table 13), and were entered into other regression analyses. The influence of these factors will be discussed later. For Acala cotton varieties, the amount of variability in yield due to ozone is less than the proportion for Pima cotton varieties, about 5% vs. 16%. For all regressions, a significant or nearly significant negative linear coefficient was computed. Only for the Pima regression was a quadratic ozone concentration term required.

The regression for Pima cotton was almost significant ($p > 0.07$) even though it was based on only 25 observations. The intercept of 25.39 bales $acre^{-1}$ at zero ozone exposure is biologically unreasonable. However, using a regression equation to extrapolate outside the range of data that the equation is based on is inappropriate. Furthermore, the large negative linear coefficient and positive quadratic coefficient computed in the present study do not agree in sign and magnitude with other published results. The negative linear coefficient is consistent with the results of other studies; however, the implausible regression equation for Pima cotton in the present study did not allow for comparisons to be made with previous research that found Pima to be more sensitive to ozone than Acala.

The regression equations were used to calculate percent losses in cotton yield in different parts of Kern County. Considering the regression for all Acalas: Yield = [3.47 - (0.0168 x 7-hr mean)], a range of 7-hr mean ozone levels of 50 to 84 ppb, and a 7-hr mean background ozone concentration of 27 ppb, percent losses in cotton yield due to ambient ozone were estimated to range from 13 to 32%. However, the estimated range of percent yield loss had a high degree of uncertainty. For example, if 5% confidence limits were calculated for sites in Kern County exposed to 7-hr mean ozone level of 50 ppb, mean percent yield losses could range from 7% to 19%. A range of similar magnitude would be expected for mean percent yield losses at sites exposed to a 7-hr mean ozone level of 84 ppb.

Table 12. Selected Regressions of Yield vs. Ozone Concentration*.

Group Analyzed	No. Obs.	r^2	Parameter Estimate	Prob > |T|
All Acalas	351	0.05	Intercept = 3.47 7-hr $[O_3]$ = -0.0168	0.0001 0.0001
Only Acala SJ2	152	0.02	Intercept = 2.97 7-hr $[O_3]$ = -0.0100	0.0001 0.11
Acalas (except SJ2)	205	0.07	Intercept = 3.62 7 hr $[O_3]$ = -0.0182	0.0001 0.0001
Pima	25	0.16	Intercept = 25.39 7 hr $[O_3]$ = -0.737 $(7\ hr\ [O_3])^2$ = 0.00582	0.04 0.07 0.06

* Soil characteristics not included. The dependent variable is cotton yield in bales $acre^{-1}$. The independent variable is the 7-hr mean ozone concentration for August 1990, in ppb. The regression is significant if the "Prob > |T|" for a non-intercept variable is < 0.05.

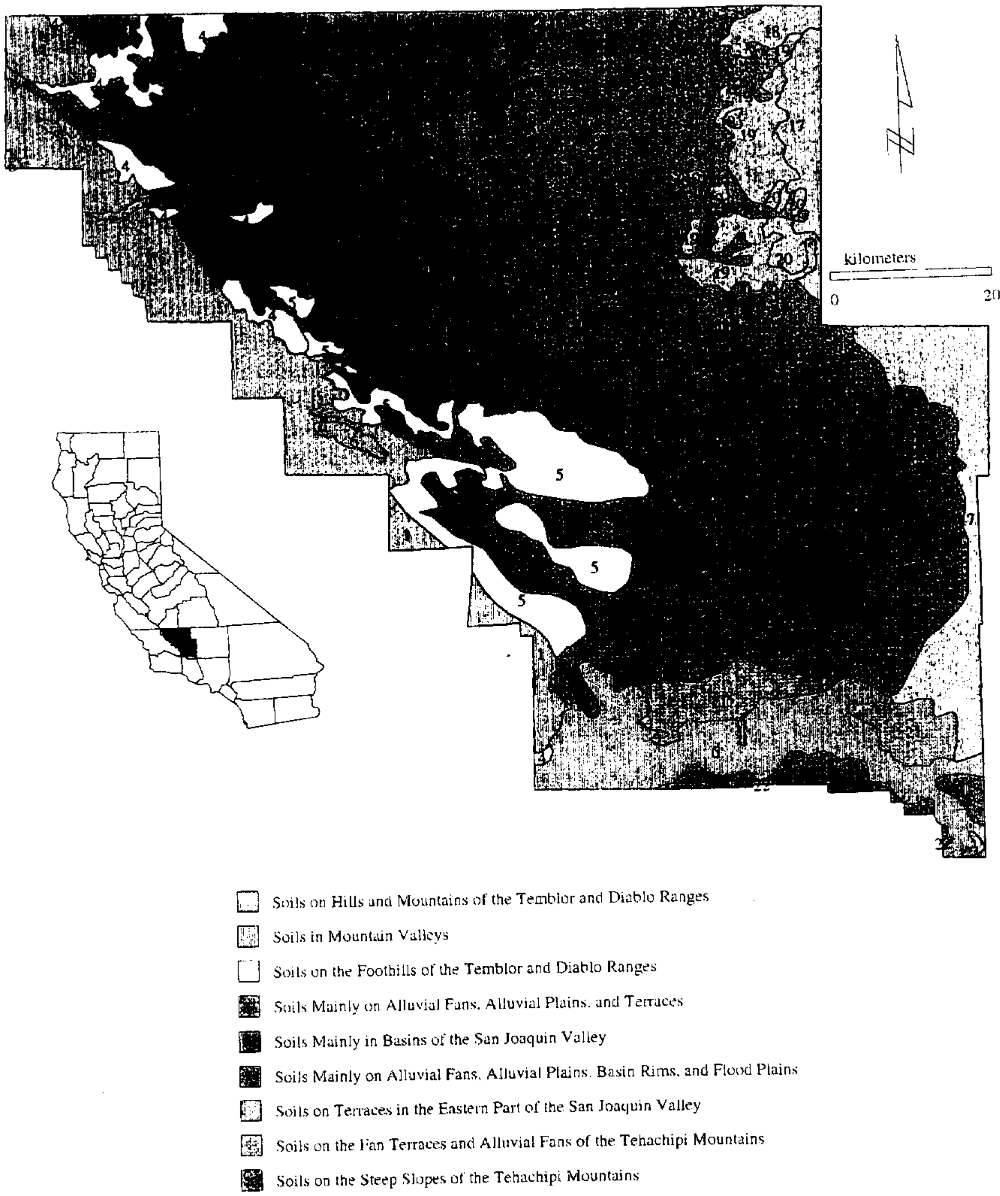


Figure 21. Soils Map of Western Kern County.

Table 13. Names and Attributes of Kern County Soils Used in the Multivariate Analysis.

Soil Series*	Soil Series Name	Available H_2O	pH	Salinity	OM	Yield Potential
1	aramburu-hillbrick	0.11	7.5	2	2	-9999[+]
4	kettleman-bitterwater	0.15	7.5	2	0.5	-9999
5	elkhills	0.11	7.9	2	1	-9999
6	pottinger-polonia	0.09	8.2	2	1	-9999
7	panoche-milham-kimberlina	0.17	7.9	2	0.5	1150
8	kimberlina	0.12	7.5	3	1	1075
10	lokern-buttonwillow	0.14	8.1	4	2	1400
11	nahrub-lethent-twisselman	0.13	7.9	6	1	850
12	garces-panoche	0.10	8.4	8	0.5	960
13	kimberlina-wasco	0.12	8.2	4	1	1075
14	mcfarland	0.15	7.3	2	1	1125
15	milham	0.16	8.2	2	0.5	1125
16	cajon-westhaven	0.07	7.9	2	1	900
17	delano-chanac	0.14	8.2	2	1	1200
18	exeter	0.12	7.0	2	1	-9999
19	delano-lewkalb-driver	0.09	7.9	2	1	1320
20	premier	0.11	7.6	2	1	1025

* Soil series number may be used to cross reference location in Figure 21.

\+ -9999 indicates no yield potential established for cotton.

Multiple Regressions of Yield on Ozone Exposure Statistics and Soil Characteristics. The inclusion of soil variables into the regression analysis identified a number of soil factors with significant regression coefficients (Table 14). Linear and quadratic terms for soil pH, soil available water, and soil salinity, were significantly associated with the yield of cotton. However, the signs and magnitudes of the coefficients do not present a consistent model that can be easily connected with biological principles. For example, soil pH or (soil pH)^2 were significant regressors in three of the regressions set involving Acala cotton. However, the sign and magnitude of the coefficient varied from analysis to analysis, and did not agree with expected results. Based on the range of observed soil pH, (i.e., 6.1 to 9.0) one would expect a negative quadratic coefficient suggesting an optimal pH for cotton production (or some other curve consistent with agronomic principles). However, the regressors for soil salinity and soil available water were more consistent in sign and magnitude. A pattern of increased salinity was associated with decreased yield. This relationship is biologically valid. Curiously, the coefficients for available water were linear and negative, suggesting that soils with a high water holding capacity are detrimental to cotton yield. The mechanism or cause-and-effect relationship is not apparent, unless there is an unknown characteristic that is highly correlated with available water in Kern County soils, that is detrimental to cotton yield. Perhaps soils with high available water are predisposed to verticillium wilt growth on the cotton, or that greater water availability is conducive to greater stomatal conductance and increased ozone uptake (Temple, 1990a). Including soil characteristic variables increased the proportion of variability in cotton yield explained by the regressions, but the increase was minimal. The r^2 value for these models ranged from 0.10 to 0.22. This is in contrast to Kerby's work, who reported an $r^2 = 0.77$. However, the soil data he used was measured precisely where the cotton was grown. The data from the Soil Conservation Service (SCS) soil maps, used for this analysis, were much less precise because they described large regions by a range of values. This lack of precision contributed to the low r^2 values observed.

The amount of variability in yield explained by regressions on ozone exposure statistics under controlled research greatly exceeds the r^2 value computed in the present study. Values of $r^2 > 75\%$ are common in the literature, whereas $r^2 < 10\%$, as observed here, are very uncommon. This result is not unexpected given that the data presented here were obtained from

Table 14. Multiple Regressions of Yield vs. Soil Characteristics or Ozone Concentration*.

Group Analyzed	Observations	r^2	Parameter Estimate	Prob > |T|
All Acalas	351	0.13	Intercept = 1.31 7 hr $[O_3]$ = -0.0225 Available Water = -3.52 Soil pH = 0.331 Salinity = -0.0381 Yield Potential = 0.00041	0.17 0.0001 0.0001 0.001 0.006 0.021
Only Acala SJ2	152	0.10	Intercept = 82.1 7 hr $[O_3]$ = -0.0194 Available Water = -4.44 Soil pH = -20.3 (Soil pH)^2 = 1.33 Salinity = -0.123	0.02 0.02 0.001 0.02 0.02 0.004
Other Acalas (except SJ2)	205	0.20	Intercept = 7.73 7 hr $[O_3]$ = -0.213 (7 hr $[O_3]$)^2 = 0.00150 (Soil pH)^2 = 0.0374 (Available Water)^2 = -10.0 (Salinity)^2 = -0.00537	0.01 0.03 0.05 0.0001 0.01 0.002
Pima	25	0.22	Intercept = -0.68481 7 hr $[O_3]$ = -0.01774 Yield Potential = 0.00053	0.67 0.16 0.03

* Dependent variable is cotton yield in bales acre^{-1}. Independent variables are the 7-hr mean ozone concentration (ppb), soil available water (inches inch^{-1}), pH, salinity, and yield potential. The regression is significant if the Prob > |T| for a non-intercept variable is $p < 0.05$.

a survey of Kern County cotton producers whose crops were subjected to a myriad of environmental factors. One of the most important factors is agronomic or cultural techniques, which accounts for more of the historical improvement in major crop yields than genetic advances (Simmonds, 1981).

The value of field work such as that reported here should not be discounted because of unfavorable comparisons of certain statistics to research done under controlled situations. Research such as that presented here can arguably be said to be more relevant to economic and regulatory decision-making than studies performed under controlled, but unrealistic conditions. The results reported here, concerning percent yield loss in cotton due to ambient ozone in Kern County, are very similar to the values calculated with equations that were developed from controlled research data (Figure 22). These data show that the percent loss in yield due to ozone could be as high as 20% or more in certain parts of the county, and half that much in the cleaner regions of the County. These percent loss numbers appear less menacing when considered in light of the percent loss in yield that could occur by, for example, failing to follow proper cotton growing procedures.

Some of the variability could also be attributed to noise and differences in agronomic practices. Cotton yields were not weighted by acreage when they were averaged over a larger section. Also some percentage of the total variability may be attributed to lack-of-fit, that may be improved by using an experimental model rather than a linear or quadratic polynomial model. The NCLAN, for example, emphasizes the exponential Weibull model as superior for fitting dose-response equations.

The results presented here show that the effects of different ozone concentrations in different parts of the County explains only about 5% of the variability in yields, whereas other factors account for 95% of the variability in yields. The implication is that growers can get more return on their investment, by controlling other agronomic factors than ozone. The effects of ozone can be discounted further by the following argument. Since ozone essentially affects all growers equally, growers that focus on factors such as fertilization and planting date may gain a competitive advantage in the marketplace over those that concern themselves with mitigating ozone. One can conclude that growers may experience a 10 to 20% loss in yield, relative to clean air, only after other cotton production factors, which are more important to high yields, are controlled.

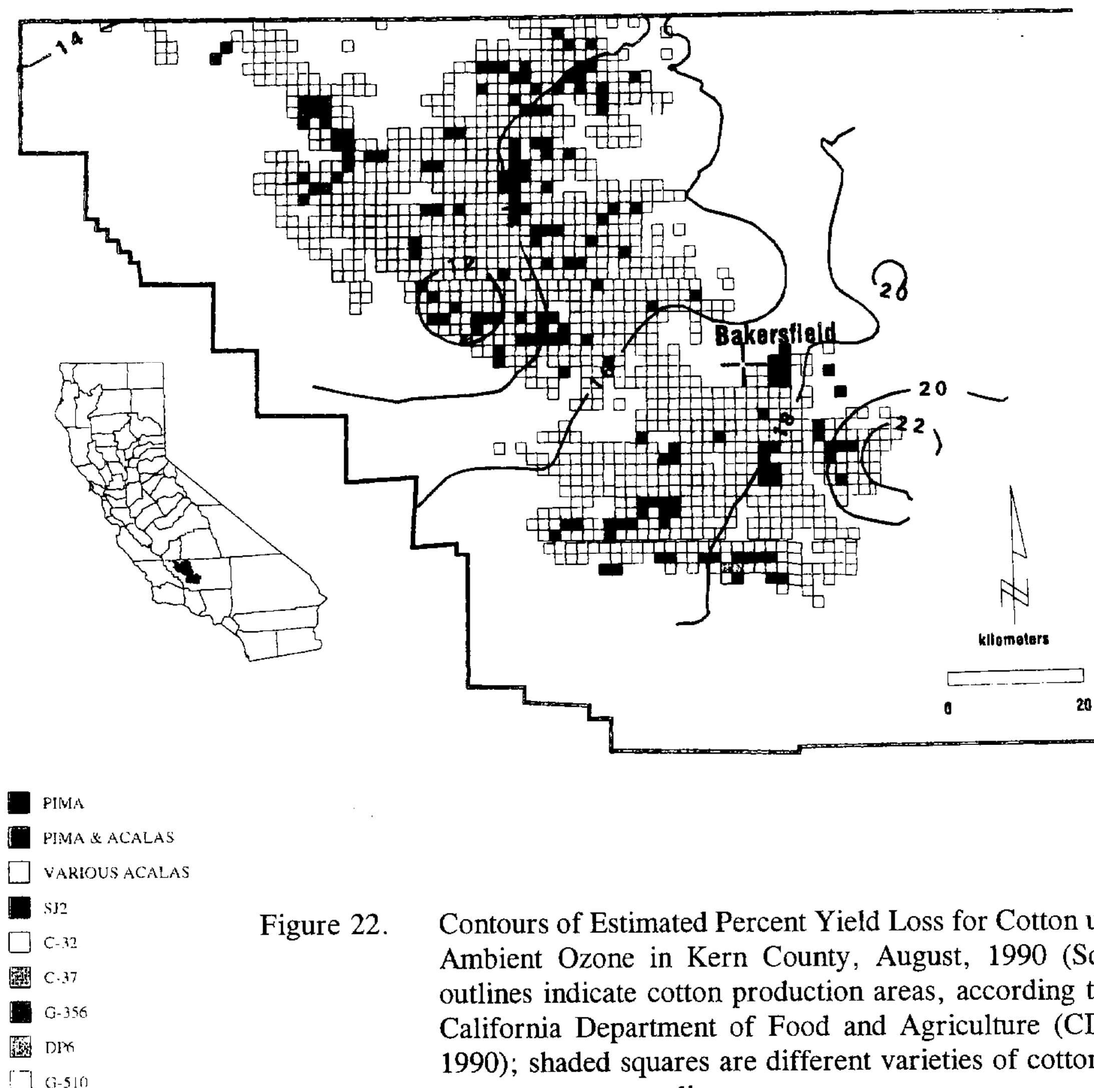


Figure 22. Contours of Estimated Percent Yield Loss for Cotton under Ambient Ozone in Kern County, August, 1990 (Square outlines indicate cotton production areas, according to the California Department of Food and Agriculture (CDFA, 1990); shaded squares are different varieties of cotton that were grown, according to grower surveys.

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APPENDIX

Sample

July 22, 1991

Gene Johnson
7312 Darrin Ave.
Bakersfield, CA 93008

Dear Mr./Ms. Johnson:

The Statewide Air Pollution Research Center, UC Riverside, in cooperation with the California Air Resources Board (ARB) initiated a program to fully evaluate the extent of yield loss in cotton due to air pollution in Kern County. There is evidence that air pollution levels are not uniform across the county, and consequently cotton grown in some areas may suffer a greater loss.

Yields per acre are required to predict regional yield losses in cotton. The California Department of Food and Agriculture (CDFA) yield records for individual growers, however, are confidential. Your assistance is very important to the success of the program.

Pesticide applicator permit records, provided by the Kern County Agricultural Commissioner's Office, indicate that you planted cotton in 1990. Would you please complete the enclosed survey and return it to me in the addressed, stamped envelope? The information that you provide will be used in strict confidence. Your name and the location of your farm will not be included in any written report or used in any manner without your consent.

The approximate planting date, variety of cotton that you grew, total acreage, and the average yield per acre within a section are requested. Farm-wide average yields are okay if all plantings were in the same general area. Also, please mark the section(s) where you grew cotton on the enclosed map. The locations will be used to identify where cotton was planted in relation to the occurrence of air pollution, and to determine yields on a per section basis for Kern County. The information will be combined with ozone concentration data and used to calculate the extent of yield loss that occurred in 1990.

If you have any questions regarding the survey, call me at (714) 787-5131, Monday through Friday. The results of the study will be available to you upon request by writing the return address on the survey sometime after December, 1991. Thank you for your cooperation.

Sincerely,

Randall Mutters
Assistant Research

Sample

Gene Johnson
7312 Darrin Ave.
Bakersfield, CA 93308

COTTON YIELD SURVEY FOR 1990

1. Planting date (approx.): ____________
2. Variety of cotton planted: ____________
3. Acres planted in cotton: ____________
4. Yield per acre (section or farm-wide): ____________
5. Mark field location on map.

Thanks again for your cooperation.

Return to:

Dr. Randall Mutters
Statewide Air Pollution Research Center
University of California
Riverside, California 92521

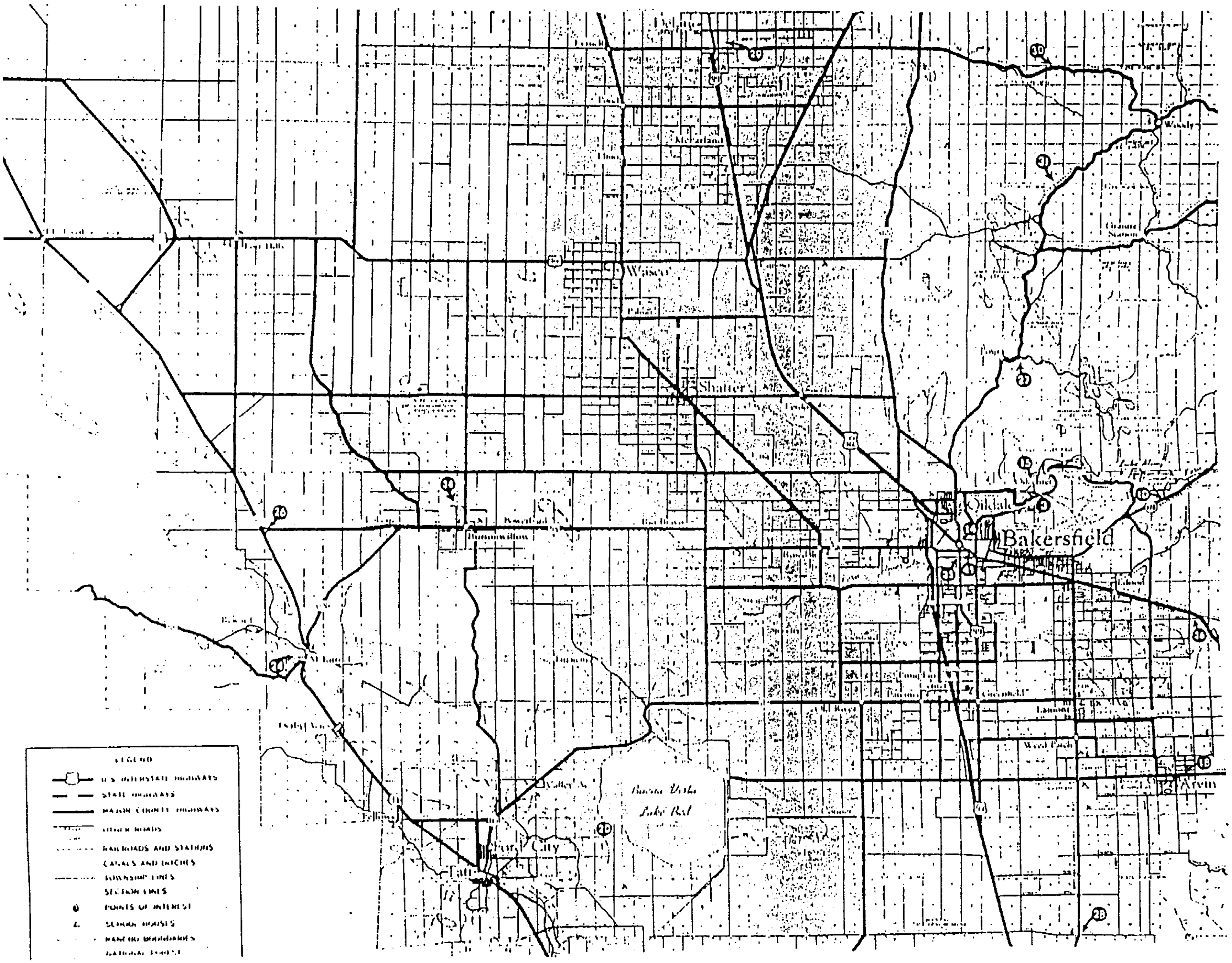
LEGEND
U.S. INTERSTATE HIGHWAYS
STATE HIGHWAYS
MAJOR COUNTY HIGHWAYS
OTHER ROADS
RAILROADS AND STATIONS
CANALS AND DITCHES
TOWNSHIP LINES
SECTION LINES
POINTS OF INTEREST
SCHOOL HOUSES
RANCHO BOUNDARIES
NATIONAL FOREST
Bakersfield
Oildale
Wasco
Shafter
McFarland
Buttonwillow
Taft
Arvin
Buena Vista
Lake Bed

TABLE A

SJVCB SCREENING TEST - 1991
D.M. CAMP & SONS - ARVIN

SOIL TYPE: TRAVER FINE SAND
PLOT SIZE: 4 ROW PLOTS - 50' LONG. 4 REPLICATIONS. TWO BORDER ROWS BETWEEN EACH PLOT IS PLANTED TO SJ-2.
PLANTING DATE: APRIL 8
LOCATION: 3/4 MILE SOUTH OF HERRING ROAD ON RANCHO DRIVE, THEN WEST APPROX. 1/3 MILE ON FIELD ROAD NEXT TO VINEYARD. (NW 1/4 S10 T32S R29E)

48 BORDER ROWS

	I	II	III	IV
1	C-213	CBX-691	DP 901	GC-9008
2	WLF-25	GC-9001	PHY-14	PHY-18
3	C-315	C-314	C-112	CBX-391
4	WLF-26	C-111	W-10	CBX-591
5	W-11	GC-9005	PHY-15	GC-9003
6	CBX-191	W-9	PHY-19	CBX-491
7	GC-510	CBX-291	WLF-27	GC-9010
8	DP 902	DP 903	GC-9007	SJ-2
9	PHY-17	DP 905	DP 904	DP 900
10	PHY-14	DP 900	CBX-191	W-9
11	W-10	WLF-27	CBX-691	C-111
12	GC-9001	WLF-25	CBX-291	DP 903
13	PHY-15	PHY-19	C-315	W-11
14	CBX-591	C-213	GC-510	DP 902
15	GC-9007	C-112	WLF-26	GC-9005
16	SJ-2	CBX-391	PHY-18	C-314
17	GC-9008	GC-9003	CBX-491	PHY-17
18	DP 901	GC-9010	DP 905	DP 904
19	CBX-291	PHY-17	DP 903	W-10
20	WLF-27	SJ-2	GC-9008	C-315
21	DP 905	DP 901	GC-9005	GC-9001
22	DP 900	DP 902	WLF-25	GC-510
23	CBX-691	CBX-491	C-111	PHY-19
24	W-9	PHY-14	W-11	WLF-26
25	CBX-391	CBX-591	GC-9010	CBX-191
26	GC-9003	PHY-18	C-314	C-112
27	DP 904	PHY-15	C-213	GC-9007
28	C-314	GC-510	CBX-591	CBX-691
29	PHY-19	W-10	CBX-391	PHY-14
30	DP 903	W-11	DP 900	DP 901
31	C-111	DP 904	PHY-17	WLF-25
32	GC-9010	C-315	GC-9001	DP 905
33	C-112	WLF-26	W-9	WLF-27
34	CBX-491	CBX-191	SJ-2	CBX-291
35	PHY-18	GC-9007	DP 902	PHY-15
36	GC-9005	GC-9008	GC-9003	C-213

------>NORTH

SJVCB SCREENING TEST - 1991
JIM AIKENS - PORTERVILLE

SOIL TYPE: CHINO FINE SANDY LOAM
PLOT SIZE: 4 ROW PLOTS - 50' LONG. 4 REPLICATIONS.
PLANTING DATE: APRIL 13
LOCATION: 1/4 MILE EAST OF ROAD 200 ON AVENUE 184, THEN SOUTH ON FIELD ROAD 1/4 MILE. (NW 1/4 Sec 12 T21S R26E)

16 BORDER ROWS → S

PORTERVILLE ACALA SCREENING 1991

1) PHY-18	CBI-291	SJ-2	CBI-491	C-315	C-112	CBI-191	GC-9005
2) WLF-25	DP 903	GC-9010	CBI-691	CBI-391	W-9	GC-9005	DP 900
3) C-111	DP 901	PHY-15	DP 905	SC-9007	WLF-27	GC-9003	PHY-17
4) GC-510	PHY-19	W-10	WLF-26	DP 902	DP 904	W-11	C-213
5) CBI-591	SC-9005	PHY-14	PHY-17	W-10	GC-9001	C-314	PHY-19
6) DP 900	C-314	DP 904	WLF-25	CBI-691	PHY-18	W-9	C-315
7) GC-9008	C-213	W-11	CBI-191	DP 905	PHY-14	C-111	DP 902
8) CBI-491	SC-9003	DP 903	CBI-391	GC-510	SJ-2	PHY-15	WLF-27
9) C-112	GC-9010	GC-9001	GC-9007	WLF-26	CBI-591	CBI-291	DP 901
10) CBI-691	DP 905	CBI-591	C-315	CBI-191	W-11	DP 904	DP 903
11) CBI-391	WLF-27	C-112	DP 902	GC-9008	C-314	GC-510	PHY-18
12) PHY-14	PHY-15	DP 900	C-213	CBI-491	C-111	SJ-2	SC-9007
13) PHY-17	W-9	GC-9005	PHY-19	DP 901	CBI-291	GC-9001	GC-9010
14) DP 902	DP 904	WLF-27	GC-9003	GC-9010	WLF-25	WLF-26	W-10
15) C-315	SJ-2	C-111	C-314	DP 903	SC-9005	C-112	CBI-391
16) GC-9001	WLF-26	PHY-18	DP 901	PHY-15	PHY-17	WLF-25	PHY-14
17) GC-9007	W-10	W-9	GC-510	DP 900	C-213	CBI-491	CBI-691
18) W-11	CBI-191	CBI-291	GC-9008	PHY-19	GC-9003	DP 905	CBI-591

SJVCB SCREENING TEST - 1991
U.C. WEST SIDE FIELD STATION

SOIL TYPE: PANOCHE CLAY LOAM
PLOT SIZE: 4 ROW PLOTS - 50' LONG. 4 REPLICATIONS.
PLANTING DATE: APRIL 11
LOCATION: U.C. WEST SIDE FIELD STATION - FIELD 25 NORTH 1/2 (SEC 27 T18S R17E)

16 BORDER ROWS

	I	II	III	IV
1	C-111	DP 902	GC-9007	DP 900
2	GC-9008	DP 903	CBX-591	SJ-2
3	W-9	GC-9010	C-314	GC-9003
4	DP 901	PHY-17	W-10	CBX-391
5	WLF-25	C-315	C-112	GC-510
6	DP 904	PHY-18	GC-9001	PHY-15
7	W-11	WLF-27	CBX-291	WLF-26
8	CBX-191	CBX-491	DP 905	PHY-14
9	GC-9005	C-213	PHY-19	CBX-691
10	DP 903	GC-510	CBX-391	W-11
11	GC-9007	SJ-2	W-9	CBX-191
12	PHY-19	C-111	PHY-17	WLF-27
13	C-314	DP 904	DP 901	GC-9010
14	CBX-691	W-10	C-213	PHY-18
15	GC-9003	GC-9005	GC-9008	GC-9001
16	DP 900	CBX-291	DP 902	C-112
17	C-315	PHY-14	PHY-15	WLF-25
18	WLF-26	CBX-591	CBX-491	DP 905
19	PHY-17	CBX-191	DP 903	CBX-291
20	PHY-14	WLF-25	DP 904	CBX-591
21	PHY-18	GC-9007	CBX-691	GC-9008
22	GC-9010	CBX-391	WLF-26	W-10
23	GC-9001	C-112	DP 900	C-315
24	C-213	PHY-15	WLF-27	PHY-19
25	DP 902	W-11	GC-510	W-9
26	SJ-2	DP 905	C-111	DP 901
27	CBX-491	C-314	GC-9003	GC-9005
28	W-10	CBX-691	C-315	GC-9007
29	CBX-591	DP 900	SJ-2	CBX-491
30	WLF-27	WLF-26	W-11	C-314
31	CBX-391	PHY-19	WLF-25	DP 902
32	PHY-15	W-9	GC-9010	DP 904
33	C-112	GC-9001	PHY-18	DP 903
34	CBX-291	DP 901	GC-9005	C-111
35	GC-510	GC-9008	PHY-14	C-213
36	DP 905	GC-9003	CBX-191	PHY-17

------>EAST

SJVCB SCREENING TEST - 1991
DOUGLAS TRETT - CHOWCHILLA

SOIL TYPE: GREENFIELD SANDY LOAM
PLOT SIZE: 4 ROW PLOTS - 50' LONG. 4 REPLICATIONS. TWO BORDER ROWS BETWEEN EACH PLOT IS PLANTED TO SJ-2.
PLANTING DATE: APRIL 28
LOCATION: APPROX. 1/4 MILE NORTH OF HARVEY PETTIT RD ON MINTURN RD, THEN WEST 1/8 MILE. TEST IS CENTER OF FIELD. (SE 1/4 S1 T9S R15E)

72 BORDER ROWS

	I	II	III	IV
1	DP 904	C-111	PHY-15	CBX-491
2	DP 900	CBX-191	W-11	C-315
3	DP 902	W-9	DP 905	PHY-18
4	GC-510	PHY-14	PHY-17	C-314
5	GC-9007	WLF-26	CBX-591	C-213
6	GC-9005	GC-9003	CBX-391	GC-9001
7	DP 901	CBX-691	WLF-27	DP 903
8	WLF-25	W-10	GC-9008	C-112
9	CBX-291	PHY-19	SJ-2	GC-9010
10	C-213	DP 905	C-314	CBX-191
11	CBX-691	GC-510	DP 903	WLF-26
12	PHY-17	CBX-491	DP 900	GC-9007
13	GC-9003	W-11	PHY-14	DP 901
14	C-111	WLF-25	GC-9010	WLF-27
15	PHY-18	GC-9001	W-10	DP 902
16	C-315	PHY-15	CBX-291	CBX-391
17	SJ-2	DP 904	W-9	GC-9008
18	CBX-591	GC-9005	C-112	PHY-19
19	W-10	GC-9008	C-111	DP 905
20	PHY-15	CBX-291	CBX-691	PHY-14
21	DP 903	CBX-391	DP 902	GC-9005
22	WLF-26	CBX-591	CBX-191	GC-510
23	C-112	C-213	CBX-491	SJ-2
24	PHY-19	WLF-27	GC-9003	W-11
25	C-314	DP 900	DP 901	DP 904
26	GC-9001	C-315	PHY-18	WLF-25
27	GC-9010	PHY-17	GC-9007	W-9
28	W-9	SJ-2	GC-9001	PHY-15
29	CBX-391	C-314	GC-510	CBX-691
30	DP 905	DP 903	GC-9005	CBX-591
31	GC-9008	DP 902	PHY-19	CBX-291
32	W-11	GC-9010	C-213	C-111
33	CBX-491	PHY-18	WLF-25	W-10
34	CBX-191	C-112	DP 904	GC-9003
35	PHY-14	GC-9007	WLF-26	PHY-17
36	WLF-27	DP 901	C-315	DP 900

------)WEST

SJVCB VARIETY TEST - 1991
CRETTOL FARMS - WASCO

SOIL TYPE: TRAVER FINE SANDY LOAM
PLOT SIZE: 6 ROW PLOTS - 1/4 MILE LONG. 4 REPLICATIONS
PLANTING DATE: APRIL 9
LOCATION: 1/4 MILE WEST OF MAGNOLIA ON DRESSER AVE. FIELD IS TO THE SOUTH
(NE 1/4 S34 T27S R24E)

REP I
CBX-190
CBX-305
GC-8910
PREMA
DP 6190
C-396
CBX-302
GC-8909
GC-510
C-306
DP 6162
C-294
GC-8902
SJ-2
DP 6100

REP II
GC-8902
C-396
GC-8909
DP 6162
C-294
C-306
CBX-305
CBX-190
GC-8910
GC-510
SJ-2
DP 6100
PREMA
CBX-302
DP 6190

REP III
C-294
GC-510
DP 6100
SJ-2
PREMA
GC-8902
GC-8909
DP 6190
DP 6162
GC-8910
C-396
CBX-302
C-306
CBX-190
CBX-305

REP IV
GC-8910
C-306
SJ-2
DP 6100
DP 6162
CBX-302
GC-510
DP 6190
CBX-305
CBX-190
GC-8909
PREMA
GC-8902
C-396
C-294

NO BORDER ROWS ------>WEST

SJVCB VARIETY TEST - 1991
EMERY RENAUD - TULARE

SOIL TYPE: CAJON FINE SANDY LOAM
PLOT SIZE: 4 ROW PLOTS - 1/4 MILE LONG
PLANTING DATE: APRIL 16
LOCATION: 1/2 MILE NORTH OF CARTMILL (AVE. 248) ON RD 92. TEST IS ON EAST SIDE OF ROAD. (NW 1/4 S27 T19S R24E)

20 Guard Rows

REP 1 1 C-306	REP 3 31 DP 6162
2 GC-8909	32 C-294
3 GC-8910	33 CBX-302
4 GC-8902	34 CBX-305
5 PREMA	35 C-396
6 CBX-190	36 DP 6190
7 DP 6100	37 GC-510
8 DP 6190	38 SJ-2
9 CBX-305	39 GC-8909
10 GC-510	40 CBX-190
11 DP 6162	41 GC-8902
12 C-396	42 DP 6100
13 SJ-2	43 GC-8910
14 CBX-302	44 PREMA
15 C-294	45 C-306
REP 2 16 SJ-2	REP 4 46 GC-8909
17 C-306	47 DP 6190
18 GC-8910	48 CBX-305
19 PREMA	49 CBX-190
20 GC-510	50 DP 6100
21 CBX-302	51 GC-8902
22 C-396	52 C-294
23 CBX-190	53 DP 6162
24 GC-8909	54 CBX-302
25 DP 6100	55 C-396
26 DP 6190	56 SJ-2
27 C-294	57 GC-510
28 DP 6162	58 C-306
29 CBX-305	59 GC-8910
30 GC-8902	60 PREMA

SJVCB VARIETY TEST - 1991
LOUIS AVILA - HANFORD

SOIL TYPE: GRANGEVILLE FINE SANDY LOAM
PLOT SIZE: 6 ROW PLOTS - 1/4 MILE LONG
PLANTING DATE: APRIL 24
LOCATION: 1/4 MILE WEST OF INTERSECTION OF DOVER AND 11TH.
(NE 1/4 S35 T17S R21E)

REP I	C-306
	CBX-190
	GC-8910
	PREMA
	C-396
	CBX-305
	DP 6162
	CBX-302
	C-294
	GC-8902
	GC-8909
	GC-510
	DP 6190
	DP 6100
	SJ-2
REP II	GC-510
	GC-8910
	C-306
	PREMA
	GC-8902
	DP 6100
	SJ-2
	C-396
	C-294
	CBX-190
	DP 6162
	GC-8909
	DP 6190
	CBX-305
	CBX-302
REP III	CBX-190
	GC-8902
	CBX-305
	DP 6190
	C-396
	C-294
	GC-8909
	GC-8910
	GC-510
	DP 6100
	C-306
	SJ-2
	CBX-302
	PREMA
	DP 6162
REP IV	DP 6190
	DP 6100
	GC-510
	C-294
	CBX-302
	GC-8909
	DP 6162
	SJ-2
	PREMA
	CBX-190
	C-396
	GC-8910
	CBX-305
	GC-8902
	C-306

12 BORDER ROWS

------>SOUTH

SJVCB VARIETY TEST - 1991
U.C. WEST SIDE FIELD STATION

SOIL TYPE: PANOCHE CLAY LOAM
PLOT SIZE: 4 ROW PLOTS - 300' LONG
PLANTING DATE: APRIL 10
LOCATION: U.C. WEST SIDE FIELD STATION - FIELD 13 SOUTH 1/2

8 BORDER ROWS

REP I	GC-8902
	GC-8910
	GC-510
	CBX-190
	PREMA
	C-306
	DP 6162
	DP 6100
	C-396
	CBX-302
	SJ-2
	C-294
	GC-8909
	CBX-305
	DP 6190
REP II	GC-510
	C-294
	C-396
	CBX-305
	CBX-190
	SJ-2
	PREMA
	GC-8910
	C-306
	CBX-302
	DP 6162
	GC-8909
	DP 6100
	GC-8902
	DP 6190
REP III	CBX-305
	DP 6190
	GC-8909
	CBX-302
	C-306
	GC-8902
	C-294
	SJ-2
	C-396
	CBX-190
	DP 6162
	GC-8910
	DP 6100
	PREMA
	GC-510
REP IV	GC-8910
	CBX-302
	DP 6100
	SJ-2
	C-396
	DP 6190
	DP 6162
	GC-8909
	C-306
	GC-8902
	GC-510
	PREMA
	CBX-305
	C-294
	CBX-190

------>EAST

SJVCB VARIETY TEST - 1991
MIKE GIFFEN - FIREBAUGH

SOIL TYPE: PANOCHE LOAM
PLOT SIZE: 6 ROW PLOTS - 1/4 MILE LONG
PLANTING DATE: APRIL 22
LOCATION: 1/3 MILE WEST OF SAN DIEGO AND ASHLAN ON FARM ROAD. (S16 T13S R14E)

REP I	GC-8902
	C-396
	CBX-190
	SJ-2
	C-294
	CBX-302
	GC-8909
	DP 6190
	GC-510
	DP 6100
	GC-8910
	C-306
	DP 6162
	PREMA
	CBX-305
REP II	CBX-302
	C-396
	CBX-305
	GC-8909
	GC-8910
	C-306
	C-294
	DP 6162
	DP 6190
	GC-8902
	CBX-190
	DP 6100
	PREMA
	GC-510
	SJ-2
REP III	GC-8909
	CBX-190
	SJ-2
	GC-8902
	DP 6162
	PREMA
	DP 6190
	DP 6100
	GC-510
	GC-8910
	C-306
	C-396
	CBX-305
	C-294
	CBX-302
REP IV	GC-510
	CBX-305
	PREMA
	C-306
	GC-8910
	DP 6190
	DP 6100
	GC-8902
	DP 6162
	SJ-2
	CBX-190
	C-396
	CBX-302
	C-294
	GC-8909

57 BORDER ROWS TO POWER POLE ------>NORTH

SJVCB VARIETY TEST - 1991
DAVID GALLEANO - MADERA

SOIL TYPE: GRANGEVILLE FINE SANDY LOAM
PLOT SIZE: 4 ROW PLOTS - APPROX. 1/4 MILE LONG. 4 BORDER ROWS OF ROYALE BETWEEN EACH REP.
PLANTING DATE: APRIL 26
LOCATION: NE CORNER OF AVE 12 AND RD 26. (S36 T11S R17E)

96 BORDER ROWS

REP I
SJ-2
PREMA
DP 6162
GC-8909
GC-8910
CBX-302
CBX-190
GC-510
C-294
DP 6190
DP 6100
C-396
CBX-305
C-306
GC-8902

REP II
C-396
DP 6162
CBX-190
GC-8902
C-306
C-294
DP 6100
GC-8910
SJ-2
CBX-302
GC-8909
PREMA
DP 6190
GC-510
CBX-305

REP III
DP 6100
C-294
DP 6190
SJ-2
CBX-305
PREMA
CBX-302
GC-8910
GC-510
DP 6162
C-306
C-396
CBX-190
GC-8902
GC-8909

REP IV
CBX-190
C-306
GC-8902
C-396
DP 6190
GC-8909
CBX-305
GC-510
C-294
CBX-302
DP 6100
SJ-2
DP 6162
GC-8910
PREMA

------>WEST

SJVCB VARIETY TEST - 1991
BOWLES FARMING - LOS BANOS

SOIL TYPE: TEMPLE SILTY CLAY
PLOT SIZE: 8 ROW PLOTS - 1/4 MILE LONG - 30" ROWS
PLANTING DATE: APRIL 17
LOCATION: 4 MILES WEST OF DOS PALOS Y ON HI 152 TO TURNER ISLAND RD. THEN NORTH APPROX. 5 MI TO PALAZZO RD THEN EAST (ALONG NORTH SIDE OF DITCH) ON FARM RD FOR 1/2 MI, THEN LEFT FOR 3/4 MI THEN RIGHT APPROX. 1/2 MI. (SE 1/4 S20 T9S R12E)

REP I
PREMA
CBX-302
SJ-2
DP 6162
GC-8902
DP 6100
GC-8910
C-396
CBX-190
C-294
CBX-305
C-306
GC-510
GC-8909
DP 6190

REP II
CBX-305
C-306
CBX-190
DP 6162
C-396
CBX-302
C-294
GC-8910
GC-8909
GC-8902
DP 6190
DP 6100
PREMA
SJ-2
GC-510

REP III
C-306
C-294
GC-8902
C-396
SJ-2
GC-8909
DP 6190
GC-510
DP 6100
CBX-190
DP 6162
GC-8910
PREMA
CBX-305
CBX-302

REP IV
GC-510
GC-8910
DP 6100
PREMA
DP 6190
CBX-190
CBX-305
GC-8909
DP 6162
SJ-2
CBX-302
C-306
C-294
GC-8902
C-396

------>SOUTH

SJVCB NATIONAL STANDARDS TEST - 1991
U.S. COTTON RESEARCH STATION - SHAFTER

SOIL TYPE: WASCO SANDY LOAM
PLOT SIZE: 4 ROW PLOTS - 60' LONG
PLANTING DATE: APRIL 9
LOCATION: SOUTH F

4 BORDER ROWS

	I	II	III	IV
1	DPL 6190	CPCSD C-294	DELTAPINE 50	CBX-302
2	DPL 6162	CPCSD C-396	CPCSD C-306	GC-8902
3	CBX-190	CBX-305	ACALA PREMA	GC-8910
4	DPL 6100	GC-8909	PAYMSTR HS-26	ACALA SJ-2
5	COKER 320	PAYMSTR HS-26	ACALA 1517-88	ACALA GC-510
6	GC-8909	DPL 6190	COKER 320	DELTAPINE 50
7	ACALA PREMA	CPCSD C-306	ACALA SJ-2	CPCSD C-294
8	CBX-305	ACALA GC-510	CBX-190	DPL 6162
9	GC-8902	GC-8910	CPCSD C-396	ACALA 1517-88
10	ACALA 1517-88	CBX-190	CBX-302	DPL 6100
11	CPCSD C-306	ACALA SJ-2	CPCSD C-294	PAYMSTR HS-26
12	GC-8910	DPL 6162	GC-8902	COKER 320
13	CPCSD C-396	DPL 6100	ACALA GC-510	CBX-305
14	DELTAPINE 50	CBX-302	DPL 6190	GC-8909
15	ACALA GC-510	GC-8902	GC-8910	ACALA PREMA
16	CPCSD C-294	DELTAPINE 50	DPL 6162	CPCSD C-306
17	ACALA SJ-2	ACALA 1517-88	DPL 6100	CBX-190
18	PAYMSTR HS-26	COKER 320	CBX-305	CPCSD C-396
19	CBX-302	ACALA PREMA	GC-8909	DPL 6190

------>WEST

U.C. WEST SIDE FIELD STATION

SOIL TYPE: PANOCHE CLAY LOAM
PLOT SIZE: 4 ROW PLOTS - 50' LONG
PLANTING DATE: APRIL 11
LOCATION: FIELD 13 SOUTH 1/4

24 BORDER ROWS

	I	II	III	IV
1	PAYMSTR HS-26	DPL 6100	COKER 320	CPCSD C-294
2	CBX-190	DELTAPINE 50	ACALA SJ-2	CPCSD C-306
3	DPL 6162	CBX-302	GC-8910	GC-8909
4	ACALA PREMA	CBX-305	ACALA 1517-88	DPL 6190
5	CPCSD C-396	GC-8902	DELTAPINE 50	ACALA GC-510
6	CPCSD C-306	ACALA PREMA	CPCSD C-294	CBX-302
7	CBX-305	CBX-190	DPL 6162	ACALA 1517-88
8	COKER 320	ACALA GC-510	GC-8902	CPCSD C-396
9	DPL 6190	ACALA SJ-2	PAYMSTR HS-26	DPL 6100
10	GC-8909	GC-8910	GC-8909	DELTAPINE 50
11	ACALA 1517-88	DPL 6162	DPL 6100	ACALA PREMA
12	ACALA SJ-2	COKER 320	ACALA GC-510	CBX-190
13	CBX-302	CPCSD C-306	CPCSD C-396	GC-8902
14	GC-8910	DPL 6190	CBX-305	PAYMSTR HS-26
15	CPCSD C-294	ACALA 1517-88	DPL 6190	ACALA SJ-2
16	ACALA GC-510	CPCSD C-294	CPCSD C-306	COKER 320
17	GC-8902	PAYMSTR HS-26	ACALA PREMA	DPL 6162
18	DPL 6100	GC-8909	CBX-190	CBX-305
19	DELTAPINE 50	CPCSD C-396	CBX-302	GC-8910

------>EAST

SJVCB PIMA VARIETY TEST - 1991
MIDLAKE FARMS - BUENA VISTA

SOIL TYPE: TEMPLE SILTY CLAY LOAM
PLOT SIZE: 8 ROW PLOTS - 1/4 MILE LONG
PLANTING DATE: APRIL 12
LOCATION: 2 1/4 MILE WEST OF OLD RIVER RD ON MILLUX RD, POWER LINE PARALLELS TEST ALONG EAST SIDE. (S33 T31S R26E)

REP I	PIMA S-6
	DPX 911
	PHY-11
	E-411
	WLFP-1
	P-69
	WPX-1
	CH-252
REP II	DPX 911
	P-69
	E-411
	WLFP-1
	CH-252
	PIMA S-6
	PHY-11
	WPX-1
REP III	WLFP-1
	CH-252
	WPX-1
	P-69
	E-411
	PHY-11
	DPX 911
	PIMA S-6
REP IV	WPX-1
	CH-252
	PIMA S-6
	PHY-11
	E-411
	DPX 911
	P-69
	WLFP-1

12 BORDER ROWS ------>NORTH

SJVCB PIMA VARIETY - 1991
JEFF HILDEBRAND - WAUKENA

SOIL TYPE: CHINO SILTY CLAY LOAM
PLOT SIZE: 6 ROW PLOTS - 1/4 MILE LONG.
PLANTING DATE: APRIL 11
LOCATION: ONE MILE NORTH OF AVE. 232 ON RD. 29, THEN WEST 3/4 MILE ON FIELD RD. IMMEDIATELY WEST OF ORCHARD. (NW1/4 S6 T20S R23E)

REP I
DPX 911
P-69
E-411
CH-252
WPX-1
WLFP-1
PIMA S-6
PHY-11

REP II
WLFP-1
PIMA S-6
WPX-1
DPX 911
P-69
E-411
PHY-11
CH-252

REP III
PHY-11
PIMA S-6
WPX-1
WLFP-1
DPX 911
E-411
CH-252
P-69

REP IV
E-411
PHY-11
P-69
CH-252
PIMA S-6
WLFP-1
DPX 911
WPX-1

------>WEST

12 BORDER ROWS

SJVCB PIMA VARIETY - 1991
U.C. WEST SIDE FIELD STATION

SOIL TYPE: PANOCHE CLAY LOAM
PLOT SIZE: 4 ROW PLOTS - 50' LONG.
PLANTING DATE: APRIL 10
LOCATION: U.C. WEST SIDE FIELD STATION - FIELD 25 SOUTH 1/2.

8 BORDER ROWS

REP I
PIMA S-6
E-411
WLFP-1
CH-252
P-69
DPX 911
WPX-1
PHY-11

REP II
PIMA S-6
WPX-1
DPX 911
CH-252
PHY-11
WLFP-1
E-411
P-69

REP III
PHY-11
DPX 911
P-69
WPX-1
E-411
CH-252
WLFP-1
PIMA S-6

REP IV
P-69
PHY-11
WLFP-1
E-411
PIMA S-6
WPX-1
CH-252
DPX 911

16 BORDER ROWS

------>EAST

SJVCB PIMA SCREENING TEST - 1991
U.S. COTTON RESEARCH STATION - SHAFTER

SOIL TYPE: WASCO SANDY LOAM
PLOT SIZE: 4 ROW PLOTS - 50' LONG
PLANTING DATE: APRIL 9
LOCATION: SOUTH F

4 BORDER ROWS

	I	II	III	IV
1	PHY-13	S 90-004	P-73	S 90-001
2	CH-253	CH-254	E-412	WLFP-3
3	WPX-3	DPX 912	P-74	DPX 913
4	PHY-12	WLFP-2	E-413	PIMA S-6
5	E-413	E-412	DPX 912	WPX-2
6	CH-254	WLFP-3	S 90-004	P-74
7	WPX-2	CH-253	WPX-3	PHY-12
8	S 90-001	PIMA S-6	PHY-13	P-73
9	PIMA S-6	DPX 913	CH-253	WLFP-2
10	S 90-004	P-73	WLFP-2	PHY-13
11	WLFP-3	PHY-12	S 90-001	WPX-3
12	P-74	WPX-2	DPX 913	E-412
13	DPX 912	E-413	WPX-2	CH-254
14	DPX 913	P-74	CH-254	S 90-004
15	WLFP-2	S 90-001	WLFP-3	E-413
16	E-412	PHY-13	PIMA S-6	DPX 912
17	P-73	WPX-3	PHY-12	CH-253

4 BORDER ROWS

------>WEST

SJVCB PIMA SCREENING TEST - 1991
U.C. WEST SIDE FIELD STATION

SOIL TYPE: PANOCHE CLAY LOAM
PLOT SIZE: 4 ROW PLOTS - 50' LONG
PLANTING DATE: APRIL 11
LOCATION: FIELD 25 MIDDLE

8 BORDER ROWS

	I	II	III	IV
1	P-74	PHY-12	WPX-2	WPX-3
2	CH-254	WLFP-3	PIMA S-6	DPX 913
3	WLFP-2	CH-253	S 90-001	E-413
4	S 90-004	E-412	DPX 912	P-73
5	CH-253	PHY-13	WPX-3	S 90-004
6	WPX-2	P-73	E-413	CH-254
7	PHY-12	DPX 912	WLFP-3	E-412
8	S 90-001	P-74	WLFP-2	PIMA S-6
9	P-73	DPX 913	PHY-13	CH-253
10	WLFP-3	WPX-3	P-74	WLFP-2
11	PHY-13	WPX-2	PHY-12	DPX 912
12	PIMA S-6	E-413	CH-254	S 90-001
13	DPX 913	S 90-004	E-412	WPX-2
14	WPX-3	WLFP-2	P-73	PHY-13
15	DPX 912	PIMA S-6	CH-253	WLFP-3
16	E-412	S 90-001	S 90-004	PHY-12
17	E-413	CH-254	DPX 913	P-74

8 BORDER ROWS ------>EAST

TABLE B

Table B. Leaf injury ratings[a] of Acala SJ-2 cotton at 11 different sites in the San Joaquin Valley, 1991.

Location No.	Site	D[b]	I[c]	G[d]	(D + I) / (D+I+G)	Injury = 10 + [0.12D + 0.40I - 0.63G]
1	S of Arvin, Rancho Dr., near Herring Rd.	8	9	5	.77	10.46
		12	4	6	.82	9.33
		10	4	4	.78	10.34
		10	4	5	.74	9.71
		12	5	4	.81	10.98
					Av .78	10.36
4	Shafter, Cotton Research Station	9	5	5	.74	9.99
		11	4	8	.65	7.95
		9	4	7	.65	8.33
		10	4	7	.66	8.46
		8	5	8	.62	7.98
					Av .66	8.54
5	S of Wasco, Dresser Ave., near Magnolia Ave.	7	6	8	.66	8.26
		8	5	12	.52	5.48
		6	5	10	.52	6.48
		6	4	11	.48	5.46
		7	8	8	.68	9.06
					Av .57	6.95
7	N of Porterville, Ave. 184, near Rd. 200	10	5	5	.75	10.11
		9	3	6	.57	8.56
		10	3	8	.61	7.43
		14	4	6	.75	9.58
		14	3	4	.81	10.43
					Av .70	9.22
8	Tulare, Rd. 92, N of Cartmill	9	0	10	.47	4.85
		9	1	10	.48	5.25
		9	0	11	.45	4.33
		9	1	11	.48	4.63
		8	1	10	.47	5.13
					Av .47	4.82
11	N of Hanford, Dover Ave. near Magnolia Ave.	8	2	11	.48	4.90
		8	1	9	.50	5.76
		7	1	12	.40	3.75
		7	3	10	.50	5.81
		9	2	10	.52	5.65
					Av .48	5.17

Table B (continued)

Location No.	Site	D[b]	I[c]	G[d]	D + I / D+I+G	Injury = 10 + [0.12D + 0.40I - 0.63G]
14	Five Points, WSFS	7	3	10	.50	5.81
		5	1	13	.32	2.88
		5	4	10	.47	5.96
		5	0	11	.31	3.73
		7	3	11	.48	5.18
					Av .42	4.71
16	W of Madera, 12th Ave., near Rd. 26	7	2	8	.52	6.66
		9	1	10	.50	5.25
		10	1	11	.50	4.75
		8	1	10	.47	5.13
		9	2	11	.50	5.03
					Av .50	5.36
19	Firebaugh, Ashlan, near San Diego Rd.	5	3	11	.42	4.93
		6	3	12	.43	4.43
		5	2	12	.37	3.90
		8	0	13	.38	2.85
		7	1	13	.33	3.13
					Av .39	3.85
21	Los Banos, E of Palazzo Rd.	6	3	12	.43	4.43
		6	2	12	.38	4.03
		7	1	10	.42	5.00
		8	1	12	.38	3.88
		7	2	11	.43	4.88
					Av .41	4.42
20	W of Chowchilla, Minturn Rd. N of Harvey Pettit Rd.	8	3	9	.52	6.56
		7	3	9	.52	6.43
		10	1	9	.55	6.00
		10	2	7	.63	7.66
		7	1	13	.38	3.13
					Av .52	5.95

[a]Five plants were rated at each site between September 2 and September 6, 1991.
[b]"D" indicates leaf drop based upon the number of nodes where leaves had abscised.
[c]"I" indicates number of leaves with either injury or senescent symptoms.
[d]"G" indicates number of green, unaffected leaves.

TABLE C

Table C. Leaf injury ratings[a] of PIMA S-6 cotton at 10 different sites in the San Joaquin Valley.

Location No.	Site	D[b]	I[c]	G[d]	D + I / D+I+G	Injury = 10 + [0.12D + 0.40I - 0.63G]
2	W of Buena Vista, Millux Rd., near Old River Rd.	5	12	4	.81	7.08
		6	10	4	.76	7.76
		6	9	6	.71	9.41
		5	12	4	.81	7.08
		5	12	4	.81	7.08
					Av .78	12.32
1	W of Arvin, Bear Mtn. Rd., E of Edison Rd.	11	5	5	.73	9.77
		10	6	5	.76	9.49
		11	7	4	.82	8.34
		10	8	4	.82	8.06
		14	5	3	.86	8.14
					Av .80	11.24
3	W of Bakersfield, Stockdale Hwy., E of Superior Rd.	5	6	11	.50	6.13
		6	5	10	.52	6.48
		7	7	8	.64	8.66
		6	5	9	.55	7.11
		6	9	7	.68	9.96
					Av .58	7.67
6	W of Hwy. 5, Morris Rd., near Stockdale Hwy.	6	2	10	.44	3.28
		7	4	10	.52	6.21
		4	5	13	.41	4.36
		10	3	10	.57	6.12
		6	3	13	.41	5.80
					Av .47	5.16
4	N of Shafter, Cotton Research Station	7	5	9	.57	7.23
		10	6	6	.73	9.88
		8	6	9	.61	7.76
		11	6	4	.80	11.26
		8	5	7	.65	8.61
					Av .67	8.95
7	W of Porterville, Rd. 190, near Ave. 152	9	4	8	.62	7.71
		10	1	11	.50	4.75
		8	2	11	.48	4.90
		7	3	9	.53	6.43
		8	4	7	.63	8.21
					Av .55	6.40

Table C (continued)

Location No.	Site	D[b]	I[c]	G[d]	(D + I) / (D+I+G)	Injury = 10 + [0.12D + 0.40I - 0.63G]
9	N of Waukena, Ave. 232, near Rd. 28	6	2	13	.38	5.50
		5	4	9	.50	6.58
		10	3	8	.62	7.43
		4	8	9	.57	8.06
		9	8	5	.77	11.19
					Av .57	7.33
14	Five Points, WSFS	5	1	13	.32	2.88
		7	1	12	.38	3.75
		6	1	14	.33	2.38
		6	2	13	.38	3.40
		6	1	13	.35	3.00
					Av .35	3.08
17	S of San Joaquin, Elkhorn Ave., W of Lassen Ave.	5	3	12	.40	4.30
		6	2	13	.38	3.40
		7	3	12	.45	4.55
		6	3	10	.47	5.68
		6	1	12	.37	3.63
					Av .41	4.31
18	S of Tranquility, James Rd., near Adams Ave.	8	0	15	.34	1.60
		6	0	14	.30	1.98
		6	0	18	.25	0.53
		7	0	16	.30	0.85
		7	0	16	.30	0.85
					Av .30	0.95

[a]Five plants were rated at each site between September 2 and September 6, 1991.
[b]"D" indicates leaf drop based upon the number of nodes where leaves had abscised.
[c]"I" indicates number of leaves with either injury or senescent symptoms.
[d]"G" indicates number of green, unaffected leaves.

TABLE D

Table D. Leaf injury ratings[a] of Non-Parcil almonds in the San Joaquin Valley, 1991.

Location No.	Site	D[b]	I[c]	G[d]	D + I / D+I+G	
1	S of Arvin, Sebastion Rd., near Rancho Rd.	7	3	105	.087	103.24
		10	5	99	.132	97.20
		10	11	112	.158	110.01
		8	4	121	.090	118.50
		9	9	114	.136	111.89
					Av .121	Av 108.12
1	N of Arvin Tejon Rd., near Buena Vista Blvd.	19	12	90	.256	88.90
		20	18	120	.241	118.36
		25	18	128	.252	126.37
		20	20	98	.290	96.91
		27	12	102	.220	100.93
					Av .252	Av 106.29
3	W of Bakersfield, 7th Standard Rd., near Hwy 43	22	9	105	.228	103.61
		17	9	99	.208	97.55
		20	13	123	.212	121.19
		18	6	115	.173	113.16
		25	9	119	.222	117.40
					Av .209	Av 100.58
5	E of Wasco, Jackson Ave., near Rowlee Rd.	9	8	101	.144	99.17
		13	6	118	.138	115.89
		11	9	111	.153	109.04
		6	6	96	.111	94.13
		13	7	93	.177	91.49
					Av .145	Av 101.94
7	W of Porterville, Rd. 190, near Ave. 152	12	12	126	.160	123.79
		10	15	105	.192	103.25
		10	21	98	.240	96.53
		15	13	114	.197	112.20
		15	19	120	.221	118.18
					Av .202	Av 110.79
10	N of Visalia, Hwy. J15, near Ave. 352	8	7	90	.143	88.37
		6	6	112	.097	109.76
		4	3	87	.074	85.20
		5	7	93	.114	91.18
		3	5	75	.096	73.48
					Av .150	Av 89.60

Table D (continued)

Location No.	Site	D[b]	I[c]	G[d]	D + I / D+I+G	
11	Hanford, Hwy. 43, E of Grangeville	5	7	93	0.114	91.18
		4	3	88	.074	86.18
		10	5	98	.133	96.22
		6	4	79	.112	77.48
		5	5	102	.089	99.93
					Av .104	Av 90.20
14	Westside Field Station, Five Points	4	1	80	.059	78.32
		4	0	76	.050	74.39
		3	2	67	.069	65.60
		4	2	85	.066	83.23
		4	2	90	.063	88.11
					Av .061	Av 77.93
13	N of Riverdale, Elkhorn Ave., near Cornelia Ave.	4	0	108	.037	105.65
		3	0	97	.030	94.87
		2	1	102	.029	99.73
		2	1	89	.022	87.04
		3	0	112	.026	109.52
					Av .029	Av 99.36
16	S of Madera, Ave. 7, near Hwy. 99	0	0	60	.00	58.61
		3	0	75	.040	73.38
		2	0	57	.034	55.76
		2	1	72	.040	70.43
		2	0	64	.030	62.60
					Av .029	Av 64.15
15	W of Fresno, Whites Bridge Rd., near Hayes Ave.	7	2	129	.065	126.32
		5	1	108	.053	106.06
		10	0	168	.056	165.04
		8	4	180	.063	176.22
		6	4	140	.067	137.07
					Av .061	Av 141.96

TABLE E

Table E. Leaf injury ratings of Thompson seedless grapes in the San Joaquin Valley.

Location No.	Site	D	I	G	D+I / D+I+G
1	S of Arvin, Sebastion Rd., near Rancho Rd.	20	25	168	.211
		15	15	155	.162
		20	10	180	.143
		25	19	147	.210
		32	28	162	.270
					Av .199
1	N of Arvin, Wheeler Ridge Rd., near Hwy. 58	22	30	190	.206
		20	21	176	.189
		26	28	133	.289
		17	15	140	.186
		34	26	160	.273
					Av .229
3	W of Bakersfield, Hwy. 43, near 7th Standard Rd.	12	6	120	.130
		10	7	134	.113
		6	5	105	.095
		16	11	152	.151
		15	4	139	.120
					Av .122
5	W of Wasco, Jackson Ave., near Gun Club Rd.	14	5	153	.110
		6	6	110	.098
		11	10	133	.136
		9	6	150	.091
		14	6	160	.111
					Av .109
7	W of Porterville, Hwy. 190 near Brant Canal	8	9	138	.110
		18	14	145	.181
		11	6	129	.116
		20	19	162	.194
		8	12	146	.120
					Av .144
8	E of Tulare, Hwy. 63, near Cartmill Ave.	12	8	110	.154
		14	8	96	.186
		10	5	85	.150
		8	9	120	.124
		10	12	111	.160
					Av .155

Table E (continued)

Location No.	Site	D	I	G	D+I / D+I+G
8	W of Tulare on Hwy. 137, near Ave. 188	7 9 9 12 9	3 5 4 5 3	110 76 95 96 68	.090 .156 .120 .115 .150 Av .126
12	E of Dinuba, Mtn. View Ave., near Rd. 73	13 16 14 11 18	8 9 11 12 6	123 97 117 105 88	.146 .205 .176 .180 .214 Av .184
13	N of Riverdale, Elkhorn Ave., near Cornelia Ave.	4 3 2 8 7	5 3 1 4 3	129 108 168 180 140	.065 .052 .017 .063 .066 Av .053
14	Near Five Points NSFS	12 10 7 7 8	3 5 4 3 6	135 160 124 128 190	.100 .125 .082 .073 .112 Av .098
16	S of Madera, Ave. 7, near Rd. 23	5 4 7 2 5	4 6 5 3 5	120 60 108 75 98	.068 .142 .100 .062 .092 Av .093
15	W of Fresno, Whites Bridge, near Haynes Ave.	9 11 9 8 6	6 7 9 7 3	108 118 135 145 110	.122 .132 .118 .100 .076 Av .110

TABLE F

Table F. Statewide economic impact of improving ozone air quality (after R. Howitt, 1992).

Ozone Scenario	Benefits to Consumers	Benefits to Producers	Total
I. Estimated Value of Crops Sold Statewide ($ Millions)			
1990 Ozone levels	$4,533	$7,114	$11,647
Reduce to 0.04 ppm	$4,808	$7,329	$12,137
Reduce to 0.025 ppm[a]	$5,245	$7,893	$13,138
II. Net Benefits of Improving Ozone Air Quality ($ Millions)			
0.04 ppm vs. 1990	$275	$215	$490
0.025 ppm vs. 1990	$713	$779	$1,492

[a]An ambient concentration of ozone at 0.025 ppm is characteristic of background levels in unpolluted locations in the world. It may not be possible to achieve this level of air quality throughout the State.

TABLE G

Table G. Relative comparison of economic impacts to costs estimated in 1984 ($ millions) (after R. Howitt, 1992)

Ozone Scenario	1990 Estimate	1984 Estimate	1990:1984 Ratio
0.04 ppm	$490	$206	2.38
0.025 ppm[a]	$1,492	$333	4.48

[a]An ambient concentration of ozone at 0.025 ppm is characteristic of background levels in unpolluted locations in the world. It may not be possible to achieve this level of air quality throughout the State.

TABLE H

Table H. Changes in regional producer surplus (after R. Howitt, 1992).

Region	1990 Ozone Levels	0.04 ppm Ozone	0.025 ppm Ozone[a]
I. Producer Surplus ($ millions)			
Sacramento	$392	$403	$427
North San Joaquin	$563	$562	$564
Central San Joaquin	$2,158	$2,285	$2,578
South San Joaquin	$653	$710	$982
Imperial	$525	$542	$513
South Coast	$2,533	$2,528	$2,523
North Coast	$191	$195	$187
North East	$59	$63	$70
South East	$40	$41	$49
Total	$7,114	$7,329	$7,893
II. Changes Relative to 1990 Ozone Levels ($ Millions)			
Sacramento	N/A[b]	$11	$35
North San Joaquin	N/A	-$1	$1
Central San Joaquin	N/A	$127	$420
South San Joaquin	N/A	$57	$329
Imperial	N/A	$17	-$12
South Coast	N/A	-$5	-$10
North Coast	N/A	$4	-$4
North East	N/A	$4	$11
South East	N/A	$1	$9
Total	N/A	$215	$779

[a]An ambient concentration of ozone at 0.025 ppm is characteristic of background levels in unpolluted locations in the world. It may not be possible to achieve this level of air quality throughout the State.

[b]N/A = not applicable.

TABLE I

Table I. Weibull and linear models that regress harvest dry weight on ozone exposure index, SUM06 (courtesy of E. H. Lee MANTECH, Corvallis, Oregon).

Crop	Study/ Moisture	Cultivar	r	c	a
Corn	A81MA	Pioneer	90.794	2.7534	
Corn	A81MA	PAG-397	92.529	4.2208	
Cotton	$+H_2O$ - C81C0+	Acala SJ-2	75.014	1.7887	997.16
Cotton	$-H_2O$ - C81CO.	Acala SJ-2	100.17	2.1261	632.47
Cotton	C82CO+	Acala SJ-2	74.210	1.1316	197.53
Cotton	C82CO-	Acala SJ-2	78.445	1.6769	177.93
Cotton	R82CO	Stoneville	87.908	1.7120	356.75
Cotton	R85CO+	Acala SJ-3	117.67	1.5227	
Cotton	R85CO-	Acala SJ-3	162.76	2.8632	
Kidney Bean	I80KB	Red Kidney	25.636	3.7503	
Kidney Bean	I82KB	Red Kidney	42.185	2.4081	
Lettuce	C83LD	Empire	53.352	5.2303	
Peanut	R8OPN	NC-6	97.905	2.1678	
Potato	P85PO	Norchip	91.247	1.0000	
Potato	P86PO	Norchip	89.611	1.3452	
Sorghum	A82SG	Dekalb	176.61	2.2720	
Soybean	A80SO	Corsoy	56.091	1.5130	
Soybean	A83GV	Amsoy-71	72.103	2.4926	
Soybean	A83CV	Corsoy	60.468	4.8496	
Soybean	A85SO+	Corsoy	126.89	3.4333	
Soybean	A85SO-	Corsoy	117.71	3.8306	
Soybean	A86SO+	Corsoy	123.25	3.3521	
Soybean	A86SO-	Corsoy	110.64	13.6555	

Table I (continued)

Soybean	B83SO+	Corsoy	63.834	1.2118	
Soybean	B83SO-	Corsoy	122.18	0.7113	
Soybean	B83SO+	Williams	74.583	1.2650	
Soybean	B83SO-	Williams	95.030	1.4967	
Soybean	T8150	Hodgson	93.548	1.0000	
Soybean	R81SO	Davis	131.94	1.2076	
Soybean	R82SO	Davis	83.484	1.5129	
Soybean	R83SO+	Davis	169.23	1.1598	
Soybean	R83SO-	Davis	254.11	1.0000	
Soybean	R84SO	Davis	99.567	1.9385	
Soybean	R86SO	Young	179.55	1.3357	
Tobacco	R83TO	McNair 944	172.55	1.1507	
Turnip	R80TN	Just Right	26.345	1.3227	
Turnip	R80TN	Purple Top	28.722	1.4976	
Turnip	RSOTN	Shogoin	30.406	1.1065	
Turnip	R80TN	Tokyo Cross	27.368	2.0765	
Wheat	A82WH	Abe	58.259	2.1375	
Wheat	A82WH	Arthur 71	59.711	2.1465	
Wheat	A83WH	Abe	42.412	7.2845	
Wheat	A83WH	Arthur 71	73.129	2.0666	
Wheat	I82WH	Vona	27.130	1.0000	
Wheat	I83WH	Vona	29.537	1.3294	

Table I (continued)

Linear models: Y-A + B*SUM06 → PRYL = B*SUM06/A					
Crop	Study/ Moisture	Cultivar	A	B	
Barley	C83BA+	CM-72	8784.36	0.0000	
Barley	C83BA-	CM-72	7739.05	-4.4243	
Linear models: LN(Y) = A + B*SUM06 → PRYL = 1-exp(B*SUM06)					
Cotton	C85CO	Acala SJ-2	5.789	-0.0018	
Cotton	C85CO-	Acala SJ-2	5.645	-0.0011	

Moisture stress (+) denotes well-watered plants and moisture stress (-) denotes drought-stressed plants.

TABLE J

08:02:04. BASE7=2.720 BASE12=2.500 BASET=542.0 BASEYR= 0 STANDARD1=99.000

Predictive equation

CROP	COUNTY	TONS	>10	7HR	12HR	-------- INDEX (1)	(2)	(3)	(4) --------	---------- TONS (1)	(2)	------------ (3)	(4) STD
ALFALFA HAY	ALAMEDA	11164	15.0	4.0	3.7	5.5	0.1	4.4	4.4	11817	11180	11673	11679
ALFALFA HAY	AMADOR	739	40.0	6.0	3.5	4.8	0.4	3.8	3.8	776	742	768	768
ALFALFA HAY	BUTTE	17458	0.0	4.2	3.5	5.0	0.0	3.9	4.0	18368	17458	18168	18176
ALFALFA HAY	COLUSA	65380	0.0	4.2	3.5	5.0	0.0	3.9	4.0	68787	65380	68040	68069
ALFALFA HAY	CONTRA COSTA	18000	3.0	3.6	2.8	1.5	0.03	1.2	1.2	18270	18005	18212	18214
ALFALFA HAY	FRESNO-E	519915	172.0	6.2	5.3	13.4	1.6	10.6	10.7	600231	528328	581326	582046
ALFALFA HAY	FRESNO-W	165085	172.0	6.2	5.3	13.4	1.6	10.6	10.7	190587	167756	184584	184813
ALFALFA HAY	GLENN	117975	0.0	4.2	3.5	5.0	0.0	3.9	4.0	124122	117975	122775	122828
ALFALFA HAY	HUMBOLDT	1189	0.0	3.7	2.8	1.3	0.0	1.0	1.0	1204	1189	1201	1201
ALFALFA HAY	IMPERIAL	1665915	3.0	3.5	3.2	3.5	0.03	2.7	2.8	1725910	1666378	1712924	1713430
ALFALFA HAY	INYO	25440	-NA-	5.4	4.0	7.0	0.03	5.6	5.6	27369	25447	26939	26955
ALFALFA HAY	KERN	795000	199.5	6.2	5.2	13.0	1.8	10.2	10.3	913292	809960	885553	886611
ALFALFA HAY	KINGS-E	245569	183.0	5.3	4.5	9.4	1.7	7.4	7.5	271133	249801	265318	265542
ALFALFA HAY	KINGS-W	33170	183.0	5.3	4.5	9.4	1.7	7.4	7.5	36623	33742	35838	35868
ALFALFA HAY	LAKE	1500	0.0	3.0	2.5	-0.10	0.0	-0.08	-0.08	1500	1500	1500	1500
ALFALFA HAY	LASSEN	142600	0.0	4.5	3.1	2.7	0.0	2.1	2.1	146507	142600	145667	145699
ALFALFA HAY	LOS ANGELES	50400	496.0	6.1	5.6	14.5	4.6	11.5	11.6	58964	52826	56927	57005
ALFALFA HAY	MADERA	243750	55.0	5.6	5.1	12.1	0.5	9.6	9.7	277439	244898	269595	269894
ALFALFA HAY	MERCED	478000	25.0	4.1	3.6	5.0	0.2	4.0	4.0	503410	479109	497839	498055
ALFALFA HAY	MODOC	123500	0.0	4.4	3.2	3.5	0.0	2.8	2.8	128011	123500	127034	127072
ALFALFA HAY	MONO	37675	-NA-	5.3	3.2	3.4	0.0	2.7	2.7	38993	37675	38708	38719
ALFALFA HAY	MONTEREY	21900	0.0	3.4	3.0	2.2	0.0	1.7	1.7	22390	21900	22285	22289
ALFALFA HAY	PLUMAS	21175	0.0	4.8	3.2	3.2	0.0	2.6	2.6	21884	21175	21731	21736
ALFALFA HAY	RIVERSIDE	289960	3.0	3.7	3.1	3.0	0.03	2.3	2.4	298781	290041	296880	296954
ALFALFA HAY	SACRAMENTO	43400	43.0	5.3	4.1	7.8	0.4	6.1	6.2	47052	43573	46233	46265
ALFALFA HAY	SAN BENITO	22400	0.0	3.9	3.5	4.5	0.0	3.6	3.6	23461	22400	23230	23239
ALFALFA HAY	SAN BERNARDINO	129600	1038.0	6.8	5.1	12.4	9.6	9.8	9.9	147913	143378	143640	143803
ALFALFA HAY	SAN JOAQUIN	447000	1.0	3.2	2.5	0.05	0.01	0.04	0.04	447213	447041	447168	447170
ALFALFA HAY	SAN LUIS OBISP	32500	2.5	3.4	2.9	2.0	0.02	1.6	1.6	33163	32508	33021	33027
ALFALFA HAY	SANTA BARBARA	28584	33.3	4.2	3.6	5.4	0.3	4.2	4.3	30210	28672	29852	29866
ALFALFA HAY	SANTA CLARA	6188	0.0	3.9	3.5	4.5	0.0	3.6	3.6	6481	6188	6417	6420
ALFALFA HAY	SHASTA	65500	0.0	4.0	3.9	6.6	0.0	5.2	5.3	70143	65500	69111	69151
ALFALFA HAY	SIERRA	2092	10.0	6.0	4.3	8.6	0.09	6.8	6.9	2289	2094	2245	2246
ALFALFA HAY	SISKIYOU	371695	0.0	4.5	3.1	2.7	0.0	2.1	2.1	381878	371695	379688	379774
ALFALFA HAY	SOLANO	100531	6.0	3.7	3.0	2.6	0.06	2.0	2.1	103184	100587	102614	102636
ALFALFA HAY	STANISLAUS	232000	25.0	4.1	3.6	5.0	0.2	4.0	4.0	244333	232538	241629	241734
ALFALFA HAY	SUTTER	30509	0.0	4.2	3.5	5.0	0.0	3.9	4.0	32099	30509	31750	31764
ALFALFA HAY	TEHAMA	23200	0.0	4.2	3.5	5.0	0.0	3.9	4.0	24409	23200	24144	24154
ALFALFA HAY	TRINITY	270	0.0	3.0	2.3	-1.1	0.0	-0.9	-0.9	270	270	270	270
ALFALFA HAY	TULARE	795000	183.0	5.8	4.9	11.6	1.7	9.1	9.2	899030	808701	874928	875850
ALFALFA HAY	YOLO	[illegible]	3.0	3.6	3.0	2.5	0.03	2.0	2.0	185686	181050	184680	184719
ALFALFA HAY	YUBA	5374	0.0	4.2	3.5	5.0	0.0	3.9	4.0	5654	5374	5593	5595
	STATEWIDE	7609302								8190836	7673943	8057698	8062806
	STATEWIDE % LOSS									7.100	0.842	5.565	5.625
ALFALFA SEED	FRESNO-E	7191	147.5	6.7	5.6	14.9	1.4	11.7	11.9	8446	7291	8147	8158
ALFALFA SEED	FRESNO-W	5491	147.5	6.2	5.6	14.9	1.4	11.7	11.9	6449	5567	6221	6229
ALFALFA SEED	GLENN	49	0.0	4.3	3.7	5.5	0.0	4.4	4.4	52	49	51	51
ALFALFA SEED	IMPERIAL	4223	1.0	3.6	2.6	0.6	0.01	0.5	0.5	4247	4223	4242	4242
ALFALFA SEED	KINGS-E	6146	182.0	5.4	4.9	11.6	1.7	9.2	9.3	6954	6251	6767	6774
ALFALFA SEED	KINGS-W	830	182.0	5.4	4.9	11.6	1.7	9.2	9.3	939	844	914	915
ALFALFA SEED	LASSEN	141	0.0	4.5	3.1	2.7	0.0	2.1	2.1	145	141	144	144
	STATEWIDE	24071								[illegible]	24366	26486	26513
	STATEWIDE % LOSS									11.608	1.211	9.118	9.211
ALMONDS	BUTTE	17200	0.0	4.3	3.7	0.0				17200			
ALMONDS	CALAVERAS	4	25.0	4.2	3.8	0.0				4			
ALMONDS	COLUSA	8100	0.0	4.3	3.7	0.0				8100			
ALMONDS	CONTRA COSTA	20	3.0	3.6	2.8	0.0				20			
ALMONDS	FRESNO-E	17249	147.5	6.2	5.6	0.0				17249			
ALMONDS	FRESNO-W	4951	147.5	6.2	5.6	0.0				4951			
ALMONDS	GLENN	5402	0.0	4.3	3.7	0.0				5402			
ALMONDS	KERN	63000	175.5	6.2	5.6	0.0				63000			
ALMONDS	KINGS-E	683	182.0	5.4	4.9	0.0				683			
ALMONDS	KINGS-W	1337	182.0	5.4	4.9	0.0				1337			
ALMONDS	LAKE	3	0.0	3.0	2.5	0.0				3			
ALMONDS	MADERA	22653	41.0	5.7	5.4	0.0				22653			
ALMONDS	MERCED	40100	25.0	4.2	3.8	0.0				40100			
ALMONDS	SAN JOAQUIN	21000	1.0	3.2	2.6	0.0				21000			
ALMONDS	SAN LUIS OBISP	99	0.0	3.6	3.1	0.0				99			
ALMONDS	SOLANO	434	6.0	3.6	3.2	0.0				434			
ALMONDS	STANISLAUS	42714	25.0	4.2	3.8	0.0				42714			
ALMONDS	SUTTER	1989	0.0	4.3	3.7	0.0				1989			
ALMONDS	TEHAMA	2030	0.0	4.3	3.7	0.0				2030			
ALMONDS	TULARE	6060	182.0	5.9	5.4	0.0				6060			
ALMONDS	YOLO	3132	3.0	3.6	3.1	0.0				3132			
ALMONDS	YUBA	858	0.0	4.3	3.7	0.0				858			
	STATEWIDE	259018								259018			
	STATEWIDE % LOSS									NO DATA			
APPLES	BUTTE	890	0.0	4.5	3.5	0.0				890			
APPLES	CALAVERAS	500	1.0	3.5	2.5	0.0				500			
APPLES	CONTRA COSTA	12440	3.0	3.9	2.6	0.0				12440			
APPLES	EL DORADO	16500	10.0	5.6	4.6	0.0				16500			
APPLES	HUMBOLDT	173	-NA-	4.4	3.3	0.0				173			
APPLES	KERN	39000	199.5	6.9	5.1	0.0				39000			
APPLES	KINGS	2072	183.0	6.0	4.4	0.0				2072			
APPLES	LAKE	23	0.0	2.9	2.4	0.0				23			
APPLES	MADERA	9965	55.0	6.2	5.0	0.0				9965			
APPLES	MARIPOSA	1384	56.0	5.4	5.2	0.0				1384			
APPLES	MENDOCINO	9643	-NA-	2.9	2.4	0.0				9643			
APPLES	MONTEREY	5010	0.0	3.5	2.9	0.0				5010			
APPLES	NEVADA	197	10.0	5.6	4.6	0.0				197			
APPLES	PLACER	482	8.0	5.2	4.3	0.0				482			
APPLES	RIVERSIDE	61	1151.0	6.6	5.2	0.0				61			
APPLES	SAN BENITO	9095	0.0	4.2	3.4	0.0				9095			
APPLES	SAN BERNARDINO	363	2841.0	8.9	6.1	0.0				363			
APPLES	SAN DIEGO	1034	78.0	5.7	4.3	0.0				1034			
APPLES	SAN JOAQUIN	20500	1.0	3.5	2.5	0.0				20500			
APPLES	SAN LUIS OBISP	4151	0.0	3.9	3.0	0.0				4151			
APPLES	SANTA CRUZ	64800	0.0	3.8	3.0	0.0				64800			
APPLES	SONOMA	69259	0.0	3.3	2.6	0.0				69259			
APPLES	STANISLAUS	7480	40.5	5.0	4.4	0.0				7480			
APPLES	SUTTER	4549	0.0	4.5	3.5	0.0				4549			
APPLES	TULARE	2160	183.0	6.6	4.8	0.0				2160			
APPLES	TUOLUMNE	279	25.0	4.5	3.5	0.0				279			
	STATEWIDE	282010								282010			
	STATEWIDE % LOSS									NO DATA			

APRICOTS	CONTRA COSTA	5800	3.0	3.6	2.7	0.0				5800			
APRICOTS	FRESNO-E	2528	172.0	6.2	5.3	0.0				2528			
APRICOTS	FRESNO-W	565	172.0	6.7	5.3	0.0				565			
APRICOTS	KERN	2000	199.5	6.2	5.2	0.0				2000			
APRICOTS	KINGS-E	1499	183.0	5.3	4.5	0.0				1499			
APRICOTS	KINGS-W	731	183.0	5.3	4.5	0.0				731			
APRICOTS	MERCED	8630	54.0	5.4	5.2	0.0				8630			
APRICOTS	RIVERSIDE	51	1650.0	7.2	5.7	0.0				51			
APRICOTS	SAN BENITO	7920	0.0	3.9	3.5	0.0				7920			
APRICOTS	SAN JOAQUIN	18800	3.0	3.7	3.0	0.0				18800			
APRICOTS	SANTA CLARA	2625	21.0	4.8	3.8	0.0				2625			
APRICOTS	SOLANO	3366	6.0	3.7	3.0	0.0				3366			
APRICOTS	STANISLAUS	71800	25.0	4.1	3.6	0.0				71800			
APRICOTS	TULARE	3510	183.0	5.8	4.9	0.0				3510			
APRICOTS	YOLO	3148	3.0	3.6	3.0	0.0				3148			
	STATEWIDE	132973								132973			
	STATEWIDE % LOSS									NO DATA			
ARTICHOKES	MONTEREY	50480	0.0	3.2	3.1	0.0				50480			
ARTICHOKES	SAN MATEO	3900	0.0	2.5	2.5	0.0				3900			
ARTICHOKES	SANTA BARBARA	7875	10.0	3.5	3.3	0.0				7875			
ARTICHOKES	SANTA CRUZ	2552	0.0	3.5	3.2	0.0				2552			
	STATEWIDE	64807								64807			
	STATEWIDE % LOSS									NO DATA			
ASPARAGUS	CONTRA COSTA	3160	7.0	4.5	3.7	0.0				3160			
ASPARAGUS	IMPERIAL	8390	1.0	4.0	3.0	0.0				8390			
ASPARAGUS	KERN	2000	355.0	6.8	5.6	0.0				2000			
ASPARAGUS	MONTEREY	15450	0.0	3.4	2.9	0.0				15450			
ASPARAGUS	ORANGE	2282	148.0	4.7	3.6	0.0				2282			
ASPARAGUS	RIVERSIDE	766	1.0	3.6	3.1	0.0				766			
ASPARAGUS	SACRAMENTO	560	43.0	5.1	4.3	0.0				560			
ASPARAGUS	SAN JOAQUIN	27875	3.5	3.7	3.0	0.0				27875			
ASPARAGUS	YOLO	598	3.5	3.5	3.1	0.0				598			
	STATEWIDE	61081								61081			
	STATEWIDE % LOSS									NO DATA			
AVOCADOS	LOS ANGELES	45	589.0	6.0	3.8	0.0				45			
AVOCADOS	MONTEREY	77	0.0	3.5	2.9	0.0				77			
AVOCADOS	ORANGE	4026	144.0	5.0	3.4	0.0				4026			
AVOCADOS	RIVERSIDE	13000	909.3	7.1	4.9	0.0				13000			
AVOCADOS	SAN BERNARDINO	322	2841.0	8.9	6.1	0.0				322			
AVOCADOS	SAN DIEGO	80942	78.0	5.7	4.3	0.0				80942			
AVOCADOS	SAN LUIS OBISP	4646	0.0	4.0	3.4	0.0				4646			
AVOCADOS	SANTA BARBARA	20739	2.7	4.5	3.7	0.0				20739			
AVOCADOS	SANTA CRUZ	89	0.0	3.7	2.9	0.0				89			
AVOCADOS	TULARE	3770	183.0	6.8	4.6	0.0				3770			
AVOCADOS	VENTURA	36180	110.0	6.6	4.8	0.0				36180			
	STATEWIDE	163836								163836			
	STATEWIDE % LOSS									NO DATA			
BARLEY	ALAMEDA	373	0.0	3.3	3.9	0.0				373			
BARLEY	BUTTE	3960	0.0	3.0	4.4	0.0				3960			
BARLEY	COLUSA	1625	0.0	3.0	4.4	0.0				1625			
BARLEY	CONTRA COSTA	510	0.0	2.5	3.4	0.0				510			
BARLEY	FRESNO-E	14155	18.0	4.7	6.3	0.0				14155			
BARLEY	FRESNO-W	36580	18.0	4.7	6.3	0.0				36580			
BARLEY	GLENN	3527	0.0	3.0	4.4	0.0				3527			
BARLEY	KERN	42000	26.5	4.3	6.5	0.0				42000			
BARLEY	KINGS-E	18032	2.0	3.4	5.9	0.0				18032			
BARLEY	KINGS-W	35796	2.0	3.4	5.9	0.0				35796			
BARLEY	LASSEN	1320	0.0	4.5	3.6	0.0				1320			
BARLEY	LOS ANGELES	63	106.0	4.2	6.9	0.0				63			
BARLEY	MADERA	6992	3.0	4.3	6.0	0.0				6992			
BARLEY	MERCED	5030	0.0	2.8	4.4	0.0				5030			
BARLEY	MODOC	41400	0.0	4.5	3.6	0.0				41400			
BARLEY	MONTEREY	19958	0.0	3.1	3.3	0.0				19958			
BARLEY	ORANGE	488	7.0	3.5	4.4	0.0				488			
BARLEY	RIVERSIDE	340	161.0	4.8	7.3	0.0				340			
BARLEY	SACRAMENTO	1650	2.0	3.4	5.4	0.0				1650			
BARLEY	SAN BENITO	8800	0.0	3.6	3.7	0.0				8800			
BARLEY	SAN BERNARDINO	120	143.0	4.7	6.8	0.0				120			
BARLEY	SAN DIEGO	345	33.0	3.9	4.1	0.0				345			
BARLEY	SAN JOAQUIN	7530	0.0	2.2	3.1	0.0				7530			
BARLEY	SAN LUIS OBISP	38250	0.0	3.0	3.5	0.0				38250			
BARLEY	SAN MATEO	300	0.0	2.4	2.8	0.0				300			
BARLEY	SANTA BARBARA	533	41.0	3.7	4.1	0.0				533			
BARLEY	SANTA CLARA	1500	0.0	3.6	3.8	0.0				1500			
BARLEY	SHASTA	1360	0.0	4.3	3.8	0.0				1360			
BARLEY	SISKIYOU	87191	0.0	4.5	3.6	0.0				87191			
BARLEY	SOLANO	39026	0.0	2.7	3.5	0.0				39026			
BARLEY	STANISLAUS	9890	0.0	2.8	4.4	0.0				9890			
BARLEY	SUTTER	8160	0.0	3.0	4.4	0.0				8160			
BARLEY	TEHAMA	600	0.0	3.0	4.4	0.0				600			
BARLEY	TULARE	39400	2.0	3.8	6.5	0.0				39400			
BARLEY	YOLO	5385	-NA-	3.0	3.4	0.0				5385			
	STATEWIDE	482189								482189			
	STATEWIDE % LOSS									0.000			
BEANS-DRY	BUTTE	2700	0.0	4.8	3.3	0.0	15.0	-11.7	5.4	2700	3177	2700	2855
BEANS-DRY	COLUSA	10403	0.0	4.6	3.4	0.0	13.9	-13.1	6.2	10403	12081	10403	11089
BEANS-DRY	FRESNO-E	8758	64.5	7.3	4.7	1.5	31.9	-24.7	15.7	8896	12856	8758	10387
BEANS-DRY	FRESNO-W	3142	64.5	7.3	4.7	1.5	31.9	-24.7	15.7	3191	4612	3142	3727
BEANS-DRY	GLENN	5306	0.0	5.6	2.5	0.0	20.8	-0.9	0.4	5306	6698	5306	5325
BEANS-DRY	KERN	15000	92.5	7.4	5.5	2.2	32.5	-26.7	20.9	15341	22236	15000	18961
BEANS-DRY	KINGS-E	2500	156.0	7.4	3.5	3.7	32.7	-14.4	7.0	2597	3716	2500	2687
BEANS-DRY	MADERA	3367	21.0	6.7	4.6	0.5	28.0	-24.1	14.8	3384	4677	3367	3954
BEANS-DRY	MERCED	5470	28.0	5.9	4.9	0.7	22.9	-25.6	17.2	5507	7091	5470	6603
BEANS-DRY	MONTEREY	3216	0.0	3.6	2.9	0.0	6.5	-6.6	2.9	3216	3438	3216	3312
BEANS-DRY	ORANGE	542	2778.0	9.5	6.2	66.7	44.1	-25.6	26.3	1626	969	542	735
BEANS-DRY	RIVERSIDE	43	555.0	8.6	4.6	13.3	39.1	-23.9	14.6	50	71	43	50
BEANS-DRY	SAN JOAQUIN	27707	1.0	3.7	1.7	0.02	7.6	18.3	-5.8	27714	29975	33106	27707
BEANS-DRY	SAN LUIS OBISP	92	10.7	3.7	3.0	0.3	7.1	-8.5	3.8	92	99	92	96
BEANS-DRY	SAN MATEO	35	0.0	3.2	2.1	0.0	3.7	8.2	-3.1	35	36	38	35
BEANS-DRY	SANTA BARBARA	2754	0.0	4.2	3.5	0.0	11.0	-14.2	6.8	2754	3095	2754	2956
BEANS-DRY	SANTA CLARA	906	7.0	5.1	3.8	0.2	17.3	-17.9	9.2	908	1096	906	998
BEANS-DRY	SOLANO	15750	5.0	4.0	2.4	0.1	9.8	2.3	-0.9	15769	17470	16121	15750
BEANS-DRY	STANISLAUS	39820	39.0	5.0	4.4	0.9	17.0	-22.5	13.1	40196	47972	39820	45814
BEANS-DRY	SUTTER	17725	0.0	4.8	3.2	0.0	15.2	-10.5	4.8	17725	20911	17725	18815
BEANS-DRY	TEHAMA	1000	0.0	5.1	3.4	0.0	17.1	-13.6	6.5	1000	1206	1000	1069
BEANS-DRY	TULARE	19300	182.0	7.6	4.0	4.4	33.3	-19.2	10.2	20182	28948	19300	21492
BEANS-DRY	YOLO	1615	3.5	3.8	2.9	0.08	8.5	-6.9	3.0	1616	1764	1615	1665
	STATEWIDE	187151								190208	234194	192924	205887
	STATEWIDE % LOSS									1.607	20.087	2.992	9.098

BROCCOLI	FRESNO-E	17908	107.5	5.8	5.7	-22.6	0.0	0.0	0.0	17908	17908	17908	17908
BROCCOLI	FRESNO-W	27892	107.5	5.8	5.7	-22.6	0.0	0.0	0.0	27892	27892	27892	27892
BROCCOLI	IMPERIAL	59163	2.0	3.4	3.3	-6.0	0.0	0.0	0.0	59163	59163	59163	59163
BROCCOLI	KINGS-E	290	13.0	3.8	5.0	-17.4	0.0	0.0	0.0	290	290	290	290
BROCCOLI	KINGS-W	3580	13.0	3.8	5.0	-17.4	0.0	0.0	0.0	3580	3580	3580	3580
BROCCOLI	MONTEREY	311656	0.0	3.2	3.1	-4.1	0.0	0.0	0.0	311656	311656	311656	311656
BROCCOLI	RIVERSIDE	15616	2.0	3.4	3.3	-6.0	0.0	0.0	0.0	15616	15616	15616	15616
BROCCOLI	SAN BENITO	8100	0.0	3.8	3.5	-7.4	0.0	0.0	0.0	8100	8100	8100	8100
BROCCOLI	SAN LUIS OBISP	50403	5.0	3.9	3.6	-7.5	0.0	0.0	0.0	50403	50403	50403	50403
BROCCOLI	SANTA BARBARA	119189	33.3	4.0	3.8	-9.2	0.0	0.0	0.0	119189	119189	119189	119189
BROCCOLI	SANTA CLARA	2600	0.0	3.8	3.5	-7.4	0.0	0.0	0.0	2600	2600	2600	2600
BROCCOLI	STANISLAUS	3630	25.0	3.7	3.9	-9.6	0.0	0.0	0.0	3630	3630	3630	3630
BROCCOLI	VENTURA	13879	69.0	4.9	4.4	-13.7	0.0	0.0	0.0	13879	13879	13879	13879
	STATEWIDE	633906								633906	633906	633906	633906
	STATEWIDE % LOSS									0.000	0.000	0.000	0.000
CANTALOUPES	FRESNO-E	130203	77.0	6.7	6.3	40.1				217304			
CANTALOUPES	FRESNO-W	202797	77.0	6.7	6.3	40.1				338461			
CANTALOUPES	IMPERIAL	279506	3.0	3.8	3.1	10.9				313587			
CANTALOUPES	KERN	23000	95.5	6.3	6.5	35.9				35879			
CANTALOUPES	KINGS-E	872	116.0	6.1	5.8	33.5				1311			
CANTALOUPES	KINGS-W	10749	116.0	6.1	5.8	33.5				16164			
CANTALOUPES	MERCED	54810	12.0	5.5	5.1	27.5				75620			
CANTALOUPES	RIVERSIDE	41040	119.0	6.3	7.8	35.5				63624			
CANTALOUPES	SAN BERNARDINO	34	5.0	6.0	7.6	32.4				50			
CANTALOUPES	STANISLAUS	24800	10.0	4.9	4.9	22.0				31553			
	STATEWIDE	767611								1093553			
	STATEWIDE % LOSS									29.806			
CARROTS	FRESNO-E	21075	172.0	5.6	5.7	0.0				21075			
CARROTS	FRESNO-W	32825	172.0	5.6	5.7	0.0				32825			
CARROTS	IMPERIAL	301585	2.0	3.4	3.3	0.0				301585			
CARROTS	KERN	708000	202.0	5.5	5.7	0.0				708000			
CARROTS	MONTEREY	144730	0.0	3.2	3.1	0.0				144730			
CARROTS	RIVERSIDE	27599	88.0	4.6	6.2	0.0				27599			
CARROTS	SAN LUIS OBISP	93960	13.5	3.9	3.3	0.0				93960			
CARROTS	SANTA BARBARA	102168	33.3	4.0	3.8	0.0				102168			
	STATEWIDE	1431942								1431942			
	STATEWIDE % LOSS									NO DATA			
CAULIFLOWER	IMPERIAL	37848	2.0	3.4	3.3	0.0				37848			
CAULIFLOWER	MONTEREY	139350	2.5	3.5	3.4	0.0				139350			
CAULIFLOWER	ORANGE	5064	43.0	3.8	4.0	0.0				5064			
CAULIFLOWER	RIVERSIDE	3666	3.0	3.9	3.6	0.0				3666			
CAULIFLOWER	SAN BENITO	2948	0.0	3.8	3.5	0.0				2948			
CAULIFLOWER	SAN DIEGO	4225	29.0	4.0	4.2	0.0				4225			
CAULIFLOWER	SAN JOAQUIN	5670	1.0	2.9	2.7	0.0				5670			
CAULIFLOWER	SAN LUIS OBISP	14062	13.5	3.8	3.4	0.0				14062			
CAULIFLOWER	SANTA BARBARA	63063	33.3	4.0	3.8	0.0				63063			
CAULIFLOWER	SANTA CRUZ	3527	0.0	3.5	3.2	0.0				3527			
CAULIFLOWER	STANISLAUS	4720	11.0	3.5	4.0	0.0				4720			
CAULIFLOWER	VENTURA	7638	58.0	4.8	4.5	0.0				7638			
	STATEWIDE	291781								291781			
	STATEWIDE % LOSS									NO DATA			
CELERY	MONTEREY	168520	0.0	3.3	3.0	0.0				168520			
CELERY	ORANGE	13559	2.0	2.9	2.5	0.0				13559			
CELERY	RIVERSIDE	5214	162.0	4.6	6.0	0.0				5214			
CELERY	SAN BENITO	24472	0.0	3.8	3.5	0.0				24472			
CELERY	SAN DIEGO	1836	67.0	4.0	3.9	0.0				1836			
CELERY	SAN LUIS OBISP	39327	5.0	4.0	3.5	0.0				39327			
CELERY	SANTA BARBARA	111538	33.3	4.1	3.8	0.0				111538			
CELERY	SANTA CLARA	4500	21.0	4.8	3.8	0.0				4500			
CELERY	SANTA CRUZ	8426	0.0	3.5	3.2	0.0				8426			
CELERY	VENTURA	327739	69.0	4.9	4.4	0.0				327739			
	STATEWIDE	705131								705131			
	STATEWIDE % LOSS									0.000			
CHERRIES	CONTRA COSTA	767	7.0	4.6	3.6	0.0				767			
CHERRIES	EL DORADO	160	10.0	5.2	4.6	0.0				160			
CHERRIES	RIVERSIDE	58	1161.0	6.1	5.4	0.0				58			
CHERRIES	SAN BENITO	1400	0.0	4.0	3.4	0.0				1400			
CHERRIES	SAN JOAQUIN	20200	1.0	3.2	2.5	0.0				20200			
CHERRIES	SANTA CLARA	2853	21.0	4.8	3.8	0.0				2853			
CHERRIES	SOLANO	53	6.0	3.7	3.0	0.0				53			
CHERRIES	STANISLAUS	3740	25.0	4.1	3.6	0.0				3740			
CHERRIES	SUTTER	48	0.0	4.2	3.5	0.0				48			
	STATEWIDE	29279								29279			
	STATEWIDE % LOSS									NO DATA			
CORN-GRAIN&SEE	AMADOR	2200	30.0	5.9	4.5	0.0				2200			
CORN-GRAIN&SEE	BUTTE	2700	0.0	4.7	3.6	0.0				2700			
CORN-GRAIN&SEE	COLUSA	18480	0.0	4.7	3.6	0.0				18480			
CORN-GRAIN&SEE	CONTRA COSTA	13500	3.0	5.0	4.0	0.0				13500			
CORN-GRAIN&SEE	FRESNO-E	4983	92.0	6.8	5.9	0.0				4983			
CORN-GRAIN&SEE	FRESNO-W	28017	92.0	6.8	5.9	0.0				28017			
CORN-GRAIN&SEE	GLENN	29464	0.0	4.7	4.0	0.0				29464			
CORN-GRAIN&SEE	KERN	20000	116.5	7.0	6.1	0.0				20000			
CORN-GRAIN&SEE	KINGS-E	36858	172.0	6.3	5.3	0.0				36858			
CORN-GRAIN&SEE	KINGS-W	4556	172.0	6.3	5.3	0.0				4556			
CORN-GRAIN&SEE	LASSEN	175	0.0	4.5	3.6	0.0				175			
CORN-GRAIN&SEE	MADERA	41990	25.0	6.3	5.6	0.0				41990			
CORN-GRAIN&SEE	MERCED	38400	31.0	5.6	5.1	0.0				38400			
CORN-GRAIN&SEE	MONTEREY	3476	0.0	3.6	2.9	0.0				3476			
CORN-GRAIN&SEE	RIVERSIDE	636	673.0	7.9	5.7	0.0				636			
CORN-GRAIN&SEE	SACRAMENTO	108000	42.0	5.9	3.9	0.0				108000			
CORN-GRAIN&SEE	SAN JOAQUIN	254000	0.0	3.3	2.9	0.0				254000			
CORN-GRAIN&SEE	SOLANO	136290	6.0	3.8	3.3	0.0				136290			
CORN-GRAIN&SEE	STANISLAUS	6000	22.5	5.0	4.8	0.0				6000			
CORN-GRAIN&SEE	SUTTER	13728	0.0	4.7	4.0	0.0				13728			
CORN-GRAIN&SEE	TEHAMA	6160	0.0	4.7	4.0	0.0				6160			
CORN-GRAIN&SEE	TULARE	47700	172.0	6.9	5.8	0.0				47700			
CORN-GRAIN&SEE	YOLO	82000	3.5	3.6	3.0	0.0				82000			
CORN-GRAIN&SEE	YUBA	2016	0.0	4.7	4.0	0.0				2016			
	STATEWIDE	901329								901329			
	STATEWIDE % LOSS									NO DATA			
CORN-SWEET	CONTRA COSTA	6290	1.0	3.6	3.3	2.4				6444			
CORN-SWEET	HUMBOLDT	183	-NA-	4.5	3.6	3.0				189			
CORN-SWEET	KINGS	7929	116.0	6.5	5.2	7.7				8593			
CORN-SWEET	LOS ANGELES	1668	905.0	6.2	7.3	13.6				1932			
CORN-SWEET	ORANGE	3184	149.0	4.6	3.7	3.2				3291			
CORN-SWEET	RIVERSIDE	34753	3.0	4.1	3.4	2.6				35679			
CORN-SWEET	SACRAMENTO	2352	2.0	4.8	5.5	8.5				2569			
CORN-SWEET	SAN BERNARDINO	803	712.0	6.3	7.7	14.6				940			
CORN-SWEET	SAN DIEGO	1960	34.0	4.3	4.1	4.6				2055			
CORN-SWEET	SANTA CLARA	5500	7.0	4.8	4.2	4.9				5780			
CORN-SWEET	SUTTER	319	0.0	4.2	4.4	5.3				337			
CORN-SWEET	VENTURA	7986	66.0	5.3	4.8	6.4				8530			
	STATEWIDE	72927								76339			
	STATEWIDE % LOSS									4.470			

COTTON	FRESNO-E	53816	135.5	7.0	5.1	23.2	17.6	19.1	34.2	70036	65312	66498	81782
COTTON	FRESNO-W	186434	135.5	7.0	5.1	23.2	17.6	19.1	34.2	242626	226259	230368	283316
COTTON	IMPERIAL	7251	1.0	3.5	3.0	2.3	4.0	3.7	4.3	7423	7552	7530	7576
COTTON	KERN	159750	153.5	7.1	5.1	23.9	17.9	19.5	35.2	210004	194594	198381	246681
COTTON	KINGS-E	96579	182.0	6.5	4.2	19.4	16.0	17.0	29.1	119785	114987	116384	136154
COTTON	KINGS-W	50198	182.0	6.5	4.2	19.4	16.0	17.0	29.1	62259	50766	60492	70760
COTTON	MADERA	24949	38.0	6.4	4.9	18.7	15.7	16.7	28.2	30703	29604	29936	34753
COTTON	MERCED	37100	51.0	5.7	5.2	12.9	12.8	13.1	20.2	42602	42538	42686	46507
COTTON	RIVERSIDE	11928	1.0	3.5	3.0	2.3	4.0	3.7	4.3	12208	12421	12385	12461
COTTON	TULARE	75240	182.0	7.2	4.7	24.8	18.2	19.9	36.4	100048	92027	93956	118332
	STATEWIDE	703243								897694	845060	858616	1038330
	STATEWIDE % LOSS									21.661	16.782	18.096	32.272
GARLIC	FRESNO-E	3502	77.0	5.2	6.3	0.0				3502			
GARLIC	FRESNO-W	99498	77.0	5.2	6.3	0.0				99498			
GARLIC	KERN	22000	98.0	5.0	6.4	0.0				22000			
GARLIC	MONTEREY	2942	0.0	3.2	3.2	0.0				2942			
GARLIC	SAN BERNARDINO	4	698.0	5.5	6.4	0.0				4			
GARLIC	SANTA CLARA	3115	0.0	3.6	3.7	0.0				3115			
	STATEWIDE	131061								131061			
	STATEWIDE % LOSS									NO DATA			
GRAPEFRUIT	IMPERIAL	3356	1.0	3.7	3.0	0.0				3356			
GRAPEFRUIT	KERN	26000	199.5	6.9	5.1	0.0				26000			
GRAPEFRUIT	ORANGE	1801	144.0	5.0	3.4	0.0				1801			
GRAPEFRUIT	RIVERSIDE	115121	190.0	5.5	4.2	0.0				115121			
GRAPEFRUIT	SAN BERNARDINO	16508	2841.0	8.9	6.1	0.0				16508			
GRAPEFRUIT	SAN DIEGO	37513	78.0	5.7	4.3	0.0				37513			
GRAPEFRUIT	TULARE	2550	183.0	6.6	4.8	0.0				2550			
GRAPEFRUIT	VENTURA	17932	86.0	6.2	4.6	0.0				17932			
	STATEWIDE	220781								220781			
	STATEWIDE % LOSS									NO DATA			
GRAPES-ALL	ALAMEDA	7615	15.0	4.5	3.6	9.5	7.8			8414	8263		
GRAPES-ALL	AMADOR	6008	43.0	5.8	4.0	12.7	10.5			6881	6711		
GRAPES-ALL	CALAVERAS	350	1.0	3.5	2.5	-0.3	-0.3			350	350		
GRAPES-ALL	CONTRA COSTA	2091	3.0	3.9	2.6	0.9	0.8			2111	2107		
GRAPES-ALL	EL DORADO	2520	10.0	5.6	4.6	17.5	14.4			3054	2945		
GRAPES-ALL	FRESNO-E	1951555	172.0	6.8	5.2	22.9	18.9			2520969	2405716		
GRAPES-ALL	FRESNO-W	52095	172.0	6.8	5.2	22.9	18.9			67535	64218		
GRAPES-ALL	KERN	623680	199.5	6.9	5.1	22.2	18.3			801543	763595		
GRAPES-ALL	KINGS-E	29722	183.0	6.0	4.4	15.8	13.0			35300	34182		
GRAPES-ALL	KINGS-W	391	183.0	6.0	4.4	15.8	13.0			464	450		
GRAPES-ALL	LAKE	12143	0.0	2.9	2.4	-1.1	-0.9			12143	12143		
GRAPES-ALL	MADERA	737671	55.0	6.2	5.0	20.7	17.1			929960	889552		
GRAPES-ALL	MARIPOSA	54	56.0	5.4	5.2	22.7	18.7			70	66		
GRAPES-ALL	MENDOCINO	59168	-NA-	2.9	2.4	-1.1	-0.9			59168	59168		
GRAPES-ALL	MERCED	120889	56.0	5.4	5.2	22.7	18.7			156352	148743		
GRAPES-ALL	MONTEREY	89400	0.0	3.5	2.9	3.2	2.6			92350	91822		
GRAPES-ALL	NAPA	132849	0.0	3.5	2.3	-1.3	-1.0			132849	132849		
GRAPES-ALL	NEVADA	473	10.0	5.6	4.6	17.5	14.4			573	553		
GRAPES-ALL	PLACER	286	8.0	5.2	4.3	15.2	12.6			337	327		
GRAPES-ALL	RIVERSIDE	92673	1013.0	7.5	4.9	20.3	16.7			116214	111288		
GRAPES-ALL	SACRAMENTO	26000	43.0	5.8	4.0	12.7	10.5			29780	29044		
GRAPES-ALL	SAN BENITO	6970	0.0	4.2	3.4	7.6	6.2			7540	7434		
GRAPES-ALL	SAN BERNARDINO	11357	1013.0	7.5	4.9	20.3	16.7			14242	13638		
GRAPES-ALL	SAN DIEGO	391	78.0	5.7	4.3	14.8	12.2			459	445		
GRAPES-ALL	SAN JOAQUIN	388120	1.0	3.5	2.5	-0.3	-0.3			388120	388120		
GRAPES-ALL	SAN LUIS OBISP	42528	2.5	3.6	2.9	3.0	2.5			43855	43618		
GRAPES-ALL	SANTA BARBARA	28244	26.8	4.4	3.6	9.1	7.5			31064	30533		
GRAPES-ALL	SANTA CLARA	4125	22.0	5.0	3.7	9.7	8.0			4566	4483		
GRAPES-ALL	SANTA CRUZ	216	0.0	3.8	3.0	3.8	3.1			224	223		
GRAPES-ALL	SOLANO	8187	6.0	3.9	3.0	3.8	3.1			8509	8451		
GRAPES-ALL	SONOMA	129544	0.0	3.3	2.6	1.2	1.0			131087	130815		
GRAPES-ALL	STANISLAUS	152000	40.5	5.0	4.4	16.1	13.3			181251	175370		
GRAPES-ALL	TULARE	534380	183.0	6.6	4.8	19.5	16.1			663829	636941		
GRAPES-ALL	YOLO	9460	3.5	3.8	3.0	4.0	3.3			9858	9786		
	STATEWIDE	5763135								6470021	6213949		
	STATEWIDE % LOSS									18.654	15.301		
GRAPES-RAISIN	FRESNO-E	1596240	172.0	6.8	5.2	22.9	18.9			2069343	1967713		
GRAPES-RAISIN	FRESNO-W	42610	172.0	6.8	5.2	22.9	18.9			55239	52526		
GRAPES-RAISIN	KERN	227680	199.5	6.9	5.1	22.2	18.3			292610	278757		
GRAPES-RAISIN	KINGS-E	18076	183.0	6.0	4.4	15.8	13.0			21468	20789		
GRAPES-RAISIN	KINGS-W	238	183.0	6.0	4.4	15.8	13.0			283	274		
GRAPES-RAISIN	MADERA	236122	55.0	6.2	5.0	20.7	17.1			297672	284738		
GRAPES-RAISIN	MERCED	6149	56.0	5.4	5.2	22.7	18.7			7954	7567		
GRAPES-RAISIN	SAN BERNARDINO	1290	1013.0	7.5	4.9	20.3	16.7			1618	1549		
GRAPES-RAISIN	TULARE	284000	183.0	6.6	4.8	19.5	16.1			352797	338507		
	STATEWIDE	2412405								3098984	2952420		
	STATEWIDE % LOSS									22.155	18.291		
GRAPES-TABLE	FRESNO-E	75485	172.0	6.8	5.2	22.9	18.9			97858	93052		
GRAPES-TABLE	FRESNO-W	2015	172.0	6.8	5.2	22.9	18.9			2612	2484		
GRAPES-TABLE	KERN	152000	199.5	6.9	5.1	22.2	18.3			195348	186099		
GRAPES-TABLE	KINGS-E	4075	183.0	6.0	4.4	15.8	13.0			4840	4687		
GRAPES-TABLE	KINGS-W	54	183.0	6.0	4.4	15.8	13.0			64	62		
GRAPES-TABLE	MADERA	40549	55.0	6.2	5.0	20.7	17.1			51119	48898		
GRAPES-TABLE	RIVERSIDE	82554	190.0	6.8	7.3	40.0	33.0			137611	123283		
GRAPES-TABLE	SAN BERNARDINO	2600	1013.0	7.5	4.9	20.3	16.7			3260	3122		
GRAPES-TABLE	SAN JOAQUIN	9120	1.0	3.5	2.5	-0.3	-0.3			9120	9120		
GRAPES-TABLE	TULARE	155500	183.0	6.6	4.8	19.5	16.1			193169	185344		
	STATEWIDE	523952								695001	656151		
	STATEWIDE % LOSS									24.611	20.148		

GRAPES-WINE	ALAMEDA	7615	15.0	4.5	3.6	9.5	7.8			8414	8263		
GRAPES-WINE	AMADOR	6008	43.0	5.8	4.0	12.7	10.5			6881	6711		
GRAPES-WINE	CALAVERAS	350	1.0	3.5	2.5	-0.3	-0.3			350	350		
GRAPES-WINE	FRESNO-E	279830	172.0	6.8	5.2	22.9	18.9			362768	344951		
GRAPES-WINE	FRESNO-W	7470	172.0	6.8	5.2	22.9	18.9			9684	9208		
GRAPES-WINE	KERN	244000	199.5	6.9	5.1	22.2	18.3			313585	298738		
GRAPES-WINE	KINGS-E	7570	183.0	6.0	4.4	15.8	13.0			8991	8706		
GRAPES-WINE	KINGS-W	100	183.0	6.0	4.4	15.8	13.0			119	115		
GRAPES-WINE	LAKE	12143	0.0	2.9	2.4	-1.1	-0.9			12143	12143		
GRAPES-WINE	MADERA	461000	55.0	6.2	5.0	20.7	17.1			581169	555916		
GRAPES-WINE	MENDOCINO	59168	-NA-	2.9	2.4	-1.1	-0.9			59168	59168		
GRAPES-WINE	MERCED	114720	56.0	5.4	5.2	22.7	18.7			148398	141176		
GRAPES-WINE	MONTEREY	89400	0.0	3.5	2.9	3.2	2.6			92350	91822		
GRAPES-WINE	NAPA	132849	0.0	3.5	2.3	-1.3	-1.0			132849	132849		
GRAPES-WINE	NEVADA	473	10.0	5.6	4.6	17.5	14.4			573	553		
GRAPES-WINE	PLACER	286	8.0	5.2	4.3	15.2	12.6			337	327		
GRAPES-WINE	RIVERSIDE	10119	1013.0	7.5	4.9	20.3	16.7			12689	12152		
GRAPES-WINE	SACRAMENTO	26000	43.0	5.8	4.0	12.7	10.5			29780	29044		
GRAPES-WINE	SAN BENITO	6970	0.0	4.2	3.4	7.6	6.2			7540	7434		
GRAPES-WINE	SAN BERNARDINO	7467	1013.0	7.5	4.9	20.3	16.7			9384	8967		
GRAPES-WINE	SAN DIEGO	391	78.0	5.7	4.3	14.8	12.2			459	445		
GRAPES-WINE	SAN JOAQUIN	379000	1.0	3.5	2.5	-0.3	-0.3			379000	379000		
GRAPES-WINE	SAN LUIS OBISP	42528	2.5	3.6	2.9	3.0	2.5			43855	43618		
GRAPES-WINE	SANTA BARBARA	28244	26.8	4.4	3.6	9.1	7.5			31064	30533		
GRAPES-WINE	SANTA CLARA	4125	22.0	5.0	3.7	9.7	8.0			4566	4483		
GRAPES-WINE	SANTA CRUZ	216	0.0	3.8	3.0	3.8	3.1			224	223		
GRAPES-WINE	SOLANO	8187	6.0	3.9	3.0	3.8	3.1			8509	8451		
GRAPES-WINE	SONOMA	129544	0.0	3.3	2.6	1.2	1.0			131087	130815		
GRAPES-WINE	STANISLAUS	152000	40.5	5.0	4.4	16.1	13.3			181251	175370		
GRAPES-WINE	TULARE	94880	183.0	6.6	4.8	19.5	16.1			117864	113090		
GRAPES-WINE	YOLO	9460	3.5	3.8	3.0	4.0	3.3			9858	9786		
	STATEWIDE	2322113								2704889	2624407		
	STATEWIDE % LOSS									14.151	11.519		
KIWIFRUIT	BUTTE	11403	0.0	4.6	3.4	0.0				11403			
KIWIFRUIT	FRESNO-E	1403	160.0	6.8	5.1	0.0				1403			
KIWIFRUIT	FRESNO-W	37	160.0	6.8	5.1	0.0				37			
KIWIFRUIT	KERN	4000	177.5	6.9	5.0	0.0				4000			
KIWIFRUIT	KINGS-E	1951	183.0	6.2	4.2	0.0				1951			
KIWIFRUIT	KINGS-W	26	183.0	6.2	4.2	0.0				26			
KIWIFRUIT	LAKE	120	0.0	3.0	2.3	0.0				120			
KIWIFRUIT	MERCED	192	53.0	5.4	5.2	0.0				192			
KIWIFRUIT	MONTEREY	58	0.0	3.5	2.9	0.0				58			
KIWIFRUIT	PLACER	231	8.0	5.3	4.2	0.0				231			
KIWIFRUIT	RIVERSIDE	15	520.0	6.7	4.5	0.0				15			
KIWIFRUIT	SAN BERNARDINO	97	965.0	7.7	4.7	0.0				97			
KIWIFRUIT	SAN LUIS OBISP	257	0.0	3.6	2.8	0.0				257			
KIWIFRUIT	SANTA CLARA	172	20.0	4.9	3.6	0.0				172			
KIWIFRUIT	SOLANO	704	6.0	4.0	2.9	0.0				704			
KIWIFRUIT	STANISLAUS	961	39.0	5.0	4.4	0.0				961			
KIWIFRUIT	SUTTER	1675	0.0	4.6	3.4	0.0				1675			
KIWIFRUIT	TULARE	12300	183.0	6.8	4.6	0.0				12300			
KIWIFRUIT	YOLO	350	3.5	3.8	2.9	0.0				350			
KIWIFRUIT	YUBA	3268	0.0	4.6	3.4	0.0				3268			
	STATEWIDE	39220								39220			
	STATEWIDE % LOSS									NO DATA			
LEMONS	FRESNO-E	11300	172.0	6.8	6.8	10.5				12620			
LEMONS	IMPERIAL	9224	1.0	3.7	4.0	6.1				9823			
LEMONS	KERN	38000	199.5	6.9	6.7	10.4				42408			
LEMONS	ORANGE	9917	144.0	5.0	4.6	7.5				10719			
LEMONS	RIVERSIDE	66182	1.0	3.7	4.0	6.1				70480			
LEMONS	SAN BERNARDINO	1783	2841.0	8.9	8.5	11.7				2020			
LEMONS	SAN DIEGO	53890	78.0	5.7	4.9	8.2				58685			
LEMONS	SAN LUIS OBISP	17150	5.0	4.1	4.3	6.9				18427			
LEMONS	SANTA BARBARA	20012	26.8	4.4	3.9	6.0				21287			
LEMONS	TULARE	40700	183.0	6.6	6.8	10.5				45454			
LEMONS	VENTURA	377212	81.0	5.3	5.8	9.4				416299			
	STATEWIDE	645370								708222			
	STATEWIDE % LOSS									8.875			
LETTUCE	FRESNO-E	2729	107.0	5.2	5.6	0.0	5.6	0.06	0.0	2729	2889	2731	2729
LETTUCE	FRESNO-W	270171	107.0	5.2	5.6	0.0	5.6	0.06	0.0	270171	286057	270322	270171
LETTUCE	IMPERIAL	383093	2.0	3.3	3.4	0.0	0.1	0.00	0.0	383093	383491	383096	383093
LETTUCE	KERN	120500	128.5	5.0	5.6	0.0	6.7	0.04	0.0	120500	129111	120548	120500
LETTUCE	MONTEREY	1490265	2.5	3.6	3.3	0.0	0.1	0.00	0.0	1490265	1492201	1490293	1490265
LETTUCE	ORANGE	8991	62.0	3.7	3.8	0.0	3.2	0.00	0.0	8991	9290	8991	8991
LETTUCE	RIVERSIDE	246611	2.0	3.1	3.3	0.0	0.1	0.00	0.0	246611	246867	246612	246611
LETTUCE	SACRAMENTO	450	-NA-	2.8	3.3	0.0	0.1	0.00	0.0	450	450	450	450
LETTUCE	SAN BENITO	29490	0.0	3.8	3.5	0.0	0.0	0.00	0.0	29490	29490	29491	29490
LETTUCE	SAN BERNARDINO	343	346.0	4.0	5.6	0.0	18.0	0.00	0.0	343	418	343	343
LETTUCE	SAN LUIS OBISP	172782	22.0	3.6	3.4	0.0	1.1	0.00	0.0	172782	174778	172785	172782
LETTUCE	SAN MATEO	133	0.0	2.8	2.4	0.0	0.0	0.00	0.0	133	133	133	133
LETTUCE	SANTA BARBARA	149371	33.3	4.0	3.8	0.0	1.7	0.01	0.0	149371	151994	149379	149371
LETTUCE	SANTA CLARA	18400	20.0	4.8	3.8	0.0	1.0	0.02	0.0	18400	18593	18404	18400
LETTUCE	SANTA CRUZ	91176	0.0	3.6	3.0	0.0	0.0	0.00	0.0	91176	91176	91178	91176
LETTUCE	VENTURA	86718	58.0	4.8	4.5	0.0	3.0	0.02	0.0	86718	89409	86739	86718
	STATEWIDE	3071223								3071223	3106347	3071495	3071223
	STATEWIDE % LOSS									0.000	1.131	0.009	0.000
NECTARINES	CONTRA COSTA	127	7.0	4.9	3.5	0.0				127			
NECTARINES	FRESNO-E	126000	160.0	6.8	5.1	0.0				126000			
NECTARINES	KERN	11000	177.5	6.9	5.0	0.0				11000			
NECTARINES	KINGS-E	7887	183.0	6.2	4.2	0.0				7887			
NECTARINES	KINGS-W	3849	183.0	6.2	4.2	0.0				3849			
NECTARINES	MADERA	6350	52.0	6.3	4.9	0.0				6350			
NECTARINES	MERCED	1210	53.0	5.4	5.2	0.0				1210			
NECTARINES	RIVERSIDE	97	1109.0	6.7	5.0	0.0				97			
NECTARINES	STANISLAUS	899	39.0	5.0	4.4	0.0				899			
NECTARINES	TULARE	64900	183.0	6.8	4.6	0.0				64900			
	STATEWIDE	222319								222319			
	STATEWIDE % LOSS									NO DATA			
OATS	ALAMEDA	1635	0.0	3.3	3.9	0.0				1635			
OATS	BUTTE	580	0.0	3.0	4.4	0.0				580			
OATS	LASSEN	1440	0.0	4.5	3.6	0.0				1440			
OATS	MERCED	5410	0.0	2.8	4.4	0.0				5410			
OATS	MODOC	1960	0.0	4.5	3.6	0.0				1960			
OATS	MONTEREY	247	0.0	3.1	3.3	0.0				247			
OATS	RIVERSIDE	451	244.0	4.6	7.8	0.0				451			
OATS	SACRAMENTO	800	2.0	3.4	5.4	0.0				800			
OATS	SAN JOAQUIN	13700	0.0	2.2	3.1	0.0				13700			
OATS	SAN MATEO	1200	0.0	2.4	2.8	0.0				1200			
OATS	SANTA BARBARA	266	33.3	3.8	4.1	0.0				266			
OATS	SANTA CLARA	6188	0.0	3.8	4.4	0.0				6188			
OATS	SISKIYOU	16782	0.0	4.5	3.6	0.0				16782			
OATS	SOLANO	5250	0.0	2.7	3.5	0.0				5250			
OATS	SONOMA	2557	0.0	2.1	2.2	0.0				2557			
OATS	SUTTER	2000	0.0	3.0	4.4	0.0				2000			
	STATEWIDE	60466								60466			
	STATEWIDE % LOSS									NO DATA			

OLIVES	BUTTE	11356	0.0	4.0	3.7	0.0			11356		
OLIVES	CALAVERAS	259	1.0	3.5	2.5	0.0			259		
OLIVES	FRESNO-E	4346	147.5	6.9	5.4	0.0			4346		
OLIVES	FRESNO-W	144	147.5	6.9	5.4	0.0			144		
OLIVES	GLENN	12054	0.0	4.5	3.5	0.0			12054		
OLIVES	KERN	4000	175.5	7.0	5.4	0.0			4000		
OLIVES	KINGS-E	1691	182.0	6.3	4.8	0.0			1691		
OLIVES	KINGS-W	250	182.0	6.3	4.8	0.0			250		
OLIVES	MADERA	7621	41.0	6.4	5.2	0.0			7621		
OLIVES	MERCED	196	54.0	5.6	5.2	0.0			196		
OLIVES	TEHAMA	19600	0.0	4.5	3.8	0.0			19600		
OLIVES	TULARE	60820	182.0	6.9	5.3	0.0			60820		
	STATEWIDE	122337							122337		
	STATEWIDE % LOSS								NO DATA		
ONIONS	CONTRA COSTA	266	3.0	4.2	4.2	16.8	3.9		320	277	
ONIONS	FRESNO-E	7844	92.0	5.7	6.0	34.8	8.1		12022	8532	
ONIONS	FRESNO-W	222856	92.0	5.7	6.0	34.8	8.1		341567	242411	
ONIONS	IMPERIAL	119642	3.0	3.9	3.6	10.9	2.5		134266	122745	
ONIONS	KERN	197000	116.5	5.6	6.1	35.5	8.3		305649	214716	
ONIONS	LOS ANGELES	45225	465.0	5.7	6.1	35.6	8.3		70275	49304	
ONIONS	MODOC	23000	0.0	4.4	3.2	7.3	1.7		24819	23398	
ONIONS	MONTEREY	12315	0.0	3.6	2.8	2.7	0.6		12653	12392	
ONIONS	RIVERSIDE	12820	178.0	5.0	5.8	33.0	7.7		19126	13887	
ONIONS	SAN BENITO	27468	0.0	3.7	3.7	12.1	2.8		31242	28280	
ONIONS	SAN BERNARDINO	265	615.0	6.1	6.5	39.4	9.1		437	292	
ONIONS	SAN JOAQUIN	32600	0.0	2.8	2.9	4.3	1.0		34050	32925	
ONIONS	SANTA CLARA	4875	17.0	5.1	3.5	9.5	2.2		5387	4985	
ONIONS	SISKIYOU	11868	0.0	4.4	3.2	7.3	1.7		12806	12073	
	STATEWIDE	718044							1004619	766192	
	STATEWIDE % LOSS								28.526	6.284	
ORANGES	BUTTE	2360	0.0	4.5	4.7	12.3	32.9	6.2	2692	3518	2515
ORANGES	FRESNO-E	227000	172.0	6.8	6.8	23.5	62.7	11.8	296824	607908	257258
ORANGES	IMPERIAL	4816	1.0	3.7	4.0	8.0	21.4	4.0	5236	6125	5017
ORANGES	KERN	232000	199.5	6.9	6.7	23.1	61.6	11.6	301833	604588	262349
ORANGES	MADERA	37602	55.0	6.2	6.6	22.7	60.6	11.4	48675	95424	42428
ORANGES	ORANGE	53722	144.0	5.0	4.6	11.3	30.2	5.7	60598	76992	56953
ORANGES	RIVERSIDE	176584	1439.0	8.0	7.2	26.2	69.9	13.1	239390	588327	203246
ORANGES	SAN BERNARDINO	63919	2841.0	8.9	8.5	33.4	88.9	16.7	95940	575941	76722
ORANGES	SAN DIEGO	128938	78.0	5.7	4.9	13.4	35.7	6.7	148880	200459	138193
ORANGES	SAN LUIS OBISP	1336	5.0	4.1	4.3	9.9	26.4	5.0	1483	1815	1406
ORANGES	TULARE	969000	183.0	6.6	6.8	23.5	62.7	11.8	1267060	2594990	1098165
ORANGES	VENTURA	202678	142.0	6.5	5.8	18.3	48.8	9.2	248139	395857	223116
	STATEWIDE	2099955							2718750	5749942	2367368
	STATEWIDE % LOSS								22.703	63.479	11.296
PEACHES	BUTTE	34379	0.0	4.3	3.5	0.0			34379		
PEACHES	CONTRA COSTA	679	3.0	3.7	2.7	0.0			679		
PEACHES	EL DORADO	180	10.0	5.4	4.6	0.0			180		
PEACHES	FRESNO-E	125900	172.0	6.4	5.3	0.0			125900		
PEACHES	KERN	12000	199.5	6.6	5.2	0.0			12000		
PEACHES	KINGS-E	25286	183.0	5.6	4.5	0.0			25286		
PEACHES	KINGS-W	11360	183.0	5.6	4.5	0.0			11360		
PEACHES	LOS ANGELES	7200	513.0	6.2	5.2	0.0			7200		
PEACHES	MADERA	13543	55.0	5.9	5.0	0.0			13543		
PEACHES	MERCED	81600	55.0	5.4	5.2	0.0			81600		
PEACHES	PLACER	339	8.0	5.0	4.3	0.0			339		
PEACHES	RIVERSIDE	612	1159.0	6.4	5.4	0.0			612		
PEACHES	SAN JOAQUIN	33900	1.0	3.3	2.5	0.0			33900		
PEACHES	SOLANO	1784	6.0	3.7	3.0	0.0			1784		
PEACHES	STANISLAUS	160800	40.0	4.8	4.4	0.0			160800		
PEACHES	SUTTER	122696	0.0	4.3	3.5	0.0			122696		
PEACHES	TEHAMA	295	0.0	4.3	3.5	0.0			295		
PEACHES	TULARE	55500	183.0	6.2	4.9	0.0			55500		
PEACHES	YOLO	1225	3.5	3.7	3.0	0.0			1225		
PEACHES	YUBA	68523	0.0	4.6	3.4	0.0			68523		
	STATEWIDE	757801							757801		
	STATEWIDE % LOSS								NO DATA		
PEARS	EL DORADO	4196	10.0	5.8	4.4	0.0			4196		
PEARS	FRESNO-E	1628	160.0	6.8	5.1	0.0			1628		
PEARS	FRESNO-W	362	160.0	6.8	5.1	0.0			362		
PEARS	LAKE	82679	0.0	3.0	2.3	0.0			82679		
PEARS	MENDOCINO	58679	-NA-	3.0	2.3	0.0			58679		
PEARS	PLACER	281	8.0	5.3	4.2	0.0			281		
PEARS	SACRAMENTO	120000	41.0	5.9	3.9	0.0			120000		
PEARS	SAN JOAQUIN	8050	1.0	3.5	2.4	0.0			8050		
PEARS	SANTA CLARA	1663	20.0	4.9	3.6	0.0			1663		
PEARS	SOLANO	21452	6.0	4.0	2.9	0.0			21452		
PEARS	SONOMA	760	0.0	3.3	2.6	0.0			760		
PEARS	SUTTER	8379	0.0	4.6	3.4	0.0			8379		
PEARS	TULARE	2300	183.0	6.7	4.9	0.0			2300		
PEARS	YOLO	8857	3.5	3.7	3.0	0.0			8857		
	STATEWIDE	319206							319206		
	STATEWIDE % LOSS								NO DATA		
PISTACHIOS	FRESNO-E	806	92.0	6.8	5.9	0.0			806		
PISTACHIOS	FRESNO-W	181	92.0	6.8	5.9	0.0			181		
PISTACHIOS	KERN	6600	116.5	7.0	6.1	0.0			6600		
PISTACHIOS	KINGS-E	1428	172.0	6.3	5.3	0.0			1428		
PISTACHIOS	KINGS-W	612	172.0	6.3	5.3	0.0			612		
PISTACHIOS	MADERA	3317	25.0	6.3	5.6	0.0			3317		
PISTACHIOS	MERCED	975	31.0	5.6	5.1	0.0			975		
PISTACHIOS	SAN LUIS OBISP	11	0.0	3.8	3.2	0.0			11		
PISTACHIOS	TULARE	1519	172.0	6.9	5.8	0.0			1519		
	STATEWIDE	15449							15449		
	STATEWIDE % LOSS								NO DATA		
PLUMS	CONTRA COSTA	35	3.0	3.6	2.7	0.0			35		
PLUMS	EL DORADO	595	10.0	5.2	4.6	0.0			595		
PLUMS	FRESNO-E	111888	172.0	6.2	5.3	0.0			111888		
PLUMS	FRESNO-W	112	172.0	6.2	5.3	0.0			112		
PLUMS	KERN	20000	199.5	6.2	5.2	0.0			20000		
PLUMS	KINGS-E	5782	183.0	5.3	4.5	0.0			5782		
PLUMS	KINGS-W	2822	183.0	5.3	4.5	0.0			2822		
PLUMS	MADERA	7146	55.0	5.6	5.1	0.0			7146		
PLUMS	MERCED	528	25.0	4.1	3.6	0.0			528		
PLUMS	PLACER	938	8.0	4.8	4.4	0.0			938		
PLUMS	RIVERSIDE	117	1161.0	6.1	5.4	0.0			117		
PLUMS	SUTTER	64	0.0	4.2	3.5	0.0			64		
PLUMS	TULARE	123640	183.0	5.8	4.9	0.0			123640		
	STATEWIDE	273667							273667		
	STATEWIDE % LOSS								NO DATA		

POTATOES	HUMBOLDT	7737	-NA-	4.6	2.7	0.0			7737		
POTATOES	KERN	412000	95.5	5.3	6.3	0.0			412000		
POTATOES	MODOC	128650	0.0	4.8	3.8	0.0			128650		
POTATOES	MONTEREY	20000	0.0	3.5	2.9	0.0			20000		
POTATOES	RIVERSIDE	94130	746.0	7.6	7.0	0.0			94130		
POTATOES	SAN DIEGO	10032	58.0	5.8	4.9	0.0			10032		
POTATOES	SAN JOAQUIN	27750	0.0	2.8	3.1	0.0			27750		
POTATOES	SISKIYOU	159936	0.0	4.5	3.1	0.0			159936		
	STATEWIDE	860235							860235		
	STATEWIDE % LOSS								NO DATA		
PRUNES	AMADOR	137	26.5	5.7	4.3	0.0			137		
PRUNES	BUTTE	32522	0.0	4.5	3.5	0.0			32522		
PRUNES	COLUSA	13475	0.0	4.5	3.5	0.0			13475		
PRUNES	FRESNO-E	4775	172.0	6.8	5.2	0.0			4775		
PRUNES	FRESNO-W	5	172.0	6.8	5.2	0.0			5		
PRUNES	GLENN	27065	0.0	4.5	3.5	0.0			27065		
PRUNES	LAKE	30	0.0	2.9	2.4	0.0			30		
PRUNES	MENDOCINO	176	-NA-	2.9	2.4	0.0			176		
PRUNES	MERCED	5060	56.0	5.4	5.2	0.0			5060		
PRUNES	SANTA CLARA	3060	22.0	5.0	3.7	0.0			3060		
PRUNES	SOLANO	4516	6.0	3.9	3.0	0.0			4516		
PRUNES	SONOMA	2473	0.0	3.3	2.6	0.0			2473		
PRUNES	SUTTER	54889	0.0	4.5	3.5	0.0			54889		
PRUNES	TEHAMA	26400	0.0	4.3	3.7	0.0			26400		
PRUNES	TULARE	10700	183.0	6.6	4.8	0.0			10700		
PRUNES	YOLO	5220	3.5	3.7	3.0	0.0			5220		
PRUNES	YUBA	37290	0.0	4.5	3.5	0.0			37290		
	STATEWIDE	227793							227793		
	STATEWIDE % LOSS								NO DATA		
RICE	BUTTE	353698	0.0	4.5	3.5	4.9	4.4	1.8	371851	369796	360113
RICE	COLUSA	443976	0.0	4.0	3.2	5.5	5.0	2.1	469983	467103	453635
RICE	FRESNO-E	693	135.5	7.0	5.1	11.1	10.2	6.4	779	772	740
RICE	FRESNO-W	15807	135.5	7.0	5.1	11.1	10.2	6.4	17777	17605	16801
RICE	GLENN	278624	0.0	4.8	3.2	5.5	5.0	2.1	294945	293137	284685
RICE	KERN	2000	153.5	7.1	5.1	11.3	10.4	6.6	2255	2233	2141
RICE	MERCED	31200	51.0	5.7	5.2	7.7	7.0	3.5	33818	33551	32342
RICE	PLACER	44000	8.0	5.5	4.2	7.4	6.7	3.3	47509	47146	45492
RICE	SACRAMENTO	47400	40.0	6.0	3.5	8.6	7.8	4.2	51860	51422	49464
RICE	SAN JOAQUIN	15600	1.0	3.5	2.3	2.1	1.9	0.6	16147	16104	15898
RICE	STANISLAUS	6920	38.0	5.2	4.7	6.7	6.0	2.8	7415	7362	7120
RICE	SUTTER	304222	0.0	4.8	3.2	5.5	5.0	2.1	322042	320069	310840
RICE	TEHAMA	4930	0.0	4.6	3.7	5.1	4.5	1.9	5184	5165	5025
RICE	YOLO	96800	3.5	3.9	2.9	3.1	2.7	1.0	99883	99513	97744
RICE	YUBA	118464	0.0	4.8	3.2	5.5	5.0	2.1	125403	124635	121041
	STATEWIDE	1764534							1866861	1855613	1803161
	STATEWIDE % LOSS								5.481	4.908	2.142
SAFFLOWER	COLUSA	4200	0.0	4.1	4.6	0.0			4200		
SAFFLOWER	FRESNO-E	1079	27.5	5.9	6.6	0.0			1079		
SAFFLOWER	FRESNO-W	14121	27.5	5.9	6.6	0.0			14121		
SAFFLOWER	GLENN	300	0.0	4.1	4.6	0.0			300		
SAFFLOWER	KERN	10000	44.0	5.9	6.7	0.0			10000		
SAFFLOWER	KINGS	89183	16.0	4.8	6.3	0.0			89183		
SAFFLOWER	MERCED	1280	2.0	5.4	5.6	0.0			1280		
SAFFLOWER	SACRAMENTO	5950	40.0	6.0	3.5	0.0			5950		
SAFFLOWER	SAN JOAQUIN	15500	0.0	3.2	3.4	0.0			15500		
SAFFLOWER	SAN LUIS OBISP	525	0.0	3.8	3.1	0.0			525		
SAFFLOWER	SANTA CLARA	600	15.0	5.0	3.2	0.0			600		
SAFFLOWER	SOLANO	5720	1.0	4.0	3.4	0.0			5720		
SAFFLOWER	SUTTER	7468	0.0	4.1	4.6	0.0			7468		
SAFFLOWER	TEHAMA	550	0.0	4.1	4.6	0.0			550		
SAFFLOWER	YOLO	20402	3.0	3.6	3.1	0.0			20402		
	STATEWIDE	176878							176878		
	STATEWIDE % LOSS								NO DATA		
SILAGE	CONTRA COSTA	13600	3.0	4.0	2.4	0.4			13661		
SILAGE	FRESNO	265000	65.0	6.8	6.0	4.0			275939		
SILAGE	GLENN	75000	0.0	4.6	3.4	0.8			75634		
SILAGE	HUMBOLDT	25853	-NA-	4.5	3.1	0.8			26059		
SILAGE	KERN	400000	73.5	6.9	6.3	4.2			417682		
SILAGE	MADERA	143910	19.0	6.3	5.7	2.9			148257		
SILAGE	MARIN	27507	0.0	2.3	1.7	-0.06			27507		
SILAGE	MERCED	1365000	9.0	5.5	4.9	1.7			1389310		
SILAGE	MONTEREY	3500	0.0	3.6	3.1	0.2			3509		
SILAGE	RIVERSIDE	24041	116.0	6.9	4.9	4.3			25122		
SILAGE	SACRAMENTO	140000	40.0	6.0	3.5	2.4			143508		
SILAGE	SAN BERNARDINO	48600	1888.0	8.5	5.3	9.2			53719		
SILAGE	SAN DIEGO	1200	71.0	5.8	4.2	2.2			1227		
SILAGE	SAN JOAQUIN	743000	1.0	3.5	2.3	0.2			744638		
SILAGE	SANTA BARBARA	26412	2.0	4.3	3.6	0.7			26586		
SILAGE	SISKIYOU	15100	0.0	4.5	3.1	0.8			15221		
SILAGE	SONOMA	77074	0.0	3.3	2.6	0.1			77185		
SILAGE	STANISLAUS	1143000	38.0	5.2	4.7	1.4			1159588		
SILAGE	SUTTER	50000	0.0	4.7	4.1	0.9			50451		
SILAGE	TEHAMA	4500	0.0	4.6	3.4	0.8			4538		
SILAGE	TULARE	1454000	116.0	7.1	5.8	4.7			1525851		
SILAGE	YUBA	25575	0.0	4.8	3.2	1.0			25832		
	STATEWIDE	6072072							6231024		
	STATEWIDE % LOSS								2.551		
SORGHUM GRAIN	COLUSA	1690	0.0	5.2	3.1	0.4			1697		
SORGHUM GRAIN	GLENN	4802	0.0	5.0	2.7	0.4			4820		
SORGHUM GRAIN	KERN	4000	92.5	7.4	5.5	1.3			4052		
SORGHUM GRAIN	MERCED	970	51.0	5.8	5.2	0.6			976		
SORGHUM GRAIN	SACRAMENTO	750	28.0	6.1	3.6	0.7			755		
SORGHUM GRAIN	SAN JOAQUIN	1500	0.0	3.4	2.7	0.06			1501		
SORGHUM GRAIN	SOLANO	1476	6.0	4.0	3.1	0.2			1478		
SORGHUM GRAIN	SUTTER	3525	120.5	6.5	4.0	0.9			3555		
SORGHUM GRAIN	TULARE	5320	172.0	7.8	4.5	1.5			5402		
SORGHUM GRAIN	YOLO	3910	3.5	3.8	2.9	0.1			3915		
	STATEWIDE	27943							28151		
	STATEWIDE % LOSS								0.739		
STRAWBERRIES	FRESNO-E	3440	42.5	4.8	5.8	0.0			3440		
STRAWBERRIES	LOS ANGELES	3758	10.0	2.5	3.1	0.0			3758		
STRAWBERRIES	MONTEREY	116800	0.0	3.2	3.2	0.0			116800		
STRAWBERRIES	ORANGE	58880	7.0	3.6	4.0	0.0			58880		
STRAWBERRIES	RIVERSIDE	442	231.0	4.3	5.9	0.0			442		
STRAWBERRIES	SAN BERNARDINO	4777	231.0	4.3	5.9	0.0			4777		
STRAWBERRIES	SAN DIEGO	25010	56.0	4.0	3.9	0.0			25010		
STRAWBERRIES	SAN LUIS OBISP	9372	22.0	3.5	3.4	0.0			9372		
STRAWBERRIES	SANTA BARBARA	105159	33.3	4.0	3.8	0.0			105159		
STRAWBERRIES	SANTA CLARA	3570	20.0	4.3	4.0	0.0			3570		
STRAWBERRIES	SANTA CRUZ	64451	0.0	3.4	3.2	0.0			64451		
STRAWBERRIES	VENTURA	98565	67.0	4.8	4.6	0.0			98565		
	STATEWIDE	494224							494224		
	STATEWIDE % LOSS								NO DATA		

SUGAR BEETS	BUTTE	69000	0.0	3.7	3.8	0.0	0.0	5.9		69000	69000	73354	
SUGAR BEETS	COLUSA	274950	0.0	3.7	3.8	0.0	0.0	5.9		274950	274950	292298	
SUGAR BEETS	FRESNO-E	484968	172.0	6.8	5.2	0.0	0.0	12.0		484968	484968	551397	
SUGAR BEETS	FRESNO-W	241032	172.0	6.8	5.2	0.0	0.0	12.0		241032	241032	274046	
SUGAR BEETS	GLENN	285677	0.0	3.7	3.8	0.0	0.0	5.9		285677	285677	303702	
SUGAR BEETS	IMPERIAL	709447	3.0	3.6	3.4	0.0	0.0	3.9		709447	709447	737880	
SUGAR BEETS	KERN	516000	98.0	5.0	6.4	0.0	0.0	17.4		516000	516000	624413	
SUGAR BEETS	KINGS-E	40977	183.0	6.0	4.4	0.0	0.0	8.3		40977	40977	44699	
SUGAR BEETS	KINGS-W	24902	183.0	6.0	4.4	0.0	0.0	8.3		24902	24902	27164	
SUGAR BEETS	MADERA	106890	55.0	6.2	5.0	0.0	0.0	10.9		106890	106890	119961	
SUGAR BEETS	MERCED	478000	56.0	5.4	5.2	0.0	0.0	12.0		478000	478000	542928	
SUGAR BEETS	MONTEREY	113500	0.0	3.4	3.0	0.0	0.0	2.2		113500	113500	116018	
SUGAR BEETS	SACRAMENTO	162000	43.0	5.6	4.1	0.0	0.0	7.0		162000	162000	174190	
SUGAR BEETS	SAN BENITO	22890	0.0	3.9	3.5	0.0	0.0	4.5		22890	22890	23973	
SUGAR BEETS	SAN JOAQUIN	840000	1.0	3.5	2.5	0.0	0.0	-0.2		840000	840000	840000	
SUGAR BEETS	SANTA CLARA	22385	16.0	4.8	3.7	0.0	0.0	5.5		22385	22385	23686	
SUGAR BEETS	SOLANO	450528	6.0	3.7	3.0	0.0	0.0	2.2		450528	450528	460523	
SUGAR BEETS	STANISLAUS	54300	40.5	5.0	4.4	0.0	0.0	8.5		54300	54300	59347	
SUGAR BEETS	SUTTER	162609	0.0	3.7	3.8	0.0	0.0	5.9		162609	162609	172869	
SUGAR BEETS	TEHAMA	15500	0.0	4.5	3.8	0.0	0.0	5.9		15500	15500	16470	
SUGAR BEETS	TULARE	129000	183.0	6.6	4.8	0.0	0.0	10.3		129000	129000	143774	
SUGAR BEETS	YOLO	228500	2.5	3.3	3.2	0.0	0.0	2.9		228500	228500	235273	
	STATEWIDE	5433055								5433055	5433055	5857967	
	STATEWIDE % LOSS									0.000	0.000	7.254	
SUNFLOWER	COLUSA	538	0.0	4.7	4.1	0.0				538			
SUNFLOWER	GLENN	1581	0.0	4.7	4.1	0.0				1581			
SUNFLOWER	SAN JOAQUIN	218	0.0	3.3	2.9	0.0				218			
SUNFLOWER	SOLANO	1946	6.0	3.8	3.3	0.0				1946			
SUNFLOWER	SUTTER	272	0.0	4.7	4.1	0.0				272			
	STATEWIDE	4555								4555			
	STATEWIDE % LOSS									NO DATA			
SWEET POTATOES	FRESNO-E	5161	135.5	7.0	5.1	0.0				5161			
SWEET POTATOES	FRESNO-W	8039	135.5	7.0	5.1	0.0				8039			
SWEET POTATOES	MERCED	62100	38.0	6.4	4.9	0.0				62100			
SWEET POTATOES	STANISLAUS	7080	38.0	5.2	4.7	0.0				7080			
	STATEWIDE	82380								82380			
	STATEWIDE % LOSS									NO DATA			
TOMATOES-FRESH	CONTRA COSTA	432	3.0	4.0	2.4	0.07				432			
TOMATOES-FRESH	FRESNO-E	941	80.0	6.9	5.7	1.9				959			
TOMATOES-FRESH	FRESNO-W	103589	80.0	6.9	5.7	1.9				105548			
TOMATOES-FRESH	HUMBOLDT	147	-NA-	4.5	3.1	1.9				150			
TOMATOES-FRESH	IMPERIAL	9804	1.0	3.4	2.5	0.02				9806			
TOMATOES-FRESH	KINGS-E	1762	116.0	6.1	5.8	2.7				1811			
TOMATOES-FRESH	KINGS-W	21731	116.0	6.1	5.8	2.7				22332			
TOMATOES-FRESH	MERCED	80113	12.0	5.5	5.1	0.3				80337			
TOMATOES-FRESH	MONTEREY	73315	0.0	3.7	3.0	0.0				73315			
TOMATOES-FRESH	ORANGE	13793	142.0	5.2	3.0	3.3				14263			
TOMATOES-FRESH	RIVERSIDE	1638	1.0	3.7	3.0	0.02				1638			
TOMATOES-FRESH	SACRAMENTO	4760	40.0	6.0	3.5	0.9				4805			
TOMATOES-FRESH	SAN BERNARDINO	20	692.0	7.4	5.9	16.1				24			
TOMATOES-FRESH	SAN DIEGO	92751	44.0	4.5	3.7	1.0				93708			
TOMATOES-FRESH	SAN JOAQUIN	83400	1.0	3.5	2.3	0.02				83419			
TOMATOES-FRESH	SANTA CLARA	5490	15.0	5.0	3.2	0.3				5509			
TOMATOES-FRESH	STANISLAUS	69400	39.0	5.0	4.4	0.9				70034			
TOMATOES-FRESH	SUTTER	369	0.0	4.8	3.2	0.0				369			
TOMATOES-FRESH	TULARE	11200	116.0	6.7	6.4	2.7				11510			
	STATEWIDE	574655								579969			
	STATEWIDE % LOSS									0.916			
TOMATOES-PROCE	COLUSA	560700	0.0	4.8	3.2	0.0	1.4	-9.1	2.7	560700	568672	560700	576077
TOMATOES-PROCE	CONTRA COSTA	119000	3.0	4.0	2.4	0.07	0.6	-15.7	-0.5	119081	119739	119000	119000
TOMATOES-PROCE	FRESNO-E	22806	80.0	6.9	5.7	1.8	6.0	11.0	12.4	23230	24262	25623	26047
TOMATOES-PROCE	FRESNO-W	2511194	80.0	6.9	5.7	1.8	6.0	11.0	12.4	2557849	2671488	2821423	2868070
TOMATOES-PROCE	IMPERIAL	356944	1.0	3.4	2.5	0.02	0.3	-14.7	-0.04	357025	357883	356944	356944
TOMATOES-PROCE	KERN	130000	153.5	7.1	5.1	3.5	6.7	6.4	10.2	134715	139263	138866	144775
TOMATOES-PROCE	KINGS-E	7433	182.0	6.5	4.2	4.1	4.9	-0.6	6.8	7755	7815	7433	7978
TOMATOES-PROCE	KINGS-W	91668	182.0	6.5	4.2	4.1	4.9	-0.6	6.8	95637	96378	91668	98388
TOMATOES-PROCE	MERCED	253000	51.0	5.7	5.2	1.2	2.8	7.2	10.6	255977	260208	272610	282992
TOMATOES-PROCE	MONTEREY	91500	0.0	3.5	2.7	0.0	0.3	-12.7	0.9	91500	91778	91500	92370
TOMATOES-PROCE	ORANGE	9330	142.0	5.2	3.0	3.2	1.9	-10.6	2.0	9642	9515	9330	9517
TOMATOES-PROCE	RIVERSIDE	28118	1.0	3.4	2.5	0.02	0.3	-14.7	-0.04	28124	28197	28118	28118
TOMATOES-PROCE	SACRAMENTO	208000	40.0	6.0	3.5	0.9	3.5	-6.6	3.9	209914	215528	208000	216498
TOMATOES-PROCE	SAN BENITO	141525	0.0	4.0	3.4	0.0	0.6	-7.4	3.5	141525	142404	141525	146708
TOMATOES-PROCE	SAN JOAQUIN	725000	1.0	3.5	2.3	0.02	0.3	-15.9	-0.6	725165	727205	725000	725000
TOMATOES-PROCE	SANTA BARBARA	7416	0.0	3.4	3.3	0.0	0.3	-8.0	3.2	7416	7436	7416	7663
TOMATOES-PROCE	SANTA CLARA	59400	15.0	5.0	3.2	0.3	1.7	-8.7	2.9	59604	60433	59400	61177
TOMATOES-PROCE	SOLANO	631890	6.0	4.0	2.8	0.1	0.6	-12.1	1.2	632756	635861	631890	639674
TOMATOES-PROCE	STANISLAUS	361000	25.0	4.8	3.4	0.6	1.4	-7.5	3.5	363070	366226	361000	373916
TOMATOES-PROCE	SUTTER	487560	0.0	4.7	3.6	0.0	1.3	-6.0	4.2	487560	493824	487560	508935
TOMATOES-PROCE	YOLO	1510000	3.5	3.6	3.0	0.08	0.4	-10.4	2.0	1511206	1515604	1510000	1541463
	STATEWIDE	8313484								8379451	8539714	8655006	8831310
	STATEWIDE % LOSS									0.787	2.649	3.946	5.864
WALNUTS	ALAMEDA	251	15.0	4.5	3.6	0.0				251			
WALNUTS	AMADOR	386	42.0	5.9	3.9	0.0				386			
WALNUTS	BUTTE	19002	0.0	4.7	3.6	0.0				19002			
WALNUTS	CALAVERAS	249	1.0	3.5	2.5	0.0				249			
WALNUTS	COLUSA	4320	0.0	4.7	3.6	0.0				4320			
WALNUTS	CONTRA COSTA	1510	3.0	4.0	2.6	0.0				1510			
WALNUTS	EL DORADO	47	10.0	5.8	4.7	0.0				47			
WALNUTS	FRESNO-E	4679	147.5	6.9	5.4	0.0				4679			
WALNUTS	FRESNO-W	1041	147.5	6.9	5.4	0.0				1041			
WALNUTS	GLENN	6656	0.0	4.4	3.7	0.0				6656			
WALNUTS	KERN	4000	175.5	7.0	5.4	0.0				4000			
WALNUTS	KINGS-E	7234	182.0	6.3	4.8	0.0				7234			
WALNUTS	KINGS-W	95	182.0	6.3	4.8	0.0				95			
WALNUTS	LAKE	3298	0.0	3.0	2.3	0.0				3298			
WALNUTS	MADERA	2371	41.0	6.4	5.2	0.0				2371			
WALNUTS	MERCED	12300	54.0	5.6	5.2	0.0				12300			
WALNUTS	MONTEREY	375	0.0	3.6	2.8	0.0				375			
WALNUTS	NAPA	157	0.0	3.5	2.3	0.0				157			
WALNUTS	PLACER	1720	8.0	5.4	4.6	0.0				1720			
WALNUTS	RIVERSIDE	61	1136.0	6.6	5.6	0.0				61			
WALNUTS	SACRAMENTO	144	42.0	5.9	3.9	0.0				144			
WALNUTS	SAN BENITO	4069	0.0	4.2	3.4	0.0				4069			
WALNUTS	SAN JOAQUIN	40100	1.0	3.5	2.5	0.0				40100			
WALNUTS	SAN LUIS OBISP	1438	0.0	3.8	2.9	0.0				1438			
WALNUTS	SANTA BARBARA	979	14.0	4.0	3.3	0.0				979			
WALNUTS	SANTA CLARA	1320	17.0	5.1	3.5	0.0				1320			
WALNUTS	SHASTA	944	0.0	4.1	3.9	0.0				944			
WALNUTS	SOLANO	2931	6.0	3.9	3.0	0.0				2931			
WALNUTS	SONOMA	53	0.0	3.3	2.6	0.0				53			
WALNUTS	STANISLAUS	35100	39.5	5.1	4.8	0.0				35100			
WALNUTS	SUTTER	17276	0.0	4.7	3.6	0.0				17276			
WALNUTS	TEHAMA	15000	0.0	4.5	3.8	0.0				15000			
WALNUTS	TULARE	35000	182.0	6.9	5.3	0.0				35000			
WALNUTS	YOLO	8812	3.5	3.7	3.0	0.0				8812			
WALNUTS	YUBA	9515	0.0	4.7	3.6	0.0				9515			
	STATEWIDE	242433								242433			
	STATEWIDE % LOSS									NO DATA			

WHEAT	ALAMEDA	1257	0.0	3.3	3.9	0.0	0.3	10.0	1257	1261	1397
WHEAT	AMADOR	301	2.0	3.8	5.3	0.0	0.7	17.8	301	303	366
WHEAT	BUTTE	21600	0.0	3.2	4.0	0.0	0.3	9.2	21600	21664	23782
WHEAT	COLUSA	122938	0.0	3.0	4.4	0.0	0.2	5.5	122938	123134	130097
WHEAT	CONTRA COSTA	6500	0.0	2.6	3.4	0.0	-0.06	-2.7	6500	6500	6500
WHEAT	FRESNO-E	55743	18.0	4.6	6.3	0.0	1.8	29.5	55743	56736	79028
WHEAT	FRESNO-W	144052	18.0	4.6	6.3	0.0	1.8	29.5	144052	146619	204227
WHEAT	GLENN	68432	0.0	3.0	4.4	0.0	0.2	5.5	68432	68541	72417
WHEAT	IMPERIAL	280014	2.0	3.5	3.4	0.0	0.5	13.0	280014	281331	321971
WHEAT	KERN	79000	24.0	4.5	6.5	0.0	1.6	28.4	79000	80309	110323
WHEAT	KINGS-E	57866	0.0	3.4	5.9	0.0	0.4	12.4	57866	58119	66036
WHEAT	KINGS-W	114869	0.0	3.4	5.9	0.0	0.4	12.4	114869	115372	131088
WHEAT	LAKE	210	0.0	2.6	2.9	0.0	-0.07	-2.9	210	210	210
WHEAT	LASSEN	1540	0.0	4.5	3.6	0.0	1.6	28.3	1540	1565	2147
WHEAT	MADERA	49680	3.0	4.2	5.9	0.0	1.2	24.5	49680	50306	65808
WHEAT	MERCED	44200	0.0	2.8	4.3	0.0	0.03	1.3	44200	44215	44788
WHEAT	MODOC	8200	0.0	4.5	3.6	0.0	1.6	28.3	8200	8335	11430
WHEAT	MONTEREY	1724	0.0	3.4	3.6	0.0	0.5	12.7	1724	1732	1975
WHEAT	PLACER	2400	0.0	4.1	5.4	0.0	1.1	22.6	2400	2426	3102
WHEAT	RIVERSIDE	50937	40.5	4.4	5.2	0.0	1.4	26.6	50937	51684	69409
WHEAT	SACRAMENTO	85000	18.0	4.4	5.3	0.0	1.5	27.2	85000	86295	116703
WHEAT	SAN BENITO	8640	0.0	3.6	3.8	0.0	0.6	14.7	8640	8688	10124
WHEAT	SAN JOAQUIN	175000	0.0	2.3	3.1	0.0	-0.2	-9.1	175000	175000	175000
WHEAT	SAN LUIS OBISP	7800	2.5	2.9	3.3	0.0	0.1	3.9	7800	7808	8115
WHEAT	SANTA BARBARA	2154	33.3	3.8	4.1	0.0	0.8	18.6	2154	2171	2646
WHEAT	SANTA CLARA	8500	0.0	3.6	3.8	0.0	0.6	14.7	8500	8547	9960
WHEAT	SHASTA	2000	0.0	3.2	4.1	0.0	0.3	9.2	2000	2006	2202
WHEAT	SISKIYOU	43865	0.0	4.3	3.5	0.0	1.3	25.6	43865	44465	58989
WHEAT	SOLANO	149778	0.0	2.8	3.3	0.0	0.08	2.4	149778	149874	153497
WHEAT	STANISLAUS	13700	0.0	2.9	4.4	0.0	0.07	2.8	13700	13710	14093
WHEAT	SUTTER	56913	0.0	3.1	4.5	0.0	0.2	6.4	56913	57021	60798
WHEAT	TEHAMA	9500	0.0	3.1	4.5	0.0	0.2	6.4	9500	9518	10149
WHEAT	TULARE	145700	0.0	3.9	8.4	0.0	0.8	19.5	145700	146949	181006
WHEAT	YOLO	210080	-NA-	3.1	3.3	0.0	0.2	7.1	210080	210532	226122
WHEAT	YUBA	4598	0.0	3.1	4.5	0.0	0.2	6.4	4598	4607	4912
	STATEWIDE	2034691							2034691	2047553	2380417
	STATEWIDE % LOSS								0.000	0.628	14.524

ALFALFA HAY	STATEWIDE % LOSS	7.100	0.842	5.565	5.625
ALFALFA SEED	STATEWIDE % LOSS	11.608	1.211	9.118	9.211
ALMONDS	STATEWIDE % LOSS	NO DATA			
APPLES	STATEWIDE % LOSS	NO DATA			
APRICOTS	STATEWIDE % LOSS	NO DATA			
ARTICHOKES	STATEWIDE % LOSS	NO DATA			
ASPARAGUS	STATEWIDE % LOSS	NO DATA			
AVOCADOS	STATEWIDE % LOSS	NO DATA			
BARLEY	STATEWIDE % LOSS	0.000			
BEANS-DRY	STATEWIDE % LOSS	1.607	20.087	~~7.993~~ 9.93	9.098
BROCCOLI	STATEWIDE % LOSS	0.000	0.000	0.000	0.000
CANTALOUPES	STATEWIDE % LOSS	29.806			
CARROTS	STATEWIDE % LOSS	NO DATA			
CAULIFLOWER	STATEWIDE % LOSS	NO DATA			
CELERY	STATEWIDE % LOSS	0.000			
CHERRIES	STATEWIDE % LOSS	NO DATA			
CORN-GRAIN&SEED	STATEWIDE % LOSS	NO DATA			
CORN-SWEET	STATEWIDE % LOSS	4.470			
COTTON	STATEWIDE % LOSS	21.661	16.782	18.096	32.272
GARLIC	STATEWIDE % LOSS	NO DATA			
GRAPEFRUIT	STATEWIDE % LOSS	NO DATA			
GRAPES-ALL	STATEWIDE % LOSS	18.654	15.301		
GRAPES-RAISIN	STATEWIDE % LOSS	22.155	18.291		
GRAPES-TABLE	STATEWIDE % LOSS	24.611	20.140		
GRAPES-WINE	STATEWIDE % LOSS	14.151	11.519		
KIWIFRUIT	STATEWIDE % LOSS	NO DATA			
LEMONS	STATEWIDE % LOSS	8.875			
LETTUCE	STATEWIDE % LOSS	0.000	1.131	0.009	0.000
NECTARINES	STATEWIDE % LOSS	NO DATA			
OATS	STATEWIDE % LOSS	NO DATA			
OLIVES	STATEWIDE % LOSS	NO DATA			
ONIONS	STATEWIDE % LOSS	28.526	6.284		
ORANGES	STATEWIDE % LOSS	22.703	63.479	11.296	
PEACHES	STATEWIDE % LOSS	NO DATA			
PEARS	STATEWIDE % LOSS	NO DATA			
PISTACHIOS	STATEWIDE % LOSS	NO DATA			
PLUMS	STATEWIDE % LOSS	NO DATA			
POTATOES	STATEWIDE % LOSS	NO DATA			
PRUNES	STATEWIDE % LOSS	NO DATA			
RICE	STATEWIDE % LOSS	5.481	4.908	2.142	
SAFFLOWER	STATEWIDE % LOSS	NO DATA			
SILAGE	STATEWIDE % LOSS	2.551			
SORGHUM GRAIN	STATEWIDE % LOSS	0.739			
STRAWBERRIES	STATEWIDE % LOSS	NO DATA			
SUGAR BEETS	STATEWIDE % LOSS	0.000	0.000	7.254	
SUNFLOWER	STATEWIDE % LOSS	NO DATA			
SWEET POTATOES	STATEWIDE % LOSS	NO DATA			
TOMATOES-FRESH	STATEWIDE % LOSS	0.916			
TOMATOES-PROCES	STATEWIDE % LOSS	0.787	2.649	3.946	5.864
WALNUTS	STATEWIDE % LOSS	NO DATA			
WHEAT	STATEWIDE % LOSS	0.000	0.628	14.524	
TOTAL GRAPES		18.870	15.468		
TOTAL ONIONS		28.526			
TOTAL WHEAT		0.000	0.628	14.524	

TABLE K

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE IN 1990

		YIELD	EXPOSURE STATISTIC					PERCENT LOSS FOR PREDICTIVE MODEL					
CROP	COUNTY	TONS	>10	7HR	12HR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ALFALFA HAY	ALAMEDA	11059	23	4.0	3.5	4.5	0.2	3.6	3.6				
ALFALFA HAY	AMADOR	1024	22	6.0	5.6	14.7	0.2	11.6	11.7				
ALFALFA HAY	BUTTE	21461	11	4.4	4.2	8.1	0.1	6.4	6.5				
ALFALFA HAY	COLUSA	76500	11	4.4	4.2	8.1	0.1	6.4	6.5				
ALFALFA HAY	CONTRA COSTA	19500	1	3.8	3.3	4.0	0.0	3.2	3.2				
ALFALFA HAY	FRESNO	714000	73	6.4	5.9	16.1	0.7	12.7	12.8				
ALFALFA HAY	GLENN	111118	11	4.4	4.2	8.1	0.1	6.4	6.5				
ALFALFA HAY	HUMBOLDT	840	0	3.3	3.1	2.8	0.0	2.2	2.2				
ALFALFA HAY	IMPERIAL	1874050	0	3.8	3.8	6.0	0.0	4.7	4.8				
ALFALFA HAY	INYO	24660	0	5.9	5.8	15.9	0.0	12.5	12.6				
ALFALFA HAY	KERN	875000	140	6.9	6.4	18.8	1.3	14.8	15.0				
ALFALFA HAY	KINGS	307586	0	5.2	4.9	11.7	0.0	9.2	9.3				
ALFALFA HAY	LAKE	1500	0	3.3	3.1	2.8	0.0	2.2	2.2				
ALFALFA HAY	LASSEN	156300	17	5.3	4.9	11.4	0.2	9.0	9.1				
ALFALFA HAY	LOS ANGELES	53400	772	7.3	7.5	23.8	7.2	18.8	19.0				
ALFALFA HAY	MADERA	239440	32	5.7	5.4	13.9	0.3	11.0	11.1				
ALFALFA HAY	MERCED	538800	20	4.6	4.4	9.0	0.2	7.1	7.2				
ALFALFA HAY	MODOC	118250	17	5.3	4.9	11.4	0.2	9.0	9.1				
ALFALFA HAY	MONO	38500	0	4.9	5.1	12.4	0.0	9.8	9.9				
ALFALFA HAY	MONTEREY	17300	0	2.8	2.6	0.4	0.0	0.3	0.3				
ALFALFA HAY	PLUMAS	17545	11	4.4	4.2	8.1	0.1	6.4	6.5				
ALFALFA HAY	RIVERSIDE	404451	0	3.8	3.8	6.0	0.0	4.7	4.8				
ALFALFA HAY	SACRAMENTO	55300	22	6.0	5.6	14.7	0.2	11.6	11.7				
ALFALFA HAY	SAN BENITO	19520	1	4.3	3.8	6.3	0.0	5.0	5.1				
ALFALFA HAY	SAN BERNARDINO	127000	159	5.4	4.7	10.4	1.5	8.2	8.3				
ALFALFA HAY	SAN JOAQUIN	428000	5	4.3	3.9	6.8	0.1	5.4	5.4				
ALFALFA HAY	SAN LUIS OBISP	22680	0	3.6	3.3	3.6	0.0	2.8	2.8				
ALFALFA HAY	SANTA BARBARA	27877	1	4.1	3.7	5.9	0.0	4.7	4.7				
ALFALFA HAY	SANTA CLARA	5600	1	4.3	3.8	6.3	0.0	5.0	5.1				
ALFALFA HAY	SHASTA	65000	17	5.3	4.9	11.4	0.2	9.0	9.1				
ALFALFA HAY	SIERRA	1743	168	6.4	6.5	19.0	1.4	15.0	15.2				
ALFALFA HAY	SISKIYOU	372735	17	5.3	4.9	11.4	0.2	9.0	9.1				
ALFALFA HAY	SOLANO	99360	0	3.7	3.3	3.8	0.0	3.0	3.0				
ALFALFA HAY	STANISLAUS	264000	20	4.6	4.4	9.0	0.2	7.1	7.2				
ALFALFA HAY	SUTTER	33099	11	4.4	4.2	8.1	0.1	6.4	6.5				
ALFALFA HAY	TEHAMA	28600	11	4.4	4.2	8.1	0.1	6.4	6.5				
ALFALFA HAY	TRINITY	300	0	3.3	3.1	2.8	0.0	2.2	2.2				
ALFALFA HAY	TULARE	945000	46	6.2	5.8	15.8	0.4	12.4	12.6				
ALFALFA HAY	YOLO	208080	6	4.7	4.2	8.1	0.1	6.4	6.5				
ALFALFA HAY	YUBA	5569	11	4.4	4.2	8.1	0.1	6.4	6.5				
	STATEWIDE	8331747											
	STATEWIDE	% LOSS				11.2	0.4	8.8	8.9				
ALFALFA SEED	FRESNO	11654	73	6.4	5.9	16.1	0.7	12.7	12.8				
ALFALFA SEED	GLENN	107	11	4.4	4.2	8.1	0.1	6.4	6.5				
ALFALFA SEED	IMPERIAL	2843	0	3.8	3.8	6.0	0.0	4.7	4.8				
ALFALFA SEED	KINGS	6353	0	5.2	4.9	11.7	0.0	9.2	9.3				
ALFALFA SEED	LASSEN	169	17	5.3	4.9	11.4	0.2	9.0	9.1				
	STATEWIDE	21126											
	STATEWIDE	% LOSS				13.5	0.4	10.6	10.7				
ALMONDS	BUTTE	33700	11	3.9	3.8								
ALMONDS	CALAVERAS	4	20	4.0	3.8								
ALMONDS	COLUSA	10140	11	3.9	3.8								
ALMONDS	CONTRA COSTA	7	1	3.5	3.1								
ALMONDS	FRESNO	27300	78	5.7	5.2								
ALMONDS	GLENN	9821	11	3.9	3.8								
ALMONDS	KERN	62300	140	6.1	5.7								
ALMONDS	KINGS	2326	0	4.8	4.6								
ALMONDS	LAKE	3	0	2.9	2.8								
ALMONDS	MADERA	27761	67	5.3	4.8								
ALMONDS	MERCED	57100	20	4.0	3.8								
ALMONDS	SAN JOAQUIN	28600	5	3.8	3.4								
ALMONDS	SAN LUIS OBISP	36	0	3.7	3.4								
ALMONDS	SOLANO	648	0	3.5	3.3								
ALMONDS	STANISLAUS	63900	20	4.0	3.8								
ALMONDS	SUTTER	3009	11	3.9	3.8								
ALMONDS	TEHAMA	4045	11	3.9	3.8								
ALMONDS	TULARE	6820	46	5.5	5.1								
ALMONDS	YOLO	3094	6	4.1	3.7								
ALMONDS	YUBA	1398	11	3.9	3.8								
	STATEWIDE	342012											
	STATEWIDE	% LOSS				NO MODEL							

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

		YIELD	EXPOSURE STATISTIC			PERCENT LOSS FOR PREDICTIVE MODEL							
CROP	COUNTY	TONS	>10	7HR	12HR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
APPLES	BUTTE	825	11	4.2	3.9								
APPLES	CALAVERAS	500	5	4.2	3.7								
APPLES	CONTRA COSTA	9210	1	3.7	3.3								
APPLES	EL DORADO	8500	173	6.2	6.2								
APPLES	HUMBOLDT	131	16	5.1	4.6								
APPLES	KERN	81600	153	6.7	6.2								
APPLES	KINGS	3027	0	5.1	4.8								
APPLES	LAKE	23	0	3.2	3.0								
APPLES	MADERA	20900	75	5.9	5.3								
APPLES	MARIPOSA	1459	22	4.7	4.4								
APPLES	MENDOCINO	10011	-NA-	3.2	3.0								
APPLES	MONTEREY	4915	0	2.9	2.7								
APPLES	NEVADA	193	173	6.2	6.2								
APPLES	PLACER	416	122	5.5	5.3								
APPLES	RIVERSIDE	81	772	5.8	5.9								
APPLES	SAN BENITO	8773	1	4.4	4.0								
APPLES	SAN BERNARDINO	927	1,922	7.9	7.2								
APPLES	SAN DIEGO	1500	59	5.5	4.8								
APPLES	SAN JOAQUIN	28300	5	4.2	3.7								
APPLES	SAN LUIS OBISP	3400	0	3.9	3.5								
APPLES	SANTA CRUZ	97650	0	3.5	3.1								
APPLES	SONOMA	52053	0	2.9	2.5								
APPLES	STANISLAUS	8540	21	4.6	4.3								
APPLES	SUTTER	4521	11	4.2	3.9								
APPLES	TULARE	12200	46	6.0	5.5								
APPLES	TUOLUMNE	605	20	4.4	4.1								
	STATEWIDE	360260											
	STATEWIDE	% LOSS				NO MODEL							
APRICOTS	CONTRA COSTA	6000	1	3.5	3.0								
APRICOTS	FRESNO	2250	83	5.6	5.1								
APRICOTS	KERN	3230	153	6.2	5.8								
APRICOTS	KINGS	1799	0	4.9	4.6								
APRICOTS	MERCED	10820	22	4.3	4.1								
APRICOTS	RIVERSIDE	37	1,059	6.7	6.0								
APRICOTS	SAN BENITO	10178	1	4.2	3.8								
APRICOTS	SAN JOAQUIN	23900	12	4.2	3.7								
APRICOTS	SANTA CLARA	2625	1	3.5	3.2								
APRICOTS	SOLANO	2423	0	3.5	3.3								
APRICOTS	STANISLAUS	62900	20	4.0	3.7								
APRICOTS	TULARE	3118	46	5.5	5.0								
APRICOTS	YOLO	2025	6	4.1	3.7								
	STATEWIDE	131297											
	STATEWIDE	% LOSS				NO MODEL							
ARTICHOKES	MONTEREY	42280	0	2.8	2.5								
ARTICHOKES	ORANGE	20	147	3.5	2.8								
ARTICHOKES	SAN MATEO	4700	0	2.2	1.9								
ARTICHOKES	SANTA BARBARA	6086	0	3.4	3.2								
ARTICHOKES	SANTA CRUZ	2630	0	3.3	2.8								
	STATEWIDE	55716											
	STATEWIDE	% LOSS				NO MODEL							
ASPARAGUS	CONTRA COSTA	1878	10	4.2	3.8								
ASPARAGUS	IMPERIAL	9701	0	4.2	4.1								
ASPARAGUS	KERN	2150	281	6.6	5.9								
ASPARAGUS	MONTEREY	15500	0	2.8	2.6								
ASPARAGUS	ORANGE	968	127	4.0	3.4								
ASPARAGUS	RIVERSIDE	1207	1	3.8	3.6								
ASPARAGUS	SACRAMENTO	820	3	3.5	3.1								
ASPARAGUS	SAN JOAQUIN	23800	12	4.2	3.7								
ASPARAGUS	YOLO	696	6	4.1	3.7								
	STATEWIDE	56720											
	STATEWIDE	% LOSS				NO MODEL							
AVOCADOS	LOS ANGELES	410	244	5.0	4.0								
AVOCADOS	MONTEREY	44	0	2.9	2.7								
AVOCADOS	ORANGE	2386	123	4.3	3.6								
AVOCADOS	RIVERSIDE	13711	437	6.0	5.3								
AVOCADOS	SAN BERNARDINO	840	1,922	7.9	7.2								
AVOCADOS	SAN DIEGO	54200	59	5.5	4.8								
AVOCADOS	SAN LUIS OBISP	1671	0	4.0	3.6								
AVOCADOS	SANTA BARBARA	17586	1	4.5	4.0								
AVOCADOS	SANTA CRUZ	50	0	3.4	3.0								
AVOCADOS	TULARE	5800	46	6.1	5.6								
AVOCADOS	VENTURA	21084	59	6.5	5.8								
	STATEWIDE	117782											
	STATEWIDE	% LOSS				NO MODEL							

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

CROP	COUNTY	YIELD TONS	EXPOSURE STATISTIC >10	7HR	12HR	PERCENT LOSS FOR PREDICTIVE MODEL (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BARLEY	BUTTE	2640	0	4.2	4.1								
BARLEY	COLUSA	900	0	4.2	4.1								
BARLEY	FRESNO	29695	39	6.2	5.8								
BARLEY	GLENN	948	0	4.2	4.1								
BARLEY	KERN	37100	60	6.5	6.1								
BARLEY	KINGS	79150	0	5.2	5.0								
BARLEY	LASSEN	944	6	5.1	4.8								
BARLEY	LOS ANGELES	1055	587	7.1	7.2								
BARLEY	MADERA	7200	10	5.5	5.2								
BARLEY	MERCED	7500	7	4.3	4.1								
BARLEY	MODOC	39025	17	5.8	5.3								
BARLEY	MONTEREY	11400	0	3.0	2.8								
BARLEY	ORANGE	170	82	4.1	3.6								
BARLEY	RIVERSIDE	167	410	7.0	6.5								
BARLEY	SACRAMENTO	1800	5	5.7	5.3								
BARLEY	SAN BENITO	5775	1	4.4	4.0								
BARLEY	SAN BERNARDINO	72	19	4.3	3.8								
BARLEY	SAN DIEGO	25	1	3.9	3.7								
BARLEY	SAN JOAQUIN	3920	3	4.2	3.8								
BARLEY	SAN LUIS OBISP	21700	0	3.7	3.3								
BARLEY	SAN MATEO	300	0	2.7	2.6								
BARLEY	SANTA BARBARA	619	0	4.3	3.9								
BARLEY	SANTA CLARA	675	1	4.4	4.0								
BARLEY	SHASTA	1105	6	5.1	4.8								
BARLEY	SISKIYOU	71823	17	5.8	5.3								
BARLEY	SOLANO	29648	0	3.7	3.4								
BARLEY	STANISLAUS	11900	7	4.3	4.1								
BARLEY	SUTTER	5959	0	4.2	4.1								
BARLEY	TEHAMA	1100	0	4.2	4.1								
BARLEY	TULARE	59800	30	6.0	5.7								
BARLEY	YOLO	5822	0	4.3	3.9								
	STATEWIDE	439937											
	STATEWIDE	% LOSS				NO MODEL							
BEANS-DRY	BUTTE	4606	11	4.5	4.3	0.3	13.5		12.9	18.8	19.3		
BEANS-DRY	COLUSA	9880	11	4.5	4.3	0.3	13.5		12.9	18.8	19.3		
BEANS-DRY	FRESNO	13900	71	6.6	6.0	1.7	27.3		24.9	36.4	37.3		
BEANS-DRY	GLENN	5383	11	4.5	4.3	0.3	13.5		12.9	18.8	19.3		
BEANS-DRY	KERN	15100	138	7.2	6.7	3.3	31.3		29.3	42.9	43.9		
BEANS-DRY	KINGS	2037	0	5.2	5.0	0.0	18.0		17.4	25.5	26.1		
BEANS-DRY	MADERA	4180	59	6.4	5.9	1.4	26.3		24.1	35.2	36.0		
BEANS-DRY	MERCED	5200	22	5.0	4.8	0.5	16.9		16.2	23.8	24.3		
BEANS-DRY	MONTEREY	2260	0	2.6	2.5	0.0	-0.6		-0.3	-0.4	-0.4		
BEANS-DRY	ORANGE	536	1,805	9.5	8.7	43.3	44.1		43.3	63.4	64.9		
BEANS-DRY	RIVERSIDE	231	159	6.0	5.1	3.8	23.3		18.4	26.9	27.5		
BEANS-DRY	SACRAMENTO	1450	19	5.6	5.1	0.5	20.8		18.3	26.8	27.4		
BEANS-DRY	SAN JOAQUIN	38920	5	4.4	4.0	0.1	12.7		10.6	15.5	15.9		
BEANS-DRY	SAN MATEO	75	0	2.5	2.3	0.0	-1.9		-1.5	-2.2	-2.2		
BEANS-DRY	SANTA BARBARA	3558	1	4.1	3.7	0.0	10.3		8.6	12.6	12.9		
BEANS-DRY	SANTA CLARA	1062	8	4.3	3.7	0.2	11.8		8.7	12.7	13.0		
BEANS-DRY	SOLANO	14625	0	3.8	3.3	0.0	7.7		5.7	8.3	8.5		
BEANS-DRY	STANISLAUS	39150	21	4.9	4.7	0.5	16.2		15.8	23.0	23.6		
BEANS-DRY	SUTTER	15104	11	4.5	4.3	0.3	13.5		12.9	18.8	19.3		
BEANS-DRY	TEHAMA	885	11	4.5	4.3	0.3	13.5		12.9	18.8	19.3		
BEANS-DRY	TULARE	16000	45	6.4	6.0	1.1	26.4		24.5	35.9	36.8		
BEANS-DRY	VENTURA	9061	95	6.2	5.5	2.3	24.9		21.3	31.2	31.9		
BEANS-DRY	YOLO	3416	6	4.9	4.4	0.2	15.8		13.1	19.1	19.6		
	STATEWIDE	206619											
	STATEWIDE	% LOSS				1.0	18.2		16.6	24.9	25.6		
BROCCOLI	FRESNO	41800	10	4.0	3.3								
BROCCOLI	IMPERIAL	60662	1	3.5	3.1								
BROCCOLI	KINGS	2844	0	3.8	3.4								
BROCCOLI	MONTEREY	281600	0	2.8	2.5								
BROCCOLI	ORANGE	3	64	3.2	2.5								
BROCCOLI	RIVERSIDE	13027	1	3.5	3.1								
BROCCOLI	SAN BENITO	11960	1	4.0	3.6								
BROCCOLI	SAN LUIS OBISP	38172	0	4.0	3.5								
BROCCOLI	SANTA BARBARA	99870	1	4.0	3.6								
BROCCOLI	SANTA CLARA	1688	1	4.0	3.6								
BROCCOLI	STANISLAUS	4690	20	3.6	3.3								
BROCCOLI	VENTURA	16164	7	4.5	3.8								
	STATEWIDE	572480											
	STATEWIDE	% LOSS				NO MODEL							
CANTALOUPES	FRESNO	351000	73	6.4	5.9	36.6							
CANTALOUPES	IMPERIAL	145428	1	3.8	3.6	11.2							
CANTALOUPES	KERN	31800	59	6.8	6.4	41.2							
CANTALOUPES	KINGS	15563	0	5.4	5.3	27.2							
CANTALOUPES	MERCED	55530	22	4.9	4.7	21.5							
CANTALOUPES	ORANGE	28	82	4.1	3.5	14.0							
CANTALOUPES	RIVERSIDE	30347	341	5.5	5.3	27.3							
CANTALOUPES	SAN BERNARDINO	211	29	5.9	5.8	31.9							
CANTALOUPES	STANISLAUS	15600	21	4.8	4.6	20.5							
	STATEWIDE	645507											
	STATEWIDE	% LOSS				30.2							

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

		YIELD	EXPOSURE STATISTIC			PERCENT LOSS FOR PREDICTIVE MODEL							
CROP	COUNTY	TONS	>10	7HR	12HR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CARROTS	FRESNO	43800	83	5.0	4.4								
CARROTS	IMPERIAL	249642	1	3.5	3.1								
CARROTS	KERN	841000	153	5.5	5.0								
CARROTS	MONTEREY	76800	0	2.8	2.5								
CARROTS	ORANGE	96	147	3.5	2.8								
CARROTS	RIVERSIDE	23709	99	4.6	4.1								
CARROTS	SAN LUIS OBISP	59262	0	3.8	3.5								
CARROTS	SANTA BARBARA	86979	1	4.0	3.6								
	STATEWIDE	1381288											
	STATEWIDE	% LOSS				NO MODEL							
CAULIFLOWER	IMPERIAL	45561	1	3.5	3.1								
CAULIFLOWER	MONTEREY	154600	0	3.2	3.0								
CAULIFLOWER	ORANGE	3350	102	3.2	2.7								
CAULIFLOWER	RIVERSIDE	4491	1	4.1	3.8								
CAULIFLOWER	SAN DIEGO	6300	1	3.8	3.5								
CAULIFLOWER	SAN JOAQUIN	5990	4	3.4	3.0								
CAULIFLOWER	SAN LUIS OBISP	14345	0	3.8	3.4								
CAULIFLOWER	SANTA BARBARA	125189	1	4.0	3.6								
CAULIFLOWER	SANTA CRUZ	7341	0	3.3	2.8								
CAULIFLOWER	STANISLAUS	5440	3	3.7	3.3								
CAULIFLOWER	VENTURA	5484	7	4.5	3.8								
	STATEWIDE	378091											
	STATEWIDE	% LOSS				NO MODEL							
CELERY	MONTEREY	240095	0	2.8	2.6								
CELERY	ORANGE	18818	45	3.1	2.5								
CELERY	RIVERSIDE	2973	129	4.6	4.1								
CELERY	SAN BENITO	19522	1	4.0	3.6								
CELERY	SAN DIEGO	3100	54	4.1	3.5								
CELERY	SAN LUIS OBISP	36428	0	4.0	3.6								
CELERY	SANTA BARBARA	89002	1	4.1	3.7								
CELERY	SANTA CLARA	5100	1	3.5	3.2								
CELERY	SANTA CRUZ	6815	0	3.3	2.8								
CELERY	VENTURA	353181	7	4.6	4.0								
	STATEWIDE	775034											
	STATEWIDE	% LOSS				NO MODEL							
CHERRIES	CONTRA COSTA	458	10	4.2	3.8								
CHERRIES	EL DORADO	38	173	5.7	5.7								
CHERRIES	RIVERSIDE	27	784	5.5	5.4								
CHERRIES	SAN BENITO	1192	1	4.3	3.9								
CHERRIES	SAN JOAQUIN	19100	5	3.8	3.4								
CHERRIES	SANTA CLARA	990	1	3.5	3.2								
CHERRIES	SOLANO	72	0	3.5	3.3								
CHERRIES	STANISLAUS	1650	20	4.0	3.7								
CHERRIES	SUTTER	35	11	3.9	3.6								
	STATEWIDE	23554											
	STATEWIDE	% LOSS				NO MODEL							
CORN-GRAIN&SEE	AMADOR	581	22	5.8	5.4								
CORN-GRAIN&SEE	BUTTE	3423	11	4.3	4.1								
CORN-GRAIN&SEE	COLUSA	12180	11	4.3	4.1								
CORN-GRAIN&SEE	CONTRA COSTA	15400	10	4.4	4.1								
CORN-GRAIN&SEE	FRESNO	17000	73	6.3	5.9								
CORN-GRAIN&SEE	GLENN	28340	11	4.4	4.2								
CORN-GRAIN&SEE	KERN	24600	105	6.6	6.2								
CORN-GRAIN&SEE	LASSEN	175	16	5.3	4.9								
CORN-GRAIN&SEE	MADERA	35942	56	5.8	5.4								
CORN-GRAIN&SEE	MERCED	48800	20	4.7	4.5								
CORN-GRAIN&SEE	SACRAMENTO	105300	22	5.9	5.5								
CORN-GRAIN&SEE	SAN JOAQUIN	185000	3	4.2	3.8								
CORN-GRAIN&SEE	SOLANO	124016	0	3.6	3.2								
CORN-GRAIN&SEE	STANISLAUS	6120	20	4.7	4.5								
CORN-GRAIN&SEE	SUTTER	7898	11	4.4	4.2								
CORN-GRAIN&SEE	TEHAMA	4680	11	4.4	4.2								
CORN-GRAIN&SEE	TULARE	41000	31	6.0	5.6								
CORN-GRAIN&SEE	YOLO	73050	6	4.5	4.1								
CORN-GRAIN&SEE	YUBA	3740	11	4.4	4.2								
	STATEWIDE	737245											
	STATEWIDE	% LOSS				NO MODEL							
CORN-SWEET	CONTRA COSTA	5090	1	3.8	3.3	2.4							
CORN-SWEET	HUMBOLDT	48	0	2.8	2.5	-0.1							
CORN-SWEET	KINGS	6034	0	5.4	5.2	7.6							
CORN-SWEET	LOS ANGELES	3233	843	6.8	5.8	9.3							
CORN-SWEET	ORANGE	2842	127	3.8	3.3	2.1							
CORN-SWEET	RIVERSIDE	34943	1	4.3	4.0	4.3							
CORN-SWEET	SACRAMENTO	1600	22	5.9	5.6	8.6							
CORN-SWEET	SAN BERNARDINO	1093	891	5.9	5.1	7.3							
CORN-SWEET	SAN DIEGO	1800	1	3.9	3.7	3.2							
CORN-SWEET	SANTA CLARA	7425	8	4.3	3.8	3.6							
CORN-SWEET	SUTTER	557	0	3.8	3.5	3.0							
CORN-SWEET	VENTURA	6857	1	4.9	4.4	5.4							
	STATEWIDE	71522											
	STATEWIDE	% LOSS				4.8							

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

CROP	COUNTY	YIELD TONS	EXPOSURE STATISTIC >10	7HR	12HR	PERCENT LOSS FOR PREDICTIVE MODEL (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
COTTON	FRESNO	251000	73	6.4	5.9	18.3	15.5	16.4	27.6	25.1	28.2	0.0	19.0
COTTON	IMPERIAL	7914	0	3.8	3.6	3.1	4.9	4.6	5.6	8.4	9.4	0.0	1.8
COTTON	KERN	188000	140	6.9	6.4	22.7	17.4	18.8	33.6	29.3	32.8	0.0	26.2
COTTON	KINGS	140771	0	5.2	4.9	9.9	10.9	10.9	15.9	18.2	20.4	0.0	9.7
COTTON	MADERA	25771	60	6.1	5.7	16.3	14.6	15.2	24.9	23.6	26.4	0.0	16.7
COTTON	MERCED	44500	22	4.9	4.7	8.2	9.8	9.6	13.5	16.1	18.0	0.0	7.4
COTTON	RIVERSIDE	9388	0	3.8	3.6	3.1	4.9	4.6	5.6	8.4	9.4	0.0	1.8
COTTON	TULARE	79448	46	6.2	5.8	17.1	15.0	15.7	26.0	24.6	27.6	0.0	18.2
	STATEWIDE	746792											
	STATEWIDE	% LOSS				17.0	14.5	15.3	26.0	24.1	27.1	0.0	18.3
GARLIC	FRESNO	137000	39	4.6	4.1								
GARLIC	KERN	25000	60	5.0	4.5								
GARLIC	MONTEREY	1095	0	2.7	2.5								
GARLIC	ORANGE	3	103	4.2	3.4								
GARLIC	SAN BENITO	4423	1	3.5	3.2								
GARLIC	SAN BERNARDINO	28	100	3.5	3.0								
GARLIC	SANTA CLARA	3088	1	3.9	3.5								
	STATEWIDE	170637											
	STATEWIDE	% LOSS				NO MODEL							
GRAPEFRUIT	IMPERIAL	3118	0	3.9	3.7								
GRAPEFRUIT	KERN	30700	153	6.7	6.2								
GRAPEFRUIT	ORANGE	4670	123	4.3	3.6								
GRAPEFRUIT	RIVERSIDE	191485	185	5.3	4.9								
GRAPEFRUIT	SAN BERNARDINO	15807	1,922	7.9	7.2								
GRAPEFRUIT	SAN DIEGO	41900	59	5.5	4.8								
GRAPEFRUIT	TULARE	3130	46	6.0	5.5								
GRAPEFRUIT	VENTURA	22409	69	6.3	5.5								
	STATEWIDE	313219											
	STATEWIDE	% LOSS				NO MODEL							
GRAPES-ALL	ALAMEDA	3435	23	4.0	3.5	8.0	6.6						
GRAPES-ALL	AMADOR	5643	22	6.0	5.6	26.0	21.4						
GRAPES-ALL	CALAVERAS	360	5	4.3	3.9	12.0	9.9						
GRAPES-ALL	CONTRA COSTA	2130	1	3.8	3.3	7.1	5.9						
GRAPES-ALL	EL DORADO	2645	168	6.4	6.5	33.6	27.8						
GRAPES-ALL	FRESNO	1964950	73	6.4	5.9	28.4	23.5						
GRAPES-ALL	KERN	619085	140	6.9	6.4	33.1	27.3						
GRAPES-ALL	KINGS	33159	0	5.2	4.9	20.6	17.0						
GRAPES-ALL	LAKE	7900	0	3.3	3.1	4.9	4.0						
GRAPES-ALL	MADERA	706749	60	6.1	5.7	26.6	22.0						
GRAPES-ALL	MARIPOSA	94	22	4.9	4.7	18.2	15.0						
GRAPES-ALL	MENDOCINO	39779	0	2.9	2.5	0.2	0.1						
GRAPES-ALL	MERCED	132712	22	4.9	4.7	18.2	15.0						
GRAPES-ALL	MONTEREY	100076	0	2.8	2.6	0.7	0.6						
GRAPES-ALL	NAPA	114304	0	3.4	3.0	4.5	3.7						
GRAPES-ALL	NEVADA	527	168	6.4	6.5	33.6	27.8						
GRAPES-ALL	PLACER	247	119	5.7	5.6	26.1	21.5						
GRAPES-ALL	RIVERSIDE	100881	159	5.4	4.7	18.4	15.2						
GRAPES-ALL	SACRAMENTO	37200	22	6.0	5.6	26.0	21.4						
GRAPES-ALL	SAN BENITO	6570	1	4.3	3.8	11.2	9.2						
GRAPES-ALL	SAN BERNARDINO	4114	159	5.4	4.7	18.4	15.2						
GRAPES-ALL	SAN DIEGO	400	29	5.6	4.8	19.4	16.0						
GRAPES-ALL	SAN JOAQUIN	353500	5	4.3	3.9	12.0	9.9						
GRAPES-ALL	SAN LUIS OBISP	35942	0	3.6	3.3	6.3	5.2						
GRAPES-ALL	SANTA BARBARA	30729	1	4.1	3.7	10.4	8.6						
GRAPES-ALL	SANTA CLARA	3875	8	4.3	3.8	10.6	8.7						
GRAPES-ALL	SANTA CRUZ	240	0	3.3	3.0	4.4	3.6						
GRAPES-ALL	SOLANO	7702	0	3.7	3.3	6.7	5.6						
GRAPES-ALL	SONOMA	111921	0	2.9	2.5	0.2	0.1						
GRAPES-ALL	STANISLAUS	168000	22	4.9	4.7	18.2	15.0						
GRAPES-ALL	TULARE	523460	46	6.2	5.8	27.8	23.0						
GRAPES-ALL	YOLO	7905	6	4.7	4.2	14.3	11.8						
	STATEWIDE	5126254											
	STATEWIDE	% LOSS				25.2	20.7						
GRAPES-RAISIN	FRESNO	1541000	73	6.4	5.9	28.4	23.5						
GRAPES-RAISIN	KERN	208085	140	6.9	6.4	33.1	27.3						
GRAPES-RAISIN	KINGS	19202	0	5.2	4.9	20.6	17.0						
GRAPES-RAISIN	MADERA	220000	60	6.1	5.7	26.6	22.0						
GRAPES-RAISIN	MERCED	9812	22	4.9	4.7	18.2	15.0						
GRAPES-RAISIN	SAN BERNARDINO	25	159	5.4	4.7	18.4	15.2						
GRAPES-RAISIN	TULARE	246530	46	6.2	5.8	27.8	23.0						
	STATEWIDE	2244654											
	STATEWIDE	% LOSS				28.5	23.6						
GRAPES-TABLE	FRESNO	77200	73	6.4	5.9	28.4	23.5						
GRAPES-TABLE	KERN	160000	140	6.9	6.4	33.1	27.3						
GRAPES-TABLE	KINGS	4247	0	5.2	4.9	20.6	17.0						
GRAPES-TABLE	MADERA	38717	60	6.1	5.7	26.6	22.0						
GRAPES-TABLE	RIVERSIDE	93806	212	6.3	6.5	34.0	28.0						
GRAPES-TABLE	SAN BERNARDINO	2288	159	5.4	4.7	18.4	15.2						
GRAPES-TABLE	SAN JOAQUIN	17500	5	4.3	3.9	12.0	9.9						
GRAPES-TABLE	TULARE	175800	46	6.2	5.8	27.8	23.0						
	STATEWIDE	569558											
	STATEWIDE	% LOSS				30.0	24.7						

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

CROP	COUNTY	YIELD	EXPOSURE STATISTIC					PERCENT LOSS FOR PREDICTIVE MODEL					
		TONS	>10	7HR	12HR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GRAPES-WINE	ALAMEDA	3435	23	4.0	3.5	8.0	6.6						
GRAPES-WINE	AMADOR	5643	22	6.0	5.6	26.0	21.4						
GRAPES-WINE	CALAVERAS	360	5	4.3	3.9	12.0	9.9						
GRAPES-WINE	FRESNO	346750	73	6.4	5.9	28.4	23.5						
GRAPES-WINE	KERN	251000	140	6.9	6.4	33.1	27.3						
GRAPES-WINE	KINGS	9710	0	5.2	4.9	20.6	17.0						
GRAPES-WINE	LAKE	7900	0	3.3	3.1	4.9	4.0						
GRAPES-WINE	MADERA	448032	60	6.1	5.7	26.6	22.0						
GRAPES-WINE	MARIPOSA	94	14	5.2	5.0	20.8	17.1						
GRAPES-WINE	MENDOCINO	39779	0	2.9	2.5	0.2	0.1						
GRAPES-WINE	MERCED	122900	22	4.9	4.7	18.2	15.0						
GRAPES-WINE	MONTEREY	100076	0	2.8	2.6	0.7	0.6						
GRAPES-WINE	NAPA	114304	0	3.4	3.0	4.5	3.7						
GRAPES-WINE	NEVADA	527	168	6.4	6.5	33.6	27.8						
GRAPES-WINE	RIVERSIDE	7075	159	5.4	4.7	18.4	15.2						
GRAPES-WINE	SACRAMENTO	37200	22	6.0	5.6	26.0	21.4						
GRAPES-WINE	SAN BENITO	6570	1	4.3	3.8	11.2	9.2						
GRAPES-WINE	SAN BERNARDINO	1801	159	5.4	4.7	18.4	15.2						
GRAPES-WINE	SAN DIEGO	400	29	5.6	4.8	19.4	16.0						
GRAPES-WINE	SAN JOAQUIN	336000	5	4.3	3.9	12.0	9.9						
GRAPES-WINE	SAN LUIS OBISP	35942	0	3.6	3.3	6.3	5.2						
GRAPES-WINE	SANTA BARBARA	30729	1	4.1	3.7	10.4	8.6						
GRAPES-WINE	SANTA CLARA	3875	8	4.3	3.8	10.6	8.7						
GRAPES-WINE	SANTA CRUZ	240	0	3.3	3.0	4.4	3.6						
GRAPES-WINE	SOLANO	7702	0	3.7	3.3	6.7	5.6						
GRAPES-WINE	SONOMA	111921	0	2.9	2.5	0.2	0.1						
GRAPES-WINE	STANISLAUS	168000	22	4.9	4.7	18.2	15.0						
GRAPES-WINE	TULARE	101150	46	6.2	5.8	27.8	23.0						
GRAPES-WINE	YOLO	7905	6	4.7	4.2	14.3	11.8						
	STATEWIDE	2307020											
	STATEWIDE	X LOSS				20.9	17.1						
KIWIFRUIT	BUTTE	11621	11	4.2	4.0								
KIWIFRUIT	FRESNO	978	78	6.2	5.6								
KIWIFRUIT	KERN	2660	153	6.9	6.4								
KIWIFRUIT	KINGS	1285	0	5.2	4.9								
KIWIFRUIT	LAKE	120	0	3.2	3.0								
KIWIFRUIT	MERCED	175	22	4.8	4.5								
KIWIFRUIT	MONTEREY	12	0	2.8	2.6								
KIWIFRUIT	PLACER	229	122	5.7	5.5								
KIWIFRUIT	RIVERSIDE	14	134	5.5	4.8								
KIWIFRUIT	SAN BERNARDINO	101	217	5.4	4.7								
KIWIFRUIT	SAN LUIS OBISP	104	0	3.7	3.3								
KIWIFRUIT	SANTA CLARA	221	8	4.3	3.7								
KIWIFRUIT	SOLANO	727	0	3.7	3.3								
KIWIFRUIT	STANISLAUS	713	22	4.8	4.5								
KIWIFRUIT	SUTTER	1682	11	4.2	4.0								
KIWIFRUIT	TULARE	13200	46	6.1	5.6								
KIWIFRUIT	YOLO	576	6	4.6	4.1								
KIWIFRUIT	YUBA	2758	11	4.2	4.0								
	STATEWIDE	37376											
	STATEWIDE	X LOSS				NO MODEL							
LEMONS	FRESNO	11360	83	6.1	6.4	10.1							
LEMONS	IMPERIAL	9632	0	3.9	4.5	7.5							
LEMONS	KERN	32000	153	6.7	7.1	10.7							
LEMONS	ORANGE	10942	123	4.3	4.5	7.4							
LEMONS	RIVERSIDE	69422	0	3.9	4.5	7.5							
LEMONS	SAN BERNARDINO	1361	1,922	7.9	8.8	11.9							
LEMONS	SAN DIEGO	47900	59	5.5	5.1	8.5							
LEMONS	SAN LUIS OBISP	14797	0	4.1	4.0	6.2							
LEMONS	SANTA BARBARA	18517	1	4.3	4.2	6.7							
LEMONS	TULARE	38800	46	6.0	6.1	9.8							
LEMONS	VENTURA	356922	6	5.0	5.6	9.2							
	STATEWIDE	611453											
	STATEWIDE	X LOSS				8.9							
LETTUCE	FRESNO	282600	73	5.2	4.6		3.8	0.1					
LETTUCE	IMPERIAL	427856	1	3.3	2.9		0.1	0.0					
LETTUCE	KERN	146300	123	5.3	4.8		6.4	0.1					
LETTUCE	MONTEREY	1414307	0	3.4	3.2		0.0	0.0					
LETTUCE	ORANGE	11249	48	3.2	2.6		2.5	0.0					
LETTUCE	RIVERSIDE	212850	0	3.0	2.7		0.0	0.0					
LETTUCE	SACRAMENTO	250	-NA-	3.7	3.2		0.0	0.0					
LETTUCE	SAN BENITO	67671	1	4.3	3.9		0.1	0.0					
LETTUCE	SAN BERNARDINO	534	117	3.5	3.0		6.1	0.0					
LETTUCE	SAN LUIS OBISP	205830	0	3.4	3.2		0.0	0.0					
LETTUCE	SANTA BARBARA	154474	1	4.0	3.6		0.1	0.0					
LETTUCE	SANTA CLARA	15825	8	4.3	3.7		0.4	0.0					
LETTUCE	SANTA CRUZ	104347	0	3.3	3.0		0.0	0.0					
LETTUCE	STANISLAUS	3740	21	4.2	3.9		1.1	0.0					
LETTUCE	VENTURA	79300	7	4.5	3.8		0.4	0.0					
	STATEWIDE	3127133											
	STATEWIDE	X LOSS					0.7	0.0					

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

CROP	COUNTY	YIELD	EXPOSURE STATISTIC			PERCENT LOSS FOR PREDICTIVE MODEL							
		TONS	>10	7HR	12HR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NECTARINES	CONTRA COSTA	93	10	4.6	4.2								
NECTARINES	FRESNO	104000	78	6.2	5.6								
NECTARINES	KERN	16700	153	6.9	6.4								
NECTARINES	KINGS	10718	0	5.2	4.9								
NECTARINES	MADERA	5508	68	6.1	5.4								
NECTARINES	MERCED	1640	22	4.8	4.5								
NECTARINES	RIVERSIDE	17	740	5.9	6.1								
NECTARINES	TULARE	82600	46	6.1	5.6								
	STATEWIDE	221276											
	STATEWIDE	% LOSS				NO MODEL							
OATS	BUTTE	245	0	2.7	2.5								
OATS	LASSEN	1500	11	4.4	4.2								
OATS	MERCED	4300	0	2.9	2.5								
OATS	MODOC	1068	11	4.4	4.2								
OATS	RIVERSIDE	1135	80	4.2	3.7								
OATS	SACRAMENTO	900	0	2.6	2.3								
OATS	SAN JOAQUIN	9070	0	2.7	2.3								
OATS	SAN MATEO	1200	0	1.9	1.7								
OATS	SANTA BARBARA	139	0	3.7	3.4								
OATS	SANTA CLARA	8100	0	3.3	2.9								
OATS	SISKIYOU	17578	11	4.4	4.2								
OATS	SOLANO	6125	-NA-	3.0	2.7								
OATS	SONOMA	1391	0	2.3	1.9								
OATS	SUTTER	2158	0	2.7	2.5								
	STATEWIDE	54909											
	STATEWIDE	% LOSS				NO MODEL							
OLIVES	BUTTE	12330	11	3.7	3.4								
OLIVES	CALAVERAS	292	5	4.3	3.8								
OLIVES	FRESNO	4590	78	6.2	5.7								
OLIVES	GLENN	7468	11	4.2	3.9								
OLIVES	KERN	13700	140	6.7	6.2								
OLIVES	KINGS	5584	0	5.0	4.8								
OLIVES	MADERA	7974	67	5.9	5.5								
OLIVES	MERCED	47	22	4.8	4.5								
OLIVES	TEHAMA	15000	11	4.3	4.1								
OLIVES	TULARE	65500	46	6.1	5.7								
	STATEWIDE	132485											
	STATEWIDE	% LOSS				NO MODEL							
ONIONS	CONTRA COSTA	277	7	3.5	3.2	6.6	1.5						
ONIONS	FRESNO	379400	44	4.7	4.1	16.0	3.7						
ONIONS	IMPERIAL	207152	1	3.6	3.3	8.0	1.9						
ONIONS	KERN	156500	153	5.9	5.4	29.0	6.7						
ONIONS	LOS ANGELES	38800	825	6.1	6.1	35.2	8.2						
ONIONS	MODOC	29942	11	3.7	3.4	9.3	2.2						
ONIONS	MONTEREY	5905	0	2.8	2.6	0.9	0.2						
ONIONS	ORANGE	463	119	3.4	2.7	2.2	0.5						
ONIONS	RIVERSIDE	20795	113	4.1	3.7	11.5	2.7						
ONIONS	SAN BENITO	20317	1	4.1	3.7	12.2	2.8						
ONIONS	SAN BERNARDINO	111	77	3.4	3.0	4.5	1.0						
ONIONS	SAN JOAQUIN	31800	3	3.1	2.7	2.1	0.5						
ONIONS	SANTA CLARA	4550	1	3.5	3.2	6.4	1.5						
ONIONS	SISKIYOU	10164	11	3.7	3.4	9.3	2.2						
ONIONS	STANISLAUS	16600	7	3.7	3.4	9.1	2.1						
	STATEWIDE	922776											
	STATEWIDE	% LOSS				16.9	3.8						
ORANGES	BUTTE	684	11	4.2	4.4	10.5		5.3					
ORANGES	FRESNO	310800	83	6.1	6.4	21.6		10.8					
ORANGES	IMPERIAL	5607	0	3.9	4.5	11.3		5.6					
ORANGES	KERN	255500	153	6.7	7.1	25.3		12.6					
ORANGES	MADERA	52512	75	5.9	5.8	18.0		9.0					
ORANGES	ORANGE	77485	123	4.3	4.5	11.2		5.6					
ORANGES	RIVERSIDE	256895	926	6.9	7.2	26.2		13.1					
ORANGES	SAN BERNARDINO	66116	1,922	7.9	8.8	34.8		17.4					
ORANGES	SAN DIEGO	141200	59	5.5	5.1	14.5		7.3					
ORANGES	SAN LUIS OBISP	1101	0	4.1	4.0	8.3		4.2					
ORANGES	TULARE	1291000	46	6.0	6.1	19.7		9.9					
ORANGES	VENTURA	195311	61	6.3	5.7	17.9		9.0					
	STATEWIDE	2654211											
	STATEWIDE	% LOSS				21.0		10.4					
PEACHES	BUTTE	36218	11	4.0	3.8								
PEACHES	CONTRA COSTA	629	1	3.6	3.2								
PEACHES	EL DORADO	150	173	6.0	5.9								
PEACHES	FRESNO	143300	83	5.9	5.3								
PEACHES	KERN	15600	153	6.5	6.0								
PEACHES	KINGS	36563	0	5.0	4.7								
PEACHES	LOS ANGELES	7028	825	6.6	6.7								
PEACHES	MADERA	9191	75	5.7	5.1								
PEACHES	MERCED	97300	22	4.5	4.3								
PEACHES	PLACER	392	122	5.3	5.1								
PEACHES	RIVERSIDE	513	783	5.7	5.7								
PEACHES	SAN JOAQUIN	44360	5	4.0	3.5								
PEACHES	SOLANO	1807	0	3.7	3.4								
PEACHES	STANISLAUS	159300	22	4.5	4.3								
PEACHES	SUTTER	130540	11	4.0	3.8								
PEACHES	TEHAMA	208	11	4.0	3.8								
PEACHES	TULARE	74300	46	5.8	5.3								
PEACHES	YOLO	1392	6	4.3	3.8								
PEACHES	YUBA	70929	11	4.2	4.0								
	STATEWIDE	829720											
	STATEWIDE	% LOSS				NO MODEL							

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

CROP	COUNTY	YIELD TONS	EXPOSURE STATISTIC >10	7HR	12HR	PERCENT LOSS FOR PREDICTIVE MODEL (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
PEARS	CONTRA COSTA	3484	6	4.4	4.0								
PEARS	EL DORADO	2413	173	6.4	6.4								
PEARS	FRESNO	1440	78	6.2	5.6								
PEARS	KERN	500	140	6.8	6.3								
PEARS	LAKE	74663	0	3.2	3.0								
PEARS	MENDOCINO	49796	-NA-	3.2	3.0								
PEARS	PLACER	343	122	5.7	5.5								
PEARS	SACRAMENTO	139000	23	5.9	5.4								
PEARS	SAN JOAQUIN	8380	5	4.2	3.7								
PEARS	SANTA CLARA	1050	8	4.3	3.7								
PEARS	SOLANO	23169	1	3.9	3.7								
PEARS	SONOMA	832	0	2.9	2.5								
PEARS	SUTTER	8942	11	4.2	4.0								
PEARS	TULARE	1000	46	5.8	5.3								
PEARS	YOLO	9167	6	4.3	3.8								
	STATEWIDE	324179											
	STATEWIDE	% LOSS				NO MODEL							
PISTACHIOS	FRESNO	1240	73	6.3	5.9								
PISTACHIOS	KERN	32300	105	6.6	6.2								
PISTACHIOS	KINGS	7201	0	5.2	5.0								
PISTACHIOS	MADERA	14890	56	5.8	5.4								
PISTACHIOS	MERCED	2580	20	4.7	4.5								
PISTACHIOS	SAN LUIS OBISP	28	0	3.8	3.4								
PISTACHIOS	TULARE	4480	31	6.0	5.6								
	STATEWIDE	62719											
	STATEWIDE	% LOSS				NO MODEL							
PLUMS	CONTRA COSTA	38	1	3.5	3.0								
PLUMS	EL DORADO	340	173	5.7	5.7								
PLUMS	FRESNO	142000	83	5.6	5.1								
PLUMS	KERN	19400	153	6.2	5.8								
PLUMS	KINGS	9311	0	4.9	4.6								
PLUMS	MADERA	6545	75	5.4	4.8								
PLUMS	MERCED	609	20	4.0	3.7								
PLUMS	PLACER	1295	122	5.1	4.9								
PLUMS	RIVERSIDE	19	784	5.5	5.4								
PLUMS	SUTTER	96	11	3.9	3.6								
PLUMS	TULARE	116470	46	5.5	5.0								
	STATEWIDE	296123											
	STATEWIDE	% LOSS				NO MODEL							
POTATOES	HUMBOLDT	7974	0	2.8	2.6	0.0	0.1						
POTATOES	KERN	421800	153	5.5	5.3	10.0	19.2						
POTATOES	MODOC	129884	17	5.1	4.8	8.0	15.5						
POTATOES	MONTEREY	20000	0	2.8	2.6	0.0	0.1						
POTATOES	RIVERSIDE	76749	673	6.9	6.7	14.9	28.7						
POTATOES	SAN JOAQUIN	32550	5	4.0	4.0	5.0	9.6						
POTATOES	SISKIYOU	161386	17	5.1	4.8	8.0	15.5						
	STATEWIDE	850343											
	STATEWIDE	% LOSS				9.3	18.1						
PRUNES	AMADOR	119	98	6.0	5.8								
PRUNES	BUTTE	16114	11	4.2	3.9								
PRUNES	COLUSA	9120	11	4.2	3.9								
PRUNES	FRESNO	3500	83	6.1	5.5								
PRUNES	GLENN	16623	11	4.2	3.9								
PRUNES	LAKE	30	0	3.2	3.0								
PRUNES	MENDOCINO	131	0	2.9	2.5								
PRUNES	MERCED	5390	22	4.7	4.4								
PRUNES	SANTA CLARA	2250	8	4.3	3.8								
PRUNES	SOLANO	3347	0	3.9	3.7								
PRUNES	SONOMA	2086	0	2.9	2.5								
PRUNES	SUTTER	34714	11	4.2	3.9								
PRUNES	TEHAMA	19610	11	4.2	3.9								
PRUNES	TULARE	14400	46	6.0	5.5								
PRUNES	YOLO	7613	6	4.3	3.8								
PRUNES	YUBA	20851	11	4.2	3.9								
	STATEWIDE	155898											
	STATEWIDE	% LOSS				NO MODEL							
RICE	BUTTE	372408	11	4.2	4.0	4.0	3.5	1.3					
RICE	COLUSA	334628	11	4.2	4.0	4.0	3.5	1.3					
RICE	FRESNO	19800	78	6.2	5.6	9.2	8.4	4.6					
RICE	GLENN	244177	11	4.2	4.0	4.0	3.5	1.3					
RICE	KERN	1850	153	6.9	6.4	10.9	10.0	6.2					
RICE	MERCED	19700	22	4.8	4.5	5.6	5.0	2.2					
RICE	PLACER	48200	122	5.7	5.5	7.8	7.1	3.6					
RICE	SACRAMENTO	39340	23	5.9	5.4	8.3	7.6	4.0					
RICE	SAN JOAQUIN	19800	5	4.2	3.7	4.1	3.6	1.4					
RICE	STANISLAUS	9040	22	4.8	4.5	5.6	5.0	2.2					
RICE	SUTTER	271631	11	4.2	4.0	4.0	3.5	1.3					
RICE	TEHAMA	3900	11	4.2	4.0	4.0	3.5	1.3					
RICE	YOLO	97600	6	4.6	4.1	5.0	4.4	1.8					
RICE	YUBA	116834	11	4.2	4.0	4.0	3.5	1.3					
	STATEWIDE	1598308											
	STATEWIDE	% LOSS				4.4	3.9	1.6					

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

		YIELD	EXPOSURE STATISTIC					PERCENT LOSS FOR PREDICTIVE MODEL					
CROP	COUNTY	TONS	>10	7HR	12HR	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SAFFLOWER	COLUSA	4400	0	3.9	3.8								
SAFFLOWER	FRESNO	11200	15	5.4	5.0								
SAFFLOWER	KERN	7980	31	5.8	5.5								
SAFFLOWER	KINGS	48598	0	4.8	4.6								
SAFFLOWER	MERCED	750	1	4.1	3.8								
SAFFLOWER	SACRAMENTO	7200	22	6.0	5.6								
SAFFLOWER	SAN JOAQUIN	11900	2	4.0	3.7								
SAFFLOWER	SAN LUIS OBISP	263	0	3.8	3.4								
SAFFLOWER	SANTA CLARA	975	8	4.3	3.8								
SAFFLOWER	SOLANO	7122	0	3.8	3.5								
SAFFLOWER	SUTTER	11775	0	3.9	3.8								
SAFFLOWER	TEHAMA	160	0	3.9	3.8								
SAFFLOWER	YOLO	29096	6	4.1	3.7								
	STATEWIDE	141419											
	STATEWIDE	% LOSS				NO MODEL							
SILAGE	CONTRA COSTA	10500	1	3.8	3.3	0.3							
SILAGE	FRESNO	293000	73	6.4	5.9	3.1							
SILAGE	GLENN	72000	11	4.4	4.2	0.7							
SILAGE	HUMBOLDT	1136	0	2.9	2.5	0.0							
SILAGE	KERN	281000	140	6.9	6.4	4.3							
SILAGE	KINGS	308265	0	5.2	4.9	1.4							
SILAGE	MADERA	129200	60	6.1	5.7	2.7							
SILAGE	MARIN	25239	0	1.9	1.7	-0.1							
SILAGE	MERCED	1511000	22	4.9	4.7	1.1							
SILAGE	RIVERSIDE	17302	33	6.3	6.1	2.9							
SILAGE	SACRAMENTO	187000	22	6.0	5.6	2.5							
SILAGE	SAN BERNARDINO	40300	1,082	6.6	5.6	3.5							
SILAGE	SAN DIEGO	1365	37	5.4	4.8	1.7							
SILAGE	SAN JOAQUIN	782000	5	4.3	3.9	0.6							
SILAGE	SANTA BARBARA	23518	1	4.1	3.7	0.5							
SILAGE	SISKIYOU	7950	17	5.3	4.9	1.5							
SILAGE	SONOMA	58871	0	2.9	2.5	0.0							
SILAGE	STANISLAUS	1294000	22	4.9	4.7	1.1							
SILAGE	SUTTER	70000	11	4.4	4.2	0.7							
SILAGE	TEHAMA	9425	11	4.4	4.2	0.7							
SILAGE	TULARE	2010000	46	6.2	5.8	2.9							
SILAGE	YUBA	21360	11	4.4	4.2	0.7							
	STATEWIDE	7154431											
	STATEWIDE	% LOSS				1.8							
SORGHUM GRAIN	GLENN	3680	11	4.3	4.0	0.2							
SORGHUM GRAIN	KERN	1820	151	7.1	6.6	1.1							
SORGHUM GRAIN	MERCED	184	22	4.9	4.6	0.3							
SORGHUM GRAIN	SAN JOAQUIN	462	5	4.3	3.8	0.2							
SORGHUM GRAIN	SOLANO	367	0	3.8	3.3	0.1							
SORGHUM GRAIN	SUTTER	2005	181	5.7	5.2	0.5							
SORGHUM GRAIN	TULARE	8100	45	6.3	5.7	0.8							
SORGHUM GRAIN	YOLO	1056	6	4.7	4.2	0.3							
	STATEWIDE	17674											
	STATEWIDE	% LOSS				0.6							
STRAWBERRIES	FRESNO	2430	12	4.2	3.6								
STRAWBERRIES	LOS ANGELES	4520	3	1.9	1.6								
STRAWBERRIES	MONTEREY	183400	0	2.7	2.5								
STRAWBERRIES	ORANGE	49920	42	3.0	2.5								
STRAWBERRIES	RIVERSIDE	705	58	3.0	2.6								
STRAWBERRIES	SAN BERNARDINO	3828	58	3.0	2.6								
STRAWBERRIES	SAN DIEGO	24111	54	4.0	3.5								
STRAWBERRIES	SAN LUIS OBISP	13548	0	3.4	3.1								
STRAWBERRIES	SANTA BARBARA	88954	0	4.0	3.7								
STRAWBERRIES	SANTA CLARA	3485	1	3.4	3.0								
STRAWBERRIES	SANTA CRUZ	57276	0	3.3	2.8								
STRAWBERRIES	VENTURA	125231	4	4.5	3.8								
	STATEWIDE	557408											
	STATEWIDE	% LOSS				NO MODEL							
SUGAR BEETS	BUTTE	59597	11	3.3	3.1			2.7					
SUGAR BEETS	COLUSA	174800	11	3.3	3.1			2.7					
SUGAR BEETS	FRESNO	512000	83	6.1	5.5			13.4					
SUGAR BEETS	GLENN	238702	11	3.3	3.1			2.7					
SUGAR BEETS	IMPERIAL	1013555	1	3.7	3.3			3.7					
SUGAR BEETS	KERN	358000	60	5.0	4.5			9.0					
SUGAR BEETS	KINGS	19282	0	5.1	4.8			10.1					
SUGAR BEETS	MADERA	37200	75	5.9	5.3			12.5					
SUGAR BEETS	MERCED	365000	22	4.7	4.4			8.6					
SUGAR BEETS	MODOC	13639	17	5.1	4.6			9.5					
SUGAR BEETS	MONTEREY	108000	0	2.8	2.7			0.7					
SUGAR BEETS	SACRAMENTO	132000	3	3.6	3.3			3.4					
SUGAR BEETS	SAN BENITO	34503	1	4.2	3.8			5.8					
SUGAR BEETS	SAN JOAQUIN	696000	5	4.2	3.7			5.3					
SUGAR BEETS	SANTA CLARA	28084	1	3.5	3.2			3.2					
SUGAR BEETS	SOLANO	393104	0	3.6	3.2			3.0					
SUGAR BEETS	STANISLAUS	72800	22	4.7	4.4			8.6					
SUGAR BEETS	SUTTER	131590	11	3.3	3.1			2.7					
SUGAR BEETS	TEHAMA	3360	11	4.4	4.2			7.6					
SUGAR BEETS	TULARE	119000	46	6.0	5.5			13.1					
SUGAR BEETS	YOLO	140150	6	3.7	3.2			3.2					
	STATEWIDE	4650366											
	STATEWIDE	% LOSS						6.1					

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

CROP	COUNTY	YIELD TONS	EXPOSURE STATISTIC >10	7HR	12HR	PERCENT LOSS FOR PREDICTIVE MODEL (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SUNFLOWER	COLUSA	763	0	4.3	4.2								
SUNFLOWER	GLENN	1631	0	4.3	4.2								
SUNFLOWER	SACRAMENTO	1320	7	4.0	3.6								
SUNFLOWER	SAN JOAQUIN	2058	3	4.2	3.8								
SUNFLOWER	SOLANO	2129	0	3.7	3.4								
SUNFLOWER	SUTTER	257	0	4.3	4.2								
	STATEWIDE	8150											
	STATEWIDE	% LOSS				NO MODEL							
SWEET POTATOES	FRESNO	9800	73	6.4	5.9								
SWEET POTATOES	MERCED	47000	60	6.1	5.7								
SWEET POTATOES	STANISLAUS	7850	22	4.9	4.7								
	STATEWIDE	64650											
	STATEWIDE	% LOSS				NO MODEL							
TOMATOES-FRESH	CONTRA COSTA	420	1	3.8	3.3	0.0							
TOMATOES-FRESH	FRESNO	127400	68	6.6	6.1	1.6							
TOMATOES-FRESH	HUMBOLDT	19	0	2.9	2.5	0.0							
TOMATOES-FRESH	IMPERIAL	15961	0	3.8	3.8	0.0							
TOMATOES-FRESH	KINGS	24000	0	5.2	5.0	0.0							
TOMATOES-FRESH	MERCED	82675	7	4.6	4.4	0.2							
TOMATOES-FRESH	MONTEREY	74286	0	3.0	2.8	0.0							
TOMATOES-FRESH	ORANGE	28935	95	4.3	3.7	2.2							
TOMATOES-FRESH	RIVERSIDE	2490	1	4.1	3.9	0.0							
TOMATOES-FRESH	SACRAMENTO	7200	22	6.0	5.6	0.5							
TOMATOES-FRESH	SAN BERNARDINO	120	100	4.4	3.9	2.3							
TOMATOES-FRESH	SAN DIEGO	114100	1	4.1	3.8	0.0							
TOMATOES-FRESH	SAN JOAQUIN	73800	5	4.3	3.9	0.1							
TOMATOES-FRESH	SANTA CLARA	3350	8	4.3	3.8	0.2							
TOMATOES-FRESH	STANISLAUS	67400	22	4.8	4.5	0.5							
TOMATOES-FRESH	SUTTER	223	11	4.4	4.2	0.3							
TOMATOES-FRESH	TULARE	10700	30	6.0	5.7	0.7							
	STATEWIDE	633079											
	STATEWIDE	% LOSS				0.5							
TOMATOES-PROCE	COLUSA	683200	11	4.3	4.1	0.3	0.9		6.4		6.0	9.0	
TOMATOES-PROCE	CONTRA COSTA	130000	1	3.8	3.4	0.0	0.5		3.4		3.1	4.7	
TOMATOES-PROCE	FRESNO	3692000	78	6.2	5.7	1.8	4.0		12.7		11.8	17.7	
TOMATOES-PROCE	IMPERIAL	334900	0	4.0	3.8	0.0	0.6		5.3		4.9	7.4	
TOMATOES-PROCE	KERN	170000	140	6.7	6.2	3.2	5.4		14.7		13.6	20.4	
TOMATOES-PROCE	KINGS	90090	0	5.0	4.8	0.0	1.7		9.1		8.4	12.7	
TOMATOES-PROCE	MERCED	240000	22	4.8	4.5	0.5	1.4		8.0		7.4	11.1	
TOMATOES-PROCE	MONTEREY	90000	0	2.8	2.7	0.0	0.0		0.7		0.7	1.0	
TOMATOES-PROCE	ORANGE	7400	98	4.2	3.4	2.2	0.8		4.5		4.1	6.2	
TOMATOES-PROCE	RIVERSIDE	28281	0	4.0	3.8	0.0	0.6		5.3		4.9	7.4	
TOMATOES-PROCE	SACRAMENTO	219000	22	5.9	5.5	0.5	3.2		11.8		10.9	16.4	
TOMATOES-PROCE	SAN BENITO	128413	1	4.3	3.9	0.0	0.9		5.6		5.2	7.8	
TOMATOES-PROCE	SAN JOAQUIN	871000	5	4.3	3.8	0.1	0.8		5.3		4.9	7.4	
TOMATOES-PROCE	SANTA BARBARA	13598	0	3.5	3.3	0.0	0.3		3.0		2.8	4.2	
TOMATOES-PROCE	SANTA CLARA	60800	8	4.4	3.8	0.2	0.9		5.3		4.9	7.4	
TOMATOES-PROCE	SOLANO	615731	0	3.7	3.3	0.0	0.4		3.1		2.9	4.4	
TOMATOES-PROCE	STANISLAUS	365000	20	4.4	4.3	0.5	1.0		6.9		6.4	9.6	
TOMATOES-PROCE	SUTTER	439992	11	4.3	4.1	0.3	0.9		6.4		6.0	9.0	
TOMATOES-PROCE	YOLO	1713000	6	4.5	4.1	0.1	1.1		6.2		5.8	8.6	
	STATEWIDE	9892405											
	STATEWIDE	% LOSS				0.8	2.2		8.8		8.1	12.3	
WALNUTS	ALAMEDA	153	23	4.0	3.5								
WALNUTS	AMADOR	437	22	5.9	5.5								
WALNUTS	BUTTE	21209	11	4.3	4.1								
WALNUTS	CALAVERAS	375	5	4.3	3.8								
WALNUTS	COLUSA	3960	11	4.3	4.1								
WALNUTS	CONTRA COSTA	1130	1	3.8	3.4								
WALNUTS	EL DORADO	108	168	6.2	6.2								
WALNUTS	FRESNO	3910	78	6.2	5.7								
WALNUTS	GLENN	5269	11	4.2	4.0								
WALNUTS	KERN	3320	140	6.7	6.2								
WALNUTS	KINGS	8512	0	5.0	4.8								
WALNUTS	LAKE	3298	0	3.2	3.0								
WALNUTS	MADERA	2496	67	5.9	5.5								
WALNUTS	MERCED	12400	22	4.8	4.5								
WALNUTS	MONTEREY	400	0	2.8	2.7								
WALNUTS	NAPA	180	0	3.4	3.1								
WALNUTS	PLACER	1250	119	5.5	5.4								
WALNUTS	RIVERSIDE	76	777	5.8	5.9								
WALNUTS	SACRAMENTO	176	22	5.9	5.5								
WALNUTS	SAN BENITO	3503	1	4.4	4.0								
WALNUTS	SAN JOAQUIN	39700	5	4.3	3.8								
WALNUTS	SAN LUIS OBISP	1069	0	3.9	3.5								
WALNUTS	SANTA BARBARA	609	0	3.9	3.6								
WALNUTS	SANTA CLARA	1288	8	4.4	3.8								
WALNUTS	SHASTA	1175	17	5.1	4.6								
WALNUTS	SOLANO	3132	0	3.7	3.3								
WALNUTS	SONOMA	57	0	2.9	2.5								
WALNUTS	STANISLAUS	38900	22	4.8	4.5								
WALNUTS	SUTTER	17418	11	4.3	4.1								
WALNUTS	TEHAMA	15500	11	4.3	4.1								
WALNUTS	TULARE	32500	46	6.1	5.7								
WALNUTS	YOLO	9274	6	4.3	3.8								
WALNUTS	YUBA	7697	11	4.3	4.1								
	STATEWIDE	240481											
	STATEWIDE	% LOSS				NO MODEL							

STATEWIDE PREDICTED YIELD LOSSES ASSOCIATED WITH OZONE

CROP	COUNTY	YIELD TONS	EXPOSURE STATISTIC >10	7HR	12HR	PERCENT LOSS FOR PREDICTIVE MODEL (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
WHEAT	AMADOR	328	0	3.8	3.4		0.8	18.3					
WHEAT	BUTTE	30680	0	2.9	2.7		0.1	3.2					
WHEAT	COLUSA	95040	0	2.7	2.5		0.0	-0.6					
WHEAT	CONTRA COSTA	6220	1	2.6	2.3		-0.1	-2.1					
WHEAT	FRESNO	152241	7	4.1	3.6		1.1	22.9					
WHEAT	GLENN	73769	0	2.7	2.5		0.0	-0.6					
WHEAT	IMPERIAL	167375	1	3.4	3.0		0.4	12.5					
WHEAT	KERN	90400	3	4.6	4.3		1.8	30.1					
WHEAT	KINGS	156323	0	4.1	3.8		1.1	22.5					
WHEAT	LAKE	210	0	2.3	2.1		-0.2	-9.1					
WHEAT	LASSEN	1000	11	4.4	4.2		1.4	26.6					
WHEAT	MADERA	72020	8	3.7	3.2		0.7	16.7					
WHEAT	MERCED	39300	0	2.8	2.6		0.1	2.4					
WHEAT	MODOC	5283	11	4.4	4.2		1.4	26.6					
WHEAT	MONTEREY	1460	0	3.2	2.9		0.3	8.5					
WHEAT	RIVERSIDE	21597	14	4.2	3.8		1.2	23.9					
WHEAT	SACRAMENTO	88092	2	3.0	2.7		0.1	4.4					
WHEAT	SAN BENITO	7200	0	3.8	3.5		0.7	17.7					
WHEAT	SAN JOAQUIN	173000	0	2.7	2.4		0.0	-0.4					
WHEAT	SAN LUIS OBISP	2915	0	3.0	2.8		0.2	5.9					
WHEAT	SANTA BARBARA	562	0	3.7	3.4		0.7	17.2					
WHEAT	SANTA CLARA	8000	0	3.8	3.5		0.7	17.7					
WHEAT	SHASTA	3655	0	2.8	2.6		0.0	1.7					
WHEAT	SISKIYOU	29328	0	4.0	3.8		1.0	21.8					
WHEAT	SOLANO	109656	0	2.7	2.4		0.0	-0.8					
WHEAT	STANISLAUS	18900	0	3.1	2.8		0.2	6.6					
WHEAT	SUTTER	44390	0	2.8	2.6		0.0	1.7					
WHEAT	TEHAMA	11300	0	2.8	2.6		0.0	1.7					
WHEAT	TULARE	158800	1	4.2	3.8		1.3	24.8					
WHEAT	YOLO	163676	0	3.2	2.8		0.3	8.3					
WHEAT	YUBA	4327	0	2.8	2.6		0.0	1.7					
	STATEWIDE	1737047											
	STATEWIDE	% LOSS					0.6	13.2					
ALFALFA HAY	STATEWIDE	% LOSS				11.2	0.4	8.8	8.9				
ALFALFA SEED	STATEWIDE	% LOSS				13.5	0.4	10.6	10.7				
ALMONDS	STATEWIDE	% LOSS				NO MODEL							
APPLES	STATEWIDE	% LOSS				NO MODEL							
APRICOTS	STATEWIDE	% LOSS				NO MODEL							
ARTICHOKES	STATEWIDE	% LOSS				NO MODEL							
ASPARAGUS	STATEWIDE	% LOSS				NO MODEL							
AVOCADOS	STATEWIDE	% LOSS				NO MODEL							
BARLEY	STATEWIDE	% LOSS				NO MODEL							
BEANS-DRY	STATEWIDE	% LOSS				1.0	18.2		16.6	24.9	25.6		
BROCCOLI	STATEWIDE	% LOSS				NO MODEL							
CANTALOUPES	STATEWIDE	% LOSS				30.2							
CARROTS	STATEWIDE	% LOSS				NO MODEL							
CAULIFLOWER	STATEWIDE	% LOSS				NO MODEL							
CELERY	STATEWIDE	% LOSS				NO MODEL							
CHERRIES	STATEWIDE	% LOSS				NO MODEL							
CORN-GRAIN&SEED	STATEWIDE	% LOSS				NO MODEL							
CORN-SWEET	STATEWIDE	% LOSS				4.8							
COTTON	STATEWIDE	% LOSS				17.0	14.5	15.3	26.0	24.1	27.1		18.3
GARLIC	STATEWIDE	% LOSS				NO MODEL							
GRAPEFRUIT	STATEWIDE	% LOSS				NO MODEL							
GRAPES-ALL	STATEWIDE	% LOSS				25.2	20.7						
GRAPES-RAISIN	STATEWIDE	% LOSS				28.5	23.6						
GRAPES-TABLE	STATEWIDE	% LOSS				30.0	24.7						
GRAPES-WINE	STATEWIDE	% LOSS				20.9	17.1						
KIWIFRUIT	STATEWIDE	% LOSS				NO MODEL							
LEMONS	STATEWIDE	% LOSS				8.9							
LETTUCE	STATEWIDE	% LOSS					0.7	0.0					
NECTARINES	STATEWIDE	% LOSS				NO MODEL							
OATS	STATEWIDE	% LOSS				NO MODEL							
OLIVES	STATEWIDE	% LOSS				NO MODEL							
ONIONS	STATEWIDE	% LOSS				16.9	3.8						
ORANGES	STATEWIDE	% LOSS				21.0		10.4					
PEACHES	STATEWIDE	% LOSS				NO MODEL							
PEARS	STATEWIDE	% LOSS				NO MODEL							
PISTACHIOS	STATEWIDE	% LOSS				NO MODEL							
PLUMS	STATEWIDE	% LOSS				NO MODEL							
POTATOES	STATEWIDE	% LOSS				9.3	18.1						
PRUNES	STATEWIDE	% LOSS				NO MODEL							
RICE	STATEWIDE	% LOSS				4.4	3.9	1.6					
SAFFLOWER	STATEWIDE	% LOSS				NO MODEL							
SILAGE	STATEWIDE	% LOSS				1.8							
SORGHUM GRAIN	STATEWIDE	% LOSS				0.6							
STRAWBERRIES	STATEWIDE	% LOSS				NO MODEL							
SUGAR BEETS	STATEWIDE	% LOSS						6.1					
SUNFLOWER	STATEWIDE	% LOSS				NO MODEL							
SWEET POTATOES	STATEWIDE	% LOSS				NO MODEL							
TOMATOES-FRESH	STATEWIDE	% LOSS				0.5							
TOMATOES-PROCES	STATEWIDE	% LOSS				0.8	2.2		8.8		8.1	12.3	
WALNUTS	STATEWIDE	% LOSS				NO MODEL							
WHEAT	STATEWIDE	% LOSS					0.6	13.2					