

CALIFORNIA POTATOES

Kern County is the major potato production area in the San Joaquin Valley (Figure 1), constituting nearly half the total acreage in California (VRIC, undated(a); Areas of Potato Production in California). Kern County potato acreage rose from only a few hundred acres before 1940 to approximately 65,000 acres in the early 1950's. In recent years, 35,000 to 40,000 acres have been planted to potatoes annually (VRIC, undated(a); Areas of Potato Production in California). In addition, based on 2005 California Pesticide Usage Data (CalPIP, 2006), approximately 64% of all pesticides applied to potatoes in California (based on total pounds chemical applied) was applied in Kern County. The majority of potatoes grown in the San Joaquin Valley are the White Rose variety (VRIC, undated(b); Potato Varieties Grown in California).

Typical cropping practices include the chopping and shredding of the previous crop, mulching, precision tillage, levelling, and sprinkler irrigation practices (VRIC, 1977; UC Cooperative Extension Farm Advisor). Sprinkler irrigation is used on 99% of crop and furrow or rill irrigation is used on 1%, this allows precise application of water, nutrients, and crop enhancement materials (USDA, 2000a). Potatoes have a shallow, sparse root system and prefer very well-drained soil (e.g., loamy sand, sandy loam, high organic) and need frequent light irrigation, 1 to 2 times a week. The crop is sprinkler irrigated throughout the season (VRIC, 2000a). Potatoes are grown as an alternating crop and the crops preceding potatoes are important for several reasons; it is best if the previous crop's roots (e.g., carrots) penetrate to a greater soil depth than that needed by the potato plant; and in the San Joaquin Valley, soybeans have been found to prevent potato scab buildup (UC Cooperative Extension Farm Advisor); VRIC, 1977).

Metfile W23155 is the meteorological data set representative of Bakersfield, CA. The station is situated in the center of Kern County, located in the extreme southern end of the great San Joaquin Valley and is partially surrounded by a horseshoe-shaped rim of mountains (NOAA, 2006). These zones of variation may be classified as valley, mountain, and desert areas, however, the overall climate can be classified as warm and semi-arid (NOAA, 2006). Its data were collected at the Meadows Field (WBAN 23155) in Bakersfield, CA, which receives an average annual rainfall of around 6.49 inches (NOAA, 2006). There is only one wet season during the year, as 90% of all precipitation falls from October through April (NOAA, 2006; TWCII, 2006). Snow in the valley is infrequent, with only a trace occurring in about one year out of seven (NOAA, 2006).

The Lewkalb series is the most common hydrologic group C soil found in Kern County where nearly half of all potatoes are grown (VRIC, undated(a); Table 5). It is a Coarse-loamy, mixed, superactive, calcareous, thermic Duric Torriorthents soil found on slopes of 0 to 2%. Potatoes in this area are generally grown on level ground (J. Nunez, personal communication). The soils are used mainly for range, as well as irrigated crops such as cotton, alfalfa, sugar beets, potatoes, and carrots are grown (USDA, 2001). The Lewkalb series was selected for this scenario because it supports potato production (USDA, 2001), is located in the highest potato production area in the state, is located in the highest potato pesticide usage area of the state, and because it is among the soils most vulnerable to runoff and erodibility in the area (Table 5).

The majority of potato bearing soils are in hydrologic group B (Table 5). The Lewkalb series however is a Hydrologic Group C soil and is listed as supporting potato production (Table 5; USDA, 2001). Lewkalb potato bearing soils have a USLE K factor of 0.32, which is common to 92% of potato bearing soils and includes the 90th percentile of these soils in erodibility (Table 5). Approximately 94% of potato bearing soils have a pH lower than Lewkalb soils. However, soil pH is not currently a PRZM input parameter and is not expected to often affect chemical fate in the acidic range. Based on the official soil series description (OSD) (USDA, 2001), Lewkalb soils have an A horizon from 0 to 23 inches (0-58 cm) deep and a C horizon from 23 to 65 inches (58-165 cm) deep. The soil parameters selected for this scenario were obtained from the USDA National Soils Characterization Database (NSCD) for Lekalb Sandy Loam. It is noted that horizon thicknesses generally agree between the OSD and NSCD, with slight variation.

Table 1. PRZM 3.12 Climate and Time Parameters for Kern County, California – Potato.

Parameter	Value	Source/Comments
Starting Date	Jan. 1, 1961	Meteorological File from Bakersfield (Kern County), CA (W23155).
Ending Date	Dec. 31, 1990	Meteorological File from Bakersfield (Kern County), (W23155).
Pan Evaporation Factor (PFAC)	0.70	PRZM Manual Figure 5.1. Value represents central California.
Snowmelt Factor (SFAC)	0	The Weather Channel Interactive, Inc. (TWCII, 2006)
Minimum Depth of Evaporation (ANETD)	25.0 cm	PRZM Manual, Figure 5.2 (EPA, 1998) Set to the midpoint of the reported range.

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Kern County, California – Potato.

Parameter	Value	Source/Comments
Method to Calculate Erosion (ERFLAG)	4 (MUSS)	Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004)
USLE K Factor (USLEK)	0.32 tons EI ⁻¹ *	USDA NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov/) Value listed for the soil series Lewkalb
USLE LS Factor (USLELS)	0.2	PRZM Manual, Table 5-5 (EPA, 1998); LS equation (Haan and Barfield, 1978) LS value for 400' slope length and 1% slope
USLE P Factor (USLEP)	1.0	Potatoes are grown with no contour practices. Joe Nunez, Farm Advisor, University of California Cooperative Extension Default for potatoes with no contour practices. PRZM Manual, Table 5-6 (EPA, 1998)
Field Area (AFIELD)	172 ha	Area of Shipman Reservoir watershed (EPA, 1999)
NRCS Hyetograph (IREG)	1	PRZM Manual, Figure 5.12 (EPA, 1998)
Slope (SLP)	1%	Midpoint of the soil range (EPA, 2004). Potatoes generally are not grown on a slope. Joe Nunez, Farm Advisor, University of California Cooperative Extension USDA 2002a (http://soils.usda.gov)
Hydraulic Length (HL)	600 m	Shipman Reservoir (EPA, 1999)
Irrigation Flag (IRFLAG)	1	Crop requires frequent light irrigation (sprinkler) 1 to 2 times a week throughout the season. Joe Nunez, Farm Advisor, University of California Cooperative Extension
IRTYPE	3 (Sprinkler)	Joe Nunez, Farm Advisor, University of California Cooperative Extension
Leaching Factor (FLEACH)	0.1	Irrigation Guidance for developing PRZM Scenario, Table 3; (June 15, 2005).
Fraction of Water Capacity when Irrigation is Applied (PCDEPL)	0.5	Set to default as per Irrigation Guidance for developing PRZM Scenario, Table 3; (EPA 2005).
Maximum Rate at which Irrigation is Applied (RATEAP)	0.1 cm hr ⁻¹	Set to default as per Irrigation Guidance for developing PRZM Scenario, Table 3; (EPA 2005).

Table 3. PRZM 3.12 Crop Parameters for Kern County, California – Potato.		
Parameter	Value	Source/Comments
Initial Crop (INICRP)	1	Set to one for all crops Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004).
Initial Surface Condition (ISCOND)	3	Material is usually left behind and the field is then fertilized. Joe Nunez, Farm Advisor, University of California Cooperative Extension
Number of Different Crops (NDC)	1	Set to number of crops in simulation.
Number of Cropping Periods (NCPDS)	30	Meteorological File from Bakersfield (Kern County), CA (W23155).
Maximum rainfall interception storage of crop (CINTCP)	0.15	Recommended value for potatoes PRZM Manual, Table 5-4 (EPA, 1998) and Guidance for Selecting Field Crop and Orchard Scenario Input Parameters (EPA, 2004).
Maximum Active Root Depth (AMXDR)	91 cm	3 feet maximum. Joe Nunez, Farm Advisor, University of California Cooperative Extension PRZM Manual, Table 5-9 (15-45 cm) (EPA, 1998)
Maximum Canopy Coverage (COVMAX)	100	Joe Nunez, Farm Advisor, University of California Cooperative Extension
Soil Surface Condition After Harvest (ICNAH)	3	Material is usually left behind and the field is then fertilized. Joe Nunez, Farm Advisor, University of California Cooperative Extension
Date of Crop Emergence (EMD, EMM, IYREM)	16/02	Potatoes are planted Jan through Mar and emergence is 2 ½ weeks later. Joe Nunez, Farm Advisor, University of California Cooperative Extension
Date of Crop Maturity (MAD, MAM, IYRMAT)	15/05	Potatoes mature approximately 90 days after emergence Joe Nunez, Farm Advisor, University of California Cooperative Extension
Date of Crop Harvest (HAD, HAM, IYRHAR)	15/06	Potatoes are harvested approximately 120 days after emergence. Joe Nunez, Farm Advisor, University of California Cooperative Extension
Maximum Dry Weight (WFMAX)	0.0	Not used in scenario (EPA, 2004)
Maximum Canopy Height (HTMAX)	60	Canopy height of potatoes in CA ranges from 20 inches to 2 feet. Joe Nunez, Farm Advisor, University of California Cooperative Extension and PRZM Manual, Table 5-16 (EPA, 1998)
SCS Curve Number (CN)	86, 81, 85	Gleams Manual Table H-4 (USDA, 1990); fallow = SR; cropping and residue = SR poor condition. Joe Nunez, Farm Advisor, University of California Cooperative Extension and PRZM Manual
Manning's N Value (MNGN)	0.014	RUSLE Project; C23PIPIC for California (Fresno) Irish Potato with conventional till and no cover (cover code = 6) (USDA, 2000b). These data are the closest to Kern County with similar cropping practices.
USLE C Factor (USLEC)	0.047 - 0.826	RUSLE Project; C23PIPIC for California (Fresno) Irish Potato with conventional till and no cover (cover code = 6) (USDA, 2000b). These data are the closest to Kern County with similar cropping practices.

Table 4. PRZM 3.12 Lewkalb Sandy Loam Soil Parameters for Kern County, California – Potato.		
Parameter	Value	Source/Comments
Total Soil Depth (CORED)	152 cm	NRCS Soil Characterization Database (SCD) (http://ssldata.nrcs.usda.gov/)
Number of Horizons (NHORIZ)	6	NRCS Soil Characterization Database (SCD) (http://ssldata.nrcs.usda.gov/); soil consists of two horizons: A and B (although the official soils description reclassified the B horizon as a C horizon). The A horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements. Lower two horizons consolidated for simplicity due to similar properties as per PRZM input guidance (EPA, 2004).
Horizon Thickness (THKNS)	10 cm (HORIZN = 1) 20 cm (HORIZN = 2) 40 cm (HORIZN = 3) 18 cm (HORIZN = 4) 10 cm (HORIZN = 5) 54 cm (HORIZN = 6)	NRCS Soil Characterization Database (SCD) (http://ssldata.nrcs.usda.gov/); Lower two horizons consolidated for simplicity due to similar properties as per PRZM input guidance (EPA, 2004).
Bulk Density (BD)	1.55 g/cm ³ (HORIZN = 1) 1.55 g/cm ³ (HORIZN = 2) 1.55 g/cm ³ (HORIZN = 3) 1.5 g/cm ³ (HORIZN = 4) 1.5 g/cm ³ (HORIZN = 5) 1.55 g/cm ³ (HORIZN = 6)	NRCS Soil Data Mart (SDM) (http://soildata.nrcs.usda.gov/); values are mean 1/3-bar moist bulk densities of a soil sampled as a Lewkalb. No SCD data were found to correlate with Lewkalb soils. SDM values were incomplete, leading to errors in PRZM.
Initial Water Content (THETO)	0.091 cm ³ /cm ³ (HORIZN =1) 0.091 cm ³ /cm ³ (HORIZN =2) 0.101 cm ³ /cm ³ (HORIZN =3) 0.135 cm ³ /cm ³ (HORIZN =4) 0.203 cm ³ /cm ³ (HORIZN =5) 0.125 cm ³ /cm ³ (HORIZN =6)	SDM values were incomplete, leading to errors in PRZM. Values are based on Field Capacity computed using Rawls and Brakensiek method for field capacity matric potential (-0.33 bar) as per PRZM manual (EPA, 1998).
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 5.0 cm (HORIZN = 2) 5.0 cm (HORIZN = 3) 3.0 cm (HORIZN = 4) 5.0 cm (HORIZN = 5) 3.0 cm (HORIZN = 6)	NRCS Soil Characterization Database (SCD) (http://ssldata.nrcs.usda.gov/); (EPA, 2004)
Field Capacity (THEFC)	0.091 cm ³ /cm ³ (HORIZN =1) 0.091 cm ³ /cm ³ (HORIZN =2) 0.101 cm ³ /cm ³ (HORIZN =3) 0.135 cm ³ /cm ³ (HORIZN =4) 0.203 cm ³ /cm ³ (HORIZN =5) 0.125 cm ³ /cm ³ (HORIZN =6)	SDM values were incomplete, leading to errors in PRZM. Values are based on Field Capacity computed using Rawls and Brakensiek method as per PRZM manual (EPA, 1998).
Wilting Point (THEWP)	0.010 cm ³ /cm ³ (HORIZN =1) 0.010 cm ³ /cm ³ (HORIZN =2) 0.010 cm ³ /cm ³ (HORIZN =3) 0.008 cm ³ /cm ³ (HORIZN =4) 0.002 cm ³ /cm ³ (HORIZN =5) 0.001 cm ³ /cm ³ (HORIZN =6)	SDM values were incomplete, leading to errors in PRZM. Values are based on wilting point computed using Rawls and Brakensiek method for wilting point matric potential (-15 bar) as per PRZM manual (EPA, 1998). Computed values for horizon 6 was less than 0.001, but reported here as 0.001 to prevent errors in PRZM.

Table 4. PRZM 3.12 Lewkalb Sandy Loam Soil Parameters for Kern County, California – Potato.		
Parameter	Value	Source/Comments
Organic Carbon Content (OC)	0.14% (HORIZN = 1) 0.14% (HORIZN = 2) 0.09% (HORIZN = 3) 0.16% (HORIZN = 4) 0.25% (HORIZN = 5) 0.11% (HORIZN = 6)	NRCS Soil Characterization Database (SCD) (http://ssldata.nrcs.usda.gov/); Values were converted to %OM for Rawls and Brakensiek equation based on %OM = %OC*1.724. Value for horizon 6 is the mean of the bottom two horizons (see NHORIZ note above).

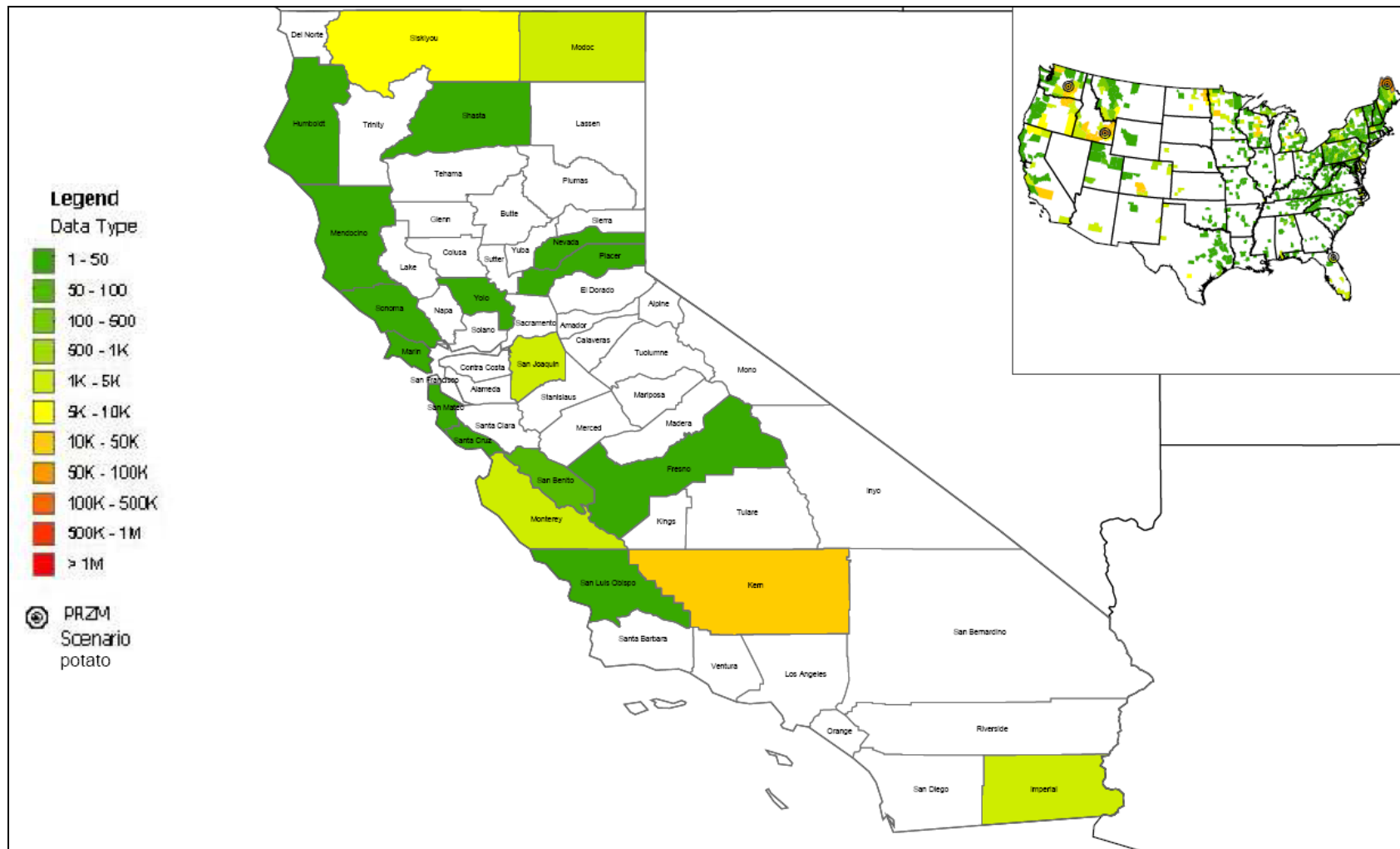


Figure 1. 2002 harvested acres for potatoes based on USDA Census of Agriculture (USDA, 2002b) for California and conterminous United States (inset) Estimates do not include data for individual farms which NASS has excluded to protect the identity of individual farms.

Table 5. Potato Bearing Soils of Kern County, California Ranked by Area.											
Soil	Total Acreage	% Area	Drainage	Erodibility	Slopes (%)	pH	OM (%)	% Sand	% Silt	% Clay	Irish potatoes-IrrYield
KIMBERLINA	170655	36.15%	B	0.32	0-5	7.5	0.75	68.3-71.3	16.7-19.7	12	340
WASCO	108895	23.07%	B	0.32	0-2	7	0.25	67.4-70.5	16.5-19.6	13	340
MILHAM	99800	21.14%	B	0.32	0-2	7.9	0.75	67.9	19.6	12.5	360
HESPERIA	27871	5.90%	B	0.32	0-9	7.3-7.9	0.25	67.4	19.6	13	300-400
LEWKALB	11580	2.45%	C	0.32	0-2	8.2	0.25	68.3	19.7	12	380
ROSAMOND	11292	2.39%	C	0.28	0-2	8.2	0.75	65.9	19.1	15	400
DRIVER	10260	2.17%	C	0.32	0-2	7.9	0.25	67.1	18.9	14	380
HAVALA	9632	2.04%	B	0.24	0-5	7.5	1.5	65.9	19.1	15	365
DESTAZO	7410	1.57%	B	0.2	0-2	8.2	0.75	67.4	19.6	13	350
WHITEWOLF	7162	1.52%	A	0.2	0-5	7.3	0.75	69.6-79.7	16.8-22.9	3.5-7.5	300
CHANAC	6670	1.41%	B	0.32	2-9	7.9	0.75	35.4	33.6	31	250
PLEITO	855	0.18%	C	0.24	2-5	7.5	1.5	55.1	17.4	27.5	250

References

- EPA. 1998. Carsel, R.F., J.C. Imhoff, P.R. Hummel, J.M. Cheplick, and A.S. Donigian, Jr. PRZM-3, A Model for Predicting Pesticide and Nitrogen Fate in the Crop Root and Unsaturated Soil Zones: Users Manual for Release 3.0. National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, GA. Online at: <http://www.epa.gov/ceampubl/gwater/przm3/przm312b.htm>.
- EPA. 1999. Jones, R.D., J. Breithaupt, J. Carleton, L. Libelo, J. Lin, R. Matzner, and R. Parker. Guidance for Use of the Index Reservoir in Drinking Water Exposure Assessments. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC.
- EPA. 2004. Abel, S.A. Pesticide Root Zone Model (PRZM) Field and Orchard Crop Scenarios: Guidance for Selecting Field Crop and Orchard Scenario Input Parameters. Environmental Fate and Effects Division, Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC. Online at: www.epa.gov/oppefed1/models/water/przm_scenario_metadata.wpd.
- EPA. 2005. Irrigation Guidance for Developing PRZM Scenarios. June 15, 2005.
- Haan, C.T. and B.J. Barfield. 1978. Hydrology and Sedimentology of Surface Mined Lands. Office of Continuing Education and Extension, College of Engineering, University of Kentucky, Lexington KY 40506. pp 286.
- NOAA. 2006. National Climatic Data Center. Climate Data Inventories – Bakersfield, CA Station. Online at: <http://www4.ncdc.noaa.gov/cgi-win/wwwcgi.dll?wwDI~StnSrch~StnID~10001177>.
- TWCII. 2006. Averages and Records for Fresno, CA. The Weather Channel Interactive, Inc. Online at: <http://www.weather.com> and <http://www.weather.com/outlook/recreation/outdoors/wxclimatology/monthly/93307>.
- USDA. 1990. Davis, F.M., R.A. Leonard, W.G. Knisel. GLEAMS User Manual, Version 1.8.55. U.S. Department of Agriculture, Agricultural Research Service (ARS), Southeast Watershed Research Laboratory, Tifton, GA. SEWRL-030190FMD.
- USDA. 2000a. Crop Profile for Potatoes in Idaho (not available for California). U.S. Department of Agriculture, Pest Management Centers. Online at: <http://www.ipmcenters.org/CropProfiles/docs/cawheat.html>.
- USDA. 2000b. Revised Universal Soil Loss Equation (RUSLE) EPA Pesticide Project. U.S. Department of Agriculture, National Resources Conservation Service (NRCS) and Agricultural Research Service (ARS).
- USDA. 2001. Official Series Description – LEWKALB Series. U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS). Accessed Online at: <http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi?-P>. December, 2006.
- USDA. 2002. 2002 Census of Agriculture. U.S. Department of Agriculture, National Agricultural Statistics Service (NASS). Online at: <http://www.nass.usda.gov/census/census02/preliminary/2002censusdates.htm>.
- VRIC undated(a). Areas of Potato Production in California. University of California Vegetable Research and Information Center. Available on-line at: <http://vric.ucdavis.edu/veginfo/commodity/potato/PotatoinCA.pdf>.
- VRIC undated(b). Potato Varieties Grown in California. University of California Vegetable Research and Information Center. Available on-line at: http://vric.ucdavis.edu/veginfo/commodity/potato/potato_varieties.pdf.
- VRIC. 1977. Potato Preplant Tillage Practices. University of California Vegetable Research and Information Center. Available on-line at: http://vric.ucdavis.edu/veginfo/commodity/potato/preplant_potatoes.pdf.

VRIC. 2000a. Fresh Market Potato Culture 200-2001. U.C. Cooperative Extension and Imperial County Circular 104-V Aug. 2000. Available on-line at: <http://www.agecon.ucdavis.edu/outreach/crop/cost-studies/Potatoes.pdf>.

VRIC. 2000b. University of California Vegetable Research and Information Center. Sample Cost To Establish And Produce. Online at: <http://www.agecon.ucdavis.edu/outreach/crop/cost-studies/Potatoes.pdf>.

VRIC. 2004. University of California Vegetable Research and Information Center. Potatoes. Online at: <http://vric.ucdavis.edu/selectnewcrop.potato.htm>.