



Current Report

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Oklahoma Agricultural Soil Test Summary 2014-2017

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Soil fertility information for an individual county or a whole state is necessary for estimating nutrient needs, tracking changes in soil pH and nutrient levels and serving as a guideline for fertilizer and manure application. The Oklahoma Cooperative Extension Service's Soil, Water and Forage Analytical Laboratory (SWFAL) analyzes soil samples and archives testing results for all 77 Oklahoma counties. A statewide and county summary of all agricultural soil samples is made every four to five years. The summary from 2014 to 2017 consists of about 47,200 samples and is presented below in Tables 1 and 2. Similar summaries from 1994 to 1999, 2000 to 2003, 2004 to 2008 and 2009 to 2013 were made and published in CR-2247, CR-2253, CR-2259 and CR-2074, respectively. All of the identifiable lawn, garden and research samples were excluded in the summary, since most of them do not represent the real condition in agricultural fields. Soil samples were analyzed for pH, buffer index (BI) if pH was less than 6.3 for lime recommendations, nitrate-nitrogen (NO₃-N, lbs/acre), soil test phosphorus (STP) index and soil test potassium (STK) index. Medians are given along with the average, because most of the data do not have normal distributions and sometimes averages give a false impression on where the center of the distribution lies for non-normal distributions. Some unusually high values were also removed from the database (NO₃-N>1,000; STP>1,000 and STK>2,000), because most of those samples were mislabeled compost or manure samples.

This summary may provide a valuable index of the soil fertility status of Oklahoma farmland, but soil samples still need to be collected and analyzed for an individual field to better manage soil fertility and to correct soil acidity problems. Similar summaries for each county are also available. To request a copy for a specific county, please contact the authors at 405-744-6630, soiltesting@okstate.edu or hailin.zhang@okstate.edu.

Soil pH and Lime Requirement

The median pH of Oklahoma soils was 6.3, which is 0.2 higher than that of the previous four years. That means 50 percent of the fields tested had a pH less than 6.3. Soil pH of

Table 1. Median, average and ranges of test results for all agricultural soil samples tested by SWFAL between 2014 and 2017.

	pH	NO ₃ -N (lbs/a)	STP Index	STK Index
Median	6.3	10	36	278
Average	6.4	19	66	334
Minimum	3.4	1	1	19
Maximum	9.7	920	999	1,983

Table 2. Distributions of soil pH, NO₃-N (lb/ac), Soil Test P Index and Soil Test K Index analyzed from 2014 to 2017.

Soil pH	<5.5	5.5-6.5	6.5-7.5	>7.5
Count	7,693	20,843	11,581	7,036
Percent	16.3%	44.2%	24.6%	14.9%
NO ₃ -N (lbs/A)	<10	10-20	20-40	>40
Count	22,120	11,759	7,893	5,350
Percent	46.9%	24.9%	16.8%	11.4%
STP Index	<40	40-65	65-120	>120
Count	25,338	9,657	5,338	6,994
Percent	53.5%	20.4%	11.3%	14.8%
STK Index	<120	120-250	250-350	>350
Count	4,984	15,616	9,640	16,856
Percent	10.6%	33.2%	20.5%	35.8%

all samples is divided into four groups and shown in Figure 1. Nearly 16 percent of the 47,200 samples had a pH less than 5.5 and indicated a potential production loss due to soil acidity. Low soil pH has become a crop production problem of increasing concern in many parts of Oklahoma. This is especially true in some counties in the central wheat growing region where as high as 30 percent of the fields had a pH less than 5.5. Strong soil acidity not only lowers the availability of

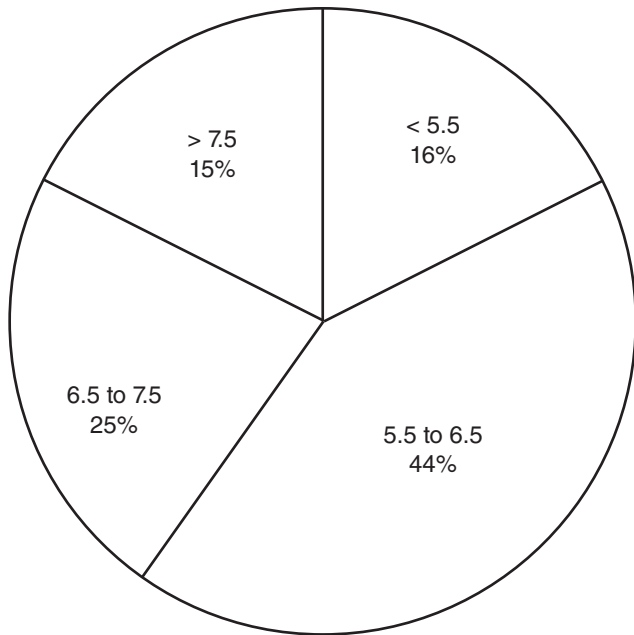


Figure 1. Soil pH distribution of Oklahoma agricultural soil samples tested between 2014 and 2017.

phosphorus, but also increases the level of toxic elements present, such as aluminum and manganese. Banding phosphate fertilizer and using aluminum-tolerant wheat varieties have shown some benefits on acid soils, but eventually lime must be used to neutralize the acidity and to sustain crop production, especially when winter wheat is rotated with other less acid-tolerant crops.

Soil Nitrate-Nitrogen (NO₃-N)

The distribution of NO₃-N in all the surface soils is shown in Table 2. The majority of the surface soil samples had less than 20 pounds residual NO₃-N per acre (median 10 pounds per acre). Only 11.4 percent of the fields sampled had NO₃-N greater than 40 pounds per acre. This indicates that most farmers would need to apply N fertilizer for the production of most crops based on surface soil tests alone. However, subsoil samples (6 to 18 inches deep) could contain significant amounts of nitrate nitrogen. Deep-rooted crops, such as winter wheat, cotton and bermudagrass can penetrate and utilize the nitrate nitrogen from the subsoil during growth. Since very few farmers submitted subsoil samples, subsoil nitrate results were not included in the summary.

Soil Test P Index

The phosphorus soil test estimates the availability of soil phosphorus during the whole growing season. The Mehlich 3 extraction method for plant-available P and K analysis has been used in Oklahoma since the 1980s. The estimated availability is reported as an index and percent sufficiency in the soil (See fact sheet PSS-2225 for more details). Phosphorus fertilizer needs to be added if the soil test P index is less than 65 (100 percent sufficient level). The available P status is graphed in Figure 2. About 54 percent of the soil samples are considered low in P availability (STP index <40) and 20 percent were in

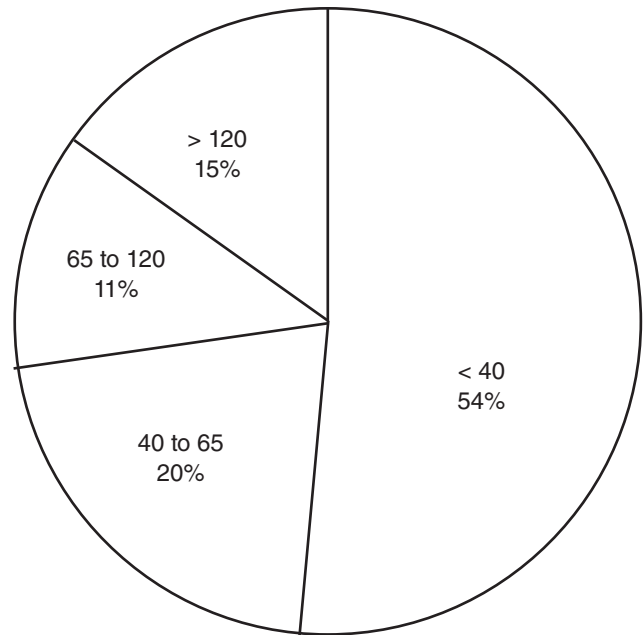


Figure 2. Distribution of soil test P index in Oklahoma agricultural soils tested between 2014 and 2017.

the medium category (STP 40-65). Therefore, those fields need various amounts of commercial P or animal manure to achieve the potential crop yields. Eleven percent of the samples had a STP index between 65 and 120. In this range, some crops may benefit from additional P fertilizer, but it may not be cost effective. About 15 percent of the fields had STP over 120, although some parts of the state had much higher percentages due to repeated application of animal manure. Knowing areas in which P is deficient will assist with manure utilization efforts through which nutrients are redistributed, thereby reducing the impact on water quality.

Soil Test K Index

Most Oklahoma soils are high in potassium. This can probably be attributed to the parent materials and low rainfall conditions under which our soils are developed. Data in Figure 3 confirms this tendency. About 44 percent of the fields had a STK index less than 250, or sufficiency less than 100 percent, for all crops except for alfalfa, which would need additional K to meet crop requirements. The 100 percent sufficiency STK for alfalfa is 350. In general, the STK levels decrease from western to eastern Oklahoma along the precipitation gradient as shown in Figure 4.

Median STK, STP and Soil pH Values by County

The median soil test K and P index, and soil pH are presented on the following Oklahoma County maps (Figures 4, 5 and 6, respectively). In general, soil pH values are neutral to calcareous in the western and southwestern parts of the state, but acidic in the eastern and north central portions. There is no obvious pattern of STP distribution, but STK decreases from the west to east.

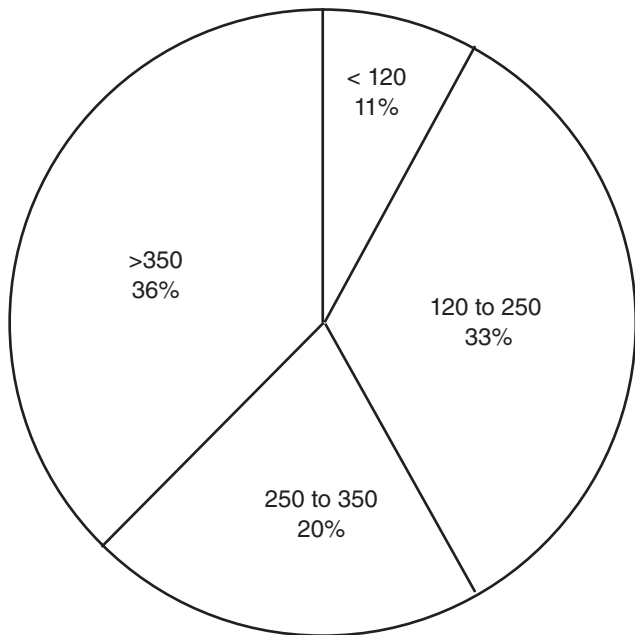


Figure 3. Distribution of soil test K index in Oklahoma agricultural soils tested between 2014 and 2017.

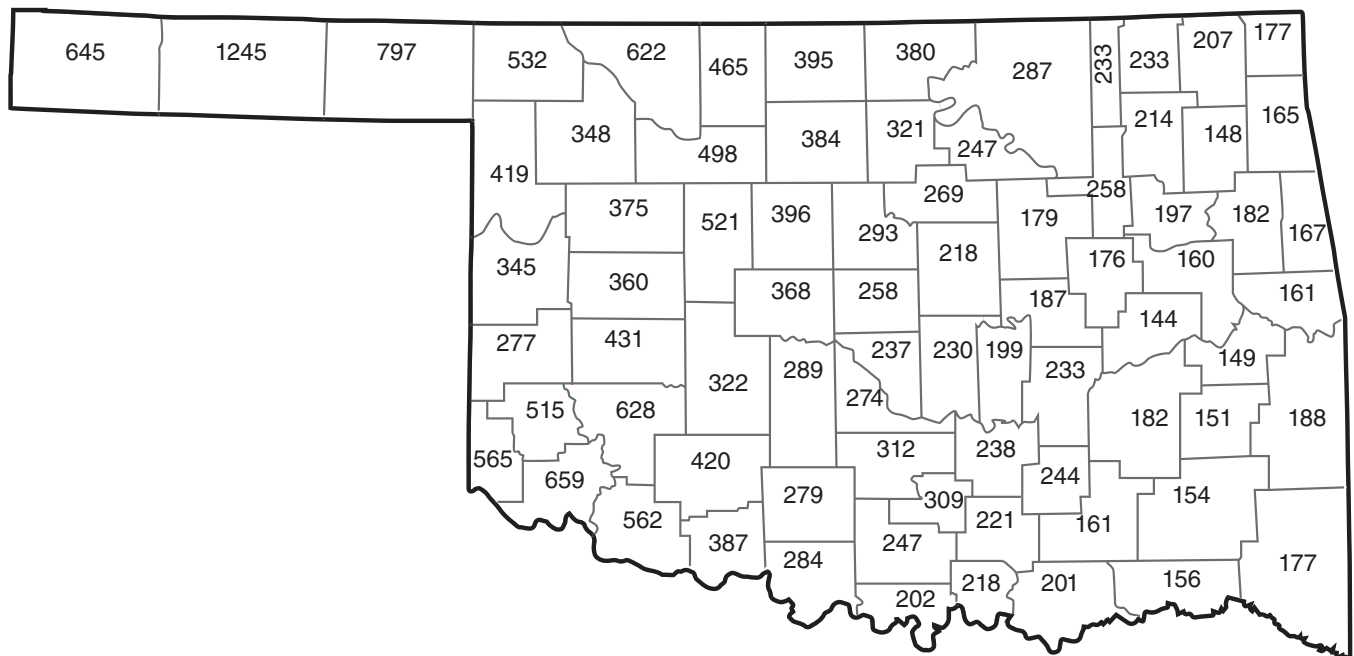


Figure 4. Median Soil Test K index values of soil samples tested between 2014 and 2017 for Oklahoma Counties.
Soil test K index ÷ 2 = mg/kg (ppm)

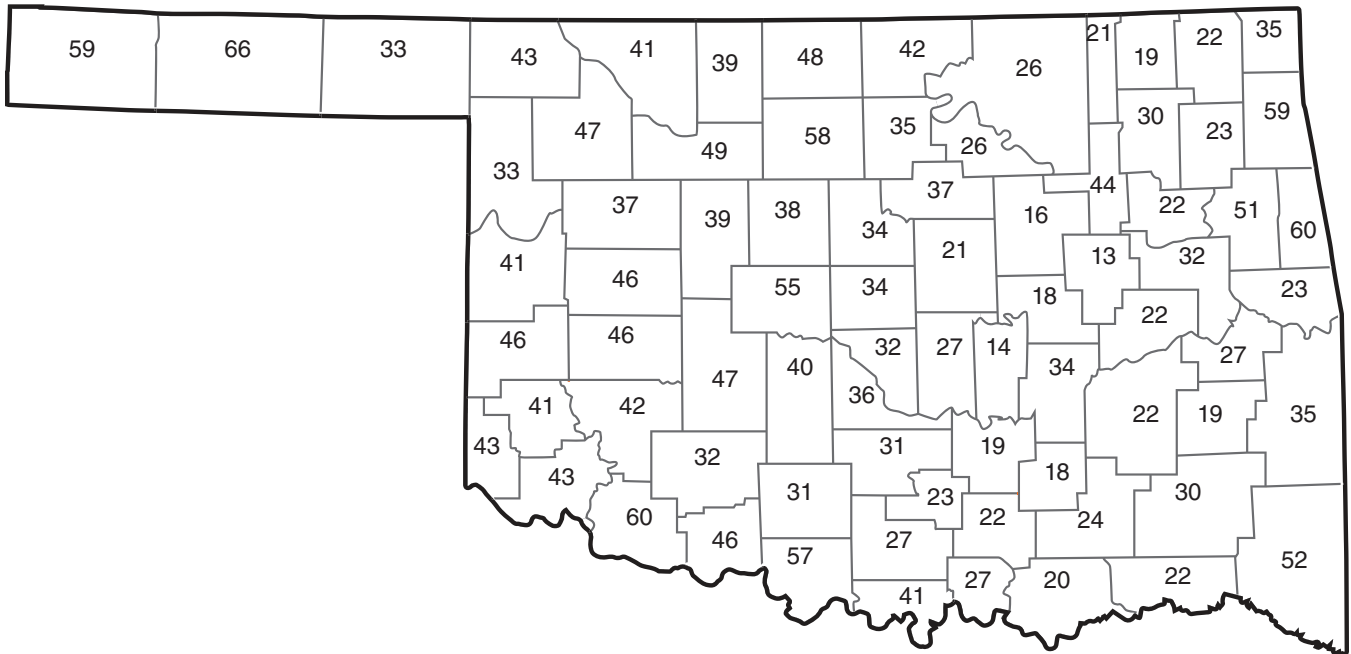


Figure 5. Median Soil Test P index values of soil samples tested between 2014 and 2017 for Oklahoma Counties.
 Soil test P index ÷ 2 = mg/kg (ppm)

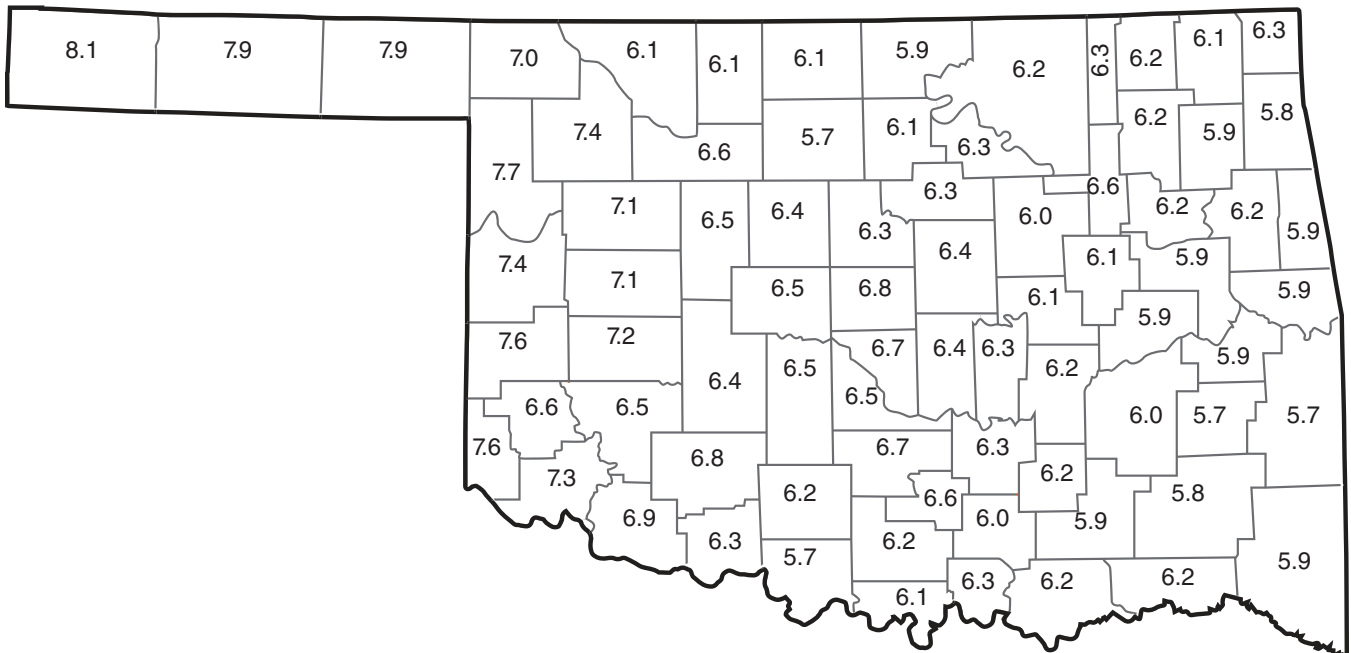


Figure 6. Median Soil pH values of soil samples tested between 2014 and 2017 for Oklahoma Counties.

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