Sesame Production in Tennessee

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Summary

- US demand for sesame currently exceeds domestic supply and has continued to increase over the past four years.
- Sesame is grown primarily in Oklahoma, Texas, and Kansas where it is prized for its high drought tolerance.
- Lines evaluated in Tennessee produced comparable yields (101 to 2123 lbs ac^{-1}) to those reported in Texas and Arkansas dryland conditions (300 to 1200 lbs ac^{-1}).
- Yields in Tennessee varied widely by location and year, potentially due to differences in precipitation. Sesame is sensitive to waterlogged soils and varieties with greater tolerance to this may do better in Tennessee.
- Yields from conventional till and no-till trials were similar, indicating either would be a good option for Tennessee producers.

Sesame is one of the oldest cultivated crops in the world with production records dating back to 1600 BC. In the US, sesame dates back to 1807, when Thomas Jefferson enthusiastically tried to grow this crop for several years, without much success, having developed a taste for the flavorful oil. Commercial production in the US began in earnest in the 1950s following the development of varieties containing a non-shattering mutation which allowed for successful machine harvest. Sesame is grown primarily in Oklahoma, Texas and Kansas (USDA NASS, 2019), where high drought tolerance makes it well adapted to these regions. In recent years, interest in this hardy crop has expanded to the South and Southeast with acreage in Mississippi, Missouri, Alabama and Arkansas. This publication will briefly cover sesame uses, global and domestic demand, and production practices, and will present results from sesame variety trials performed in Tennessee.

Sesame Uses

Sesame seeds are a familiar sight on baked goods, such as hamburger buns and bagels. These small seeds and flavorful oil are used to add a unique, nutty flavor to many dishes. Tahini, which is a paste made from sesame, is an essential ingredient in hummus. Sesame seeds and oil are also popular in many Asian dishes. Additionally, the oil from sesame is utilized in a number of processed foods and products, including margarine, shortening, soaps, pharmaceuticals, lubricants and cosmetics.

Global and Domestic Demand

Sesame production in the US has increased more than 10-fold over the past 10 years, growing from 4,978 acres in 2007 to 55,178 acres in 2017 (USDA NASS, 2019). In spite of this increase in production, US demand for sesame continues to exceed supply. In 2017, 15.8 thousand tons of sesame were produced in the US (USDA NASS, 2019). However, the US imported 39.8 thousand tons ($70.9 million) of sesame seed and 21.4 thousand tons ($93 million) of sesame oil (USDA FAS, 2019). While imports of sesame seeds have fluctuated over the past four years, imports of sesame oil have steadily increased. These trends indicate a potentially favorable outlook for increased domestic production.

Sesame Production

Variable	Recommendation
Planting Date	Soil temp. > 70 F
Planting Depth	0.75 to 2 in
Seeding Rate	2 to 4.5 lbs ac^{-1}
Row Spacing	6 to 12 in
Nitrogen Rate	30 to 60 lbs ac^{-1} (half at planting, half at early repro.)

Sesame grows best on well-drained silt loam soils and does not tolerate waterlogging at any growth stage (Myers, 2002). Given a period of three to five days of adequate moisture at establishment, sesame can also do well on sandy soils and is highly drought tolerant once established. A pH of 7.0 is considered ideal, though research supporting this is limited.

Because sesame is tropical in origin, germination is inhibited at soil temperatures below 70 F. A frost-free period of 110 to 150 days is required for production, depending on variety ("Sesame – Production Guide", 2007). In Tennessee, planting generally should be around June 1. This timing makes sesame a good option as an alternative to soybeans in a wheat double cropping system, although tillage may be necessary to attain an adequate stand if equipment is not available to plant no-till into heavy wheat stubble. Recommended planting depth and rate vary with reports of planting depths from 0.75 to 2 inches and rates from 2 to 4.5 lbs ac^{-1} (Langham et al., 2010a; Meyers, 2002; "Sesame – Production Guide", 2007). Sesame will self-thin or increase branching to compensate for plant population, making optimization of seeding rate less critical. Seeding rate should be increased if lack of moisture or cooler temperatures are anticipated. Row spacing can range from 6 to 36 inches. While results vary, the majority of research studies have shown significantly higher yields under narrow row spacing (6 to 12 inches) (Couch et al., 2017). Narrower spacing may also be preferred given the limited options for weed control. Most sesame is grown in conventionally tilled systems with limited research into no-tillage systems.

The Sesasco Corporation recommends a split nitrogen application, with half applied at planting and half at early reproductive (bud) stage (Langham et al., 2010a). Total units of N applied is dependent on water availability. In Tennessee dryland production, 30 to 60 lbs ac^{-1} of N is recommended (Langham et al., 2010a). Few herbicides are available for use in sesame and many can cause undesirable effects, such as stunting. Because of potential negative impacts of herbicides, management practices, such as narrow row spacing and early season cultivation, up to flowering, should be a first line of defense against weeds. Further weed control in sesame can be achieved with preemergence herbicides such as S-metolachlor, diuron or linuron (Couch et al., 2017). Postemergence weed control is more challenging, particularly in no-tillage systems. Clethodim or sethoxydim may be applied early in the season to control grassy weeds; however, there are currently no broadleaf weed control options that are safe to use in a sesame crop (Ferrell and Leon, 2015). In some cases, yield losses due to herbicide damage may be less than losses sustained from unchecked weed pressure. Additional consideration should be given to crops used in rotation with sesame, as sesame is highly susceptible to some herbicides used in soybean, peanut, and cotton, including imazethapyr, imazapic and trifloxysulfuron (Ferrell and Leon, 2015)

Varieties evaluated in Tennessee matured approximately 150-160 days after planting. If planted in June, sesame would be ready to harvest in late October or early November. Sesame can be harvested using a combine fitted with a small grain header. Because seeds are small, lower air speed and cylinder speed are necessary to prevent seed loss during harvest. Seed should be harvested as dry as possible since low air movement through the densely packed, high oil content seeds could cause rancidity. The Sesaco Corporation will dock seed delivered with foreign material, broken seed, or high moisture (>6 percent).

In addition to benefits from increasing on-farm crop diversification, growing sesame may also improve soil health and reduce pathogen populations (Couch et al., 2017). The extensive feeder roots and large taproot that contribute to drought tolerance in sesame help break up compaction and improve soil structure. Because sesame is a non-host for root knot nematode, it can also reduce populations of this important soybean pathogen.

Marketing and variety selection

The majority of sesame produced in the US is contracted by the Sesaco Corporation, which is the only source for adapted commercial varieties in the US. Sesame is sold by the pound rather than by the bushel. Growers should have a contract in place prior to planting sesame.

Results of Sesame Research in Tennessee

Most sesame is grown in conventionally tilled fields with varieties developed for the primary growing areas of Texas and Oklahoma. Because producers in Tennessee primarily utilize no-tillage systems with very different environmental conditions from typical sesame growing areas, research was needed to establish baseline yields, determine effectiveness of production under no-tillage systems, and evaluate varieties for adaptation to Tennessee. This research was performed in cooperation with the Sesaco Corporation, which is the primary source for developed varieties in the US.

Conventionally tilled (CT) and no-tillage (NT) yield trials were established using six Sesaco sesame lines in 2014 and repeated in 2015 with four additional lines. Locations included the Plant Sciences Unit of the East Tennessee AgResearch and Education Center (Knoxville), Highland Rim AgResearch and Education Center (Springfield), and the AgResearch and Education Center at Milan (Milan). The Knoxville location was discarded in 2014 due to poor stands and excessive weed pressure. Varieties were arranged in a randomized complete block design with four replications at each location each year.

Planting

Plots were planted with a no-till drill set on 7.5 inch row spacing at Springfield and Knoxville and 10 inch row spacing at Milan. The planting depth was set at approximately 0.375 to 0.50 inches and seeding rate was 3.5 lbs ac^{-1}. Individually harvested plots were 5 feet by 30 feet.

Weed Management

At all locations and years, except Milan 2014, plots were sprayed with Dual Magnum (pre-emergence; 1 pt ac^{-1}) and Diuron (post-emergence; 1 qt ac^{-1}). At Milan in 2014, plots were sprayed with a tank mix of Dual Magnum and Diuron pre-emergence which caused considerable plant damage; therefore, these two chemicals should be applied separately and not as a tank mix. None of the tests were irrigated in either year.

Harvest

All plots were harvested with an ALMACO SPC 40 plot combine equipped with a small grain header. Plots were harvested in late fall after leaf-drop and when the plant stems and pods had turned brown, as described in the Sesaco harvest guide (Langham et al., 2010b). Seed weight and moisture were recorded and converted to lbs ac^{-1}. The planting and harvest dates and soil types at all locations and both years are presented in Table 1.

Table 1. Location information from University of Tennessee AgResearch and Education Centers where sesame variety tests were conducted in 2014 and 2015.

2014

Location	Management	Planting Date	Harvest Date	Soil Type
Springfield	Conventional Tillage	May 29, 2014	Nov. 11, 2014	Mountview Silt Loam
Springfield	No-Tillage	May 29, 2014	Nov. 11, 2014	Mountview Silt Loam
Milan	Conventional Tillage	June 17, 2014	Nov. 21, 2014	Grenada Silt Loam
Milan	No-Tillage	June 17, 2014	Nov. 21, 2014	Grenada Silt Loam

2015

Location	Management	Planting Date	Harvest Date	Soil Type
Knoxville	Conventional Tillage	June 11, 2015	Nov. 24, 2015	Etowah Loam
Springfield	Conventional Tillage	June 12, 2015	Oct. 30, 2015	Crider Silt Loam
Springfield	No-Tillage	June 12, 2015	Oct. 30, 2015	Crider Silt Loam
Milan	Conventional Tillage	June 30, 2015	Dec. 8, 2015	Loring Silt Loam
Milan	No-Tillage	June 30, 2015	Dec. 8, 2015	Loring Silt Loam

Results

Yields varied widely by location and year. In 2014, yields were highest at the Milan location, averaging 1,461 lbs ac^{-1} across both NT and CT systems (Table 2). This result was surprising due to the herbicide damage sustained in 2014 at Milan; however, it illustrates the ability of sesame to branch out in compensation for early season damage to stands. Yields were lower at the Springfield location, averaging only 816 lbs ac^{-1}, a decrease of 645 lbs ac^{-1} compared with the Milan location. This was likely due to the higher precipitation during the sesame growing season at Springfield (23 inches) compared to Milan (15 inches) (Table 4).

Yields between NT and CT systems were similar within location, with higher yields under CT at Springfield (+164 lbs ac^{-1}) and higher yields under NT at Milan (+184 lbs ac^{-1}). The plants reached a height of about 4 feet, and reached harvestable maturity around 150 to 160 days after planting (Table 1). There were no observable differences in plant stands between CT and NT seedbed preparations. In 2014, no significant differences were observed among entries.

Table 2. Mean yields of six Sesaco sesame varieties evaluated at two Tennessee locations (Springfield, Milan) under two management systems [no-tillage (NT) and conventional tillage (CT)] during 2014.

Variety	Avg. Yield† ± Std Err (n=4)	Springfield NT	Springfield CT	Milan NT	Milan CT	Avg. Moisture (n=4)	Avg. Height (n=4)
	lbs ac^{-1}					*%*	*inches*
S35	993 ± 127	860	785	1476	853	5.3	49
S28	1346 ± 116	665	926	2123	1668	5.3	48
S32	1216 ± 122	654	1024	1601	1585	4.6	47
S34	1207 ± 121	602	908	1408	1910	5.7	45
S36	1044 ± 122	627	839	1362	1348	5.0	47
S30	1026 ± 121	996	905	1345	856	5.1	47
Avg.	**1139**	**734**	**898**	**1553**	**1370**	**5.2**	**47**

†All Yields are adjusted to 7% moisture.

In 2015, the high/low yielding locations were reversed compared with 2014 (Table 3). Springfield had the highest mean yield across systems (1,288 lbs ac^{-1}) with much lower yields observed at Milan (444 lbs ac^{-1}). Knoxville was also included in 2015 as CT only and averaged 597 lbs ac^{-1}. Differences between NT and CT were also reversed compared with 2014. Higher yields were observed under NT at Springfield (+395 lbs ac^{-1}) and slightly higher yields under CT at Milan (+47 lbs ac^{-1}). In 2015, mean yield did differ significantly among entries. Hybrid S35 was a top yielding variety (not significantly different from the highest yielding hybrid) across all locations and systems. Hybrids S30, S32, and S39, also did well, with top yields in four out of five tests.

Table 3. Mean yields of ten Sesaco sesame varieties evaluated at three Tennessee locations (Knoxville, Springfield, Milan) under two management systems (no-tillage (NT) and conventional tillage (CT)) during 2015.

Variety	Avg. Yield ± Std Err (n=5)	Knoxville CT	Springfield NT	Springfield CT	Milan NT	Milan CT	Avg. Moisture (n=5)
	lbs ac^{-1}						%
S30	941 ± 53	575 bc	1490 a	1172 abc	743 a	727 a	3.4
S35	937 ± 64	740 ab	1670 a	1078 abcd	608 ab	588 ab	3.5
S32	905 ± 50	670 abc	1944 a	985 bcd	544 ab	379 cd	3.3
S39	838 ± 62	717 ab	1450 a	1258 abc	181 bc	585 ab	3.7
S38	837 ± 51	538 bc	1402 a	1418 a	420 bc	407 bcd	3.8
S37	813 ± 50	799 a	1503 a	898 cd	425 bc	441 bcd	3.6
S28	807 ± 51	609 bc	1420 a	1297 ab	247 c	461 bcd	3.7
EXP-7	804 ± 53	609 bc	1506 a	1094 abcd	399 abc	411 bcd	3.8
S36	749 ± 50	507 c	1338 a	973 bcd	461 abc	467 bc	3.6
S34	472 ± 60	101 d	1133 a	731 d	180 c	212 d	4.1
Avg.	**810**	**587**	**1486**	**1090**	**421**	**468**	**3.6**

†All Yields are adjusted to 7% moisture.

In summary, the sesame lines evaluated in Tennessee produced comparable yields to those reported in Texas and Arkansas under dryland conditions (300 to 1200 lbs ac^{-1}). However, yields in Tennessee ranged widely by location and year. This variation may have been due to differences in precipitation during the growing season. Higher yielding trials (Milan 2014, Springfield 2015) received between 15 and 16 inches of rain during the growing season while lower yielding trials (Springfield 2014, Milan 2015, Knoxville 2015) received between 23 and 27 inches of rain (Table 4). Sesame is sensitive to waterlogged soils and may not tolerate periods of above average precipitation. Yields from CT were similar to yields from the NT and either system would be a good option for producers in Tennessee. Finally, there were differences among the lines in yielding ability. Depending on hybrid/location/yr/seedbed type, yields ranged from a low of 101 lbs ac^{-1} to a high of 2123 lbs ac^{-1}.

Sesame appears to be a potentially profitable crop for Tennessee producers looking for opportunities to diversify their production systems. While sesame is prized for drought tolerance, producers in Tennessee may see more consistent yields when selecting varieties that have a greater tolerance to both high and low levels of precipitation.

Table 4. Total precipitation and soil temperature at planting by location and year during sesame trials in Tennessee.

Location/ Year	Total Precip. 5 dap†	Total Precip. full season†	Soil Temperature at Planting†
	in.	*in.*	*^0F*
Knoxville			
- 2015	0	26.98	74
Springfield			
- 2014	0.72	23.06	71
- 2015	0	16.27	75
Milan			
- 2014	0	15.48	75
- 2015	1.67	24.36	74

†data obtained from weather stations located on experiment station property and available through the National Centers for Environmental Information (NOAA)

Resources

Couch, A. R.M. Gloaguen, D.R. Landham, G.J. Hochmuth, J.M. Bennet, and D.L. Rowland. 2017. Non-dehiscent sesame (*Sesamum indicum* L.): its unique production potential and expansion into the Southeastern USA. Journal of Crop Improvement 31 (2): 101-172.

Ferrell, J., and R. Leon. 2015. Weed management in sesame. University of Florida IFAS Extension SS-AGR-392.

Langham, D.R., J. Riney, G. Smith, T. Wiemers, D. Peeper, and T. Speed. 2010a. Sesame Producer Guide. Sesaco Corporation.

Langham, D.R., J. Riney, J. Aubin, D. Peeper, T. Speed, G. Smith, and Ti. Wiemers. 2010b. Sesame Harvest Guide. Sesaco Corporation.

Myers, R.L. 2002. Sesame: A High Value Oilseed. Jefferson Institute.

Sesame Profile, Agricultural Marketing Resource Center (AGMRC), August 2018. (https://www.agmrc.org/commodities-products/grains-oilseeds/sesame-profile)

Sesame - Production Guide. Texas A&M AgriLife Research and Extension Center at San Angelo. Jan. 29, 2007. (http://sanangelo.tamu.edu/extension/agronomy/agronomy-publications/sesame-production-guide/)

United States Department of Agriculture National Agricultural Statistics Service (USDA NASS). Nass.usda.gov. Accessed 20 July 2019.

United States Department of Agriculture Foreign Agricultural Service (USDA FAS). Fas.usda.gov. Accessed 20 July 2019.

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