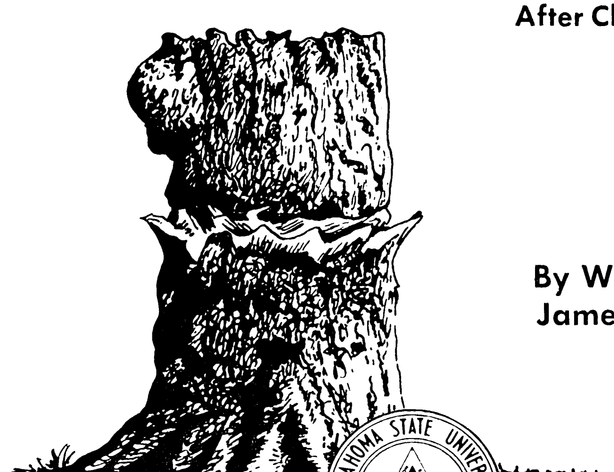
Technical Bulletin
T-80 AUG. 1959

Food Reserves in Post Oak Stumps & Roots

Results of a 5-Year Study of Changes in Food Reserves in Post Oak Stumps and Roots After Chemical Treatment

By W. C. Elder and
James E. Webster



OKLAHOMA STATE UNIVERSITY
SCIENCE SERVING AGRICULTURE
1891
EXPERIMENT STATION

CONTENTS

Food Reserves in Post Oak Stumps and Roots

By W. C. Elder and James E. Webster*

Departments of Agronomy and Biochemistry
Oklahoma State University

Research has indicated that hardwood trees and brush are more susceptible to chemical control methods at certain times of the year than at other times. It is generally believed that the best time for treating brush foliage with 2,4-D and 2,4,5-T comes after spring growth, when root reserves are being replenished.

McIlvain recommends the dates of May 1 until June 10 for spraying sand sage, *Artemisia filifolia*, with 2,4-D in Oklahoma (3). June 1, or when the plant reaches full leaf size, was found to be the best time to spray scrub oak species in central Oklahoma by Elwell and Elder (1). Mesquite, in Texas, is best controlled with 2,4,5-T applied six weeks after the first leaves appear in spring, according to Young and Fisher (6).

There is more divergent opinion concerning the best time to make basal and frill treatments on trees. Dormant treatments are used primarily, but many times good results are received from treatments during the growing season.

In an effort to establish a sound basis for chemical treatments, the Oklahoma Agricultural Experiment Station conducted tests to determine the food reserves in the stumps and roots of oak trees throughout the year. Food reserves were also determined from chemically treated trees in an attempt to find how growth is inhibited.

* The authors wish to acknowledge the assistance of James Gassaway and Jack Dressen, former research assistants in the Department of Agronomy, for their help in collecting wood samples for chemical analysis.

Methods of the Study

In November, 1951, nine post oak, *Quercus stella,* trees ten to twelve inches in diameter were chosen for the test. The trees were carefully selected for uniformity in trunk size, height, spacing and soil site. These trees were assigned at random for the following treatments:

1. Three trees were left standing.

2. Three trees were sawed off 12 to 18 inches above the ground and each stump was sprayed with 300 ml. of a mixture that contained 8 lbs. of 2,4-D and 8 lbs. of 2,4,5-T in 100 gallons of diesel oil.

3. Three trees were sawed off 12 to 18 inches above the ground but the stumps were not chemically treated and the sprouts were allowed to grow.

Samples for chemical analysis were secured by collecting borings with a one-inch wood auger at 8 to 10 inches above the ground. Approximately 50 grams of borings were collected from each tree or stump. Root samples were collected by removing soil from a one- to two-foot depth and exposing large roots. A ½-inch wood auger was used to collect borings from the roots. The soil was replaced after samples were collected. The root samples were composited from the three trees receiving the same treatment.

Samples were collected monthly during April, May, June, and July. During the rest of the year, samples were collected bi-monthly.

The original trees were sampled for 20 months, then discarded and new trees selected. Three series of tests were made during the five-year sampling period.

Chemical analyses—processing of samples. The wood borings were delivered to the Biochemistry laboratory in sealed jars. These samples were immediately dried for 24 hours at 105° C. in order to secure moisture values. The dried samples were stored in glass jars in the dark until a later time, when they were ground through the fine mesh screen of a Wiley cutting mill. Later, aliquots of the prepared material were extracted in Soxhlets for 36 hours with 80% ethanol. Extracts were diluted to 500 ml. with 80% ethanol and stored until sugars could be determined. The extracted and dried residues were pulverized in ball mills for 36 hours and the residues stored until acid-hydrolyzable determinations could be made.

Chemical Determinations: Soluble sugars in the extracts were determined as follows: Ethanol was evaporated from aliquots of the extracts placed on a steam bath, after which the samples were taken up in water. The water samples were clarified with lead acetate and excess lead was removed with potassium oxalate. Reducing sugars values were determined on the clarified extracts, using the method of Shaffer and Hartman (4). Total sugars were determined by the same method on aliquots of these clarified extracts after they had been hydrolyzed over night with HCl. Sucrose was calculated as 95% of the difference between reducing and total sugars.

Acid-hydrolyzable values were determined on the finely ground, extracted residues. These determinations were made according to the directions for starch in the A.O.A.C. (5); however, much more than starch is included in these values. This procedure involved digesting the samples for 2.5 hours with boiling dilute HCl and then filtering the digests. Reducing sugars were determined on these digests as directed above. Recorded values represent 0.9 of the reducing sugar values.

All nitrogen values were determined by the Kjeldahl-Gunning method described in the A.O.A.C. (5). Alcohol-soluble nitrogen was determined on aliquots of the extracts and total nitrogen was determined on the whole ground samples before extraction. Insoluble nitrogen was secured by calculation. The figure obtained represents the difference between soluble and total nitrogen.

Ash percentages were secured by ashing 2 gram portions of the samples in a muffle furnace at 600° C. held overnight.

Results of the Study

The one-inch hole made 12 inches above ground in standing trees, to obtain wood samples for chemical analysis, apparently did not injure the trees. The holes were soon sealed over with new growth, making it difficult to locate the trees a few years after sampling was discontinued. The chemically treated stumps made very little regrowth and appeared to be dead, but apparently decomposed very little during the sampling period. The non-treated stumps produced sprouts that were 4 to 6 feet high before sampling was discontinued.

A review of weather records shows below normal rainfall for the entire five years. Less than 60% of the normal rainfall fell during 1954 and 1956. Precipitation was almost normal in 1953 and above normal in 1951, the year preceding the test.

Total sugars and soluble solids were lower during 1952 and 1953 in the roots of standing trees. Otherwise, all the analyses were quite similar from year to year.

The data are summarized in Table I.

Soluble Solids: In general, soluble solids did not change greatly during the year in either the roots or the above-ground samples. High readings in the roots of standing trees were found in January and December, while April, May and June had the lowest readings. Basal samples from standing trees showed a slight increase of solids over the roots, with January highest and April the lowest month. Cutting the trees and allowing the sprouts to grow did not affect the soluble solids when compared with the growing trees. However, in the 2,4-D and 2,4,5-T treated stumps, the solids were lowered approximately 20%. Most of this loss occurred in the latter part of the sampling period for each group of trees, when the stumps appeared to be completely dead.

The greatest variability found in soluble solids was from above ground samples of individual trees. Average reading for the untreated trees was 8.5%, but a range of 5% to 12% was common from the untreated trees. It was interesting to find that the high and low readings were associated with individual trees, and that the changes made by individual trees during the year followed the pattern given in Table I. Since the samples of roots were composited for each treatment, it is impossible to evaluate the solids from the roots of individual trees.

Total Sugars: Nearly all of the total sugars shown in Table I are reducing sugars. Sucrose content was always less than 0.30% and many times was down to 0%. In all of the analytical data, the sugar content showed greater variation than the other materials. This was especially true when treatments and samples from the roots and stumps were compared.

In the roots of treated stumps, sugars were 33% less than in roots of standing trees and 40% less than from the tree trunk samples. The untreated stumps showed considerably more sugars than the treated stumps, but much less than the standing trees. Sugars were very low in all the tree trunks and stumps, being less than 1% in standing trees.

Seasonal change of sugar percentages followed a definite pattern in both the root and basal borings. The three high months were December, January and February. A gradual reduction occurred during March and April, reaching a low in May. Readings from all the treatments and different locations in the tree indicate that sugars slowly recover in post oak during the summer and fall months.

Although there was wide variability in the sugar content of the samples, individual trees did not show as wide a variability of sugars as was found for soluble solids.

Total Nitrogen: Approximately one-third of the total nitrogen in Table I is soluble nitrogen. Nitrogen was very low in all the samples, but was 20% to 30% greater in the roots than in the trunk samples. Treatments did not change the nitrogen content in either roots or stumps. Nitrogen appeared to be slightly higher in the roots during January, February and March; otherwise the readings were similar throughout the season. Sugars were high in December, January and February.

Acid-hydrolyzable Materials: A narrow range of from 26% to 30% of acid-hydrolyzable material was found in the oaks. The average in the roots was approximately 28% and in the trunks it was approximately 27%. Slightly higher percentages were found in the roots during the first part of the year; otherwise all other readings were very similar.

Summary

Wood samples for analysis were collected from the roots and trunks of post oak trees. One group of trees was left standing; a second group was sawed off 12 to 18 inches above ground and treated with a 2,4-D and 2,4,5-T mixture in diesel oil; and a third group was sawed off but not treated. Samples were collected for 20 months from each group of trees. Three series of trees were used in the five-year study. Chemical analyses included the percentages of moisture, ash, reducible sugars, sucrose, acid-hydrolyzable materials, soluble and insoluble nitrogen, and soluble solids.

Soluble solids were practically the same in the roots and trunks of standing trees and untreated stumps. Treated stumps showed 15% to 20% less soluble solids. Highest readings in the standing trees were in December and January and the lowest in April, May and June. Greater variation was found in individual trees than from the different treatments or location of sampling.

Roots contained almost twice the amount of total sugars contained in trunk samples. The treated stumps contained 30% to 40% less

sugars than standing trees. In the standing trees, sugars were highest in December, January and February and lowest in May.

Stumps treated with 2,4-D and 2,4,5-T mixtures had lower soluble solids and total sugars; however, this loss did not show up until a few months after treatment.

Not enough differences were found in total nitrogen or acid-hydrolyzable values to mention, except that 20% to 30% more nitrogen was found in the roots than in the above-ground samples.

From the data collected in this study it appears that highest food reserves in post oak occur during December, January and February. A reduction starts in the spring months, reaching a low for the year in May. The reserves are gradually built up in the summer and fall months, reaching a peak in January.

It is interesting to note that the time usually considered best for foliage application (June) is after food reserves are lowest and while they are in the process of increasing. On the other hand, frill and stump treatments are usually made during the months of December, January and February, and reserves were highest during this period.

Literature Cited

1. Elwell, Harry M. and W. C. Elder. Tests of aerial applications of herbicides on post oak and black jack brush in Oklahoma; Progress Report, 1952-1953. Okla. Agr. Exp. Sta. Mimeographed Circular M-258. May, 1954.

2. Leonard, Oliver A. and Alden S. Crafts. Uptake and distribution of radioactive 2,4-D by brush species. Hilgardia, Vol. 26, #6, Dec. 1956.

3. McIlvain, E. H. Seventeen-year summary of Range Improvement Studies at the U. S. Southern Great Plains Field Station. Woodward, Oklahoma. 1937-1953.

4. Morrow, Austin C. *Biochemical Laboratory Methods.* John Wiley and Sons. 1927.

5. *Official and Tentative Methods of Analysis.* Association of Official Agricultural Chemists. 7th Ed. 1950.

6. Young, Dale W. and C. E. Fisher. Toxicity and Translocation of herbicides in mesquite. Proceedings of Seventh Annual North Central Weed Control Conference. p. 278. 1950.

Table I.—A Summary of Results for Five Years of Chemical Analysis on the Stumps and Roots of Post Oak (*Quercus stellata*) to Determine the Food Reserves Throughout the Years and to Determine the Effect of Herbicidal Treatments on Stumps.

(Percent of Dry Weight)

Treatment	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
Soluble solids from Roots													
Standing trees (trunk)	8.54	8.14	7.81	7.32	7.72	8.17	8.57	8.32	8.24	7.56	8.06	9.87	8.19
Treated Stumps	8.20	7.71	7.00	6.72	7.20	6.73	6.11	6.31	6.00	5.75	5.84	6.90	6.71
Non-Treated Stumps	8.60	8.20	7.90	7.90	7.70	9.20	8.76	7.70	8.38	8.42	8.41	8.40	8.30
Soluble Solids from Stumps													
Standing trees (trunk)	9.48	8.95	8.26	8.07	8.36	8.46	9.26	8.96	9.01	8.67	8 50	8.45	8.70
Treated Stumps	7.64	7.43	7.00	6.86	7.40	6.93	7.90	7.53	7.00	6.76	6.60	7.20	7.18
Non-Treated Stumps	8.68	8.46	8.44	7.72	7.90	8.18	8.80	8.54	8.30	8.15	8.03	8.08	8.27
Total Sugars from Roots													
Standing trees (trunk)	2.03	1.64	1.13	1.03	.68	1.11	1.41	1.56	1.38	1.57	1.55	2.06	1.42
Treated Stumps	1.41	1.19	.73	.88	.89	1.15	.76	.81	1.03	.97	1.03	1.03	.99
Non-Treated Stumps	1.83	1.68	1.30	1.10	1.11	.96	1.11	.93	1.61	1.40	1.31	1.18	1.29
Total Sugars from Stumps													
Standing trees (trunk)	1.27	.96	.63	.60	.52	.59	.81	.91	.93	.98	1.02	1.35	.89
Treated Stumps	.94	.71	.43	.43	.51	.48	.54	.31	.48	.45	.44	.44	.51
Non-Treated Stumps	.99	.79	.52	.54	.59	.58	.50	.54	.64	.57	.53	.58	.61
Total Nitrogen from Roots													
Standing trees (trunk)	.28	.28	.28	.23	.18	.22	.23	.24	.25	.27	.25	.23	.25
Treated Stumps	.27	.26	.27	.25	.21	.21	.21	.23	.21	.21	.20	.21	.23
Non-Treated Stumps	.29	.29	.29	.25	.24	.25	.20	.24	.25	.25	.19	.19	.24
Total Nitrogen from Stumps													
Standing trees (trunk)	.18	.17	.17	.15	.15	.15	.17	.17	.17	.17	.17	.18	.17
Treated Stumps	.17	.17	.18	.18	.19	.18	.17	.16	.16	.16	.16	.16	.17
Non-Treated Stumps	.18	.17	.18	.19	.17	.18	.15	.17	.18	.18	.18	.18	.18
Acid-hydrolyzable values from Roots													
Standing trees (trunk)	29.6	29.50	30.00	30.10	28.90	27.00	27.90	26.60	28.50	27.90	27.70	27.00	28.39
Treated Stumps	28.90	28.80	29.30	28.70	30.58	28.04	26.51	27.62	27.68	27.70	27.81	27.24	28.17
Non-Treated Stumps	29.60	29.90	30.10	29.40	30.10	27.10	27.60	27.10	27.10	27.08	26.1	26.40	28.12
Acid-hydrolyzable values from Stumps													
Standing trees (trunk)	27.19	27.64	28.05	28.36	28.00	26.74	26.73	26.38	27.00	26.94	26.70	26.31	27.17
Treated Stumps	26.68	26.80	27.29	27.88	28.70	27.40	27.30	27.16	27 60	27.56	27.85	26.43	27.38
Non-Treated Stumps	26.17	26.81	27.97	28.03	26.65	27.20	25.72	25.60	26.29	26.38	26.17	25.23	26.58