AN ECOLOGICAL STUDY OF THE BALD CYPRESS IN INDIANA

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The bald cypress, *Taxodium distichum* (L.) Richard, (Fig. 1), grows along the Atlantic coast from southern Delaware to Florida and westward along the Gulf to Texas and north in the Mississippi Valley to southwestern Indiana and southern Illinois. Little Cypress Swamp in the southwestern part of Knox County has the largest acreage of this species in Indiana. This tree also occurs in smaller areas in Posey, Vanderburg, and Warrick counties.

Fig. 1—A portion of two branches of the bald cypress with numerous foliar shoots and a few cones[1].

In June, 1929, the author with a class of Indiana University plant ecology students made several visits, during a period of three consecutive weeks, to the cypress swamps in the above mentioned counties.

[1] The author is indebted to Dr. Paul Weatherwax for the photographs shown in figures 1, 4, and 5.

"Proc. Ind. Acad. Sci., vol. 41, 1931 (1932)."

The purpose was to study some of the ecological factors of a cypress swamp. In May, 1931, a DePauw University plant ecology class and the writer visited the Little Cypress Swamp. Although no different data were obtained than in 1929, the drier condition of the area permitted study farther into the swamp.

Discussion of Field Data. Because of the necessity of brevity the detailed data recorded from the field studies are omitted. Although a general discussion of germination and of seedlings is the purpose of this report a few remarks concerning the trees may be of interest.

The largest tree found, (Fig. 2), had a circumference of 45 ft. 4 in. at base and 27 ft. 2 in. four and one-half feet above base.

Fig. 2—The largest cypress tree reported in the Little Cypress Swamp. The hole near the base is the result of an examination by lumbermen to determine whether or not the tree would make satisfactory lumber.

The cypress "knees" were numerous and some measured a few inches over four feet in height. (Fig. 3.)

Many large cypress stumps 10 to 15 ft. high were conspicuous during the period of low water. Approximately 400 species of vascular plants were collected in the areas studied, identified, and deposited in the Herbarium of Indiana University.

Hundreds of cypress seedlings a few inches in height were observed in the swamp east of Mt. Vernon. The cotyledons were fully expanded and the first leaves were beginning to appear. Frequently the seedlings were found in clumps. This condition was brought about in various ways: (1) several seeds and cones were washed together in the lower portions of the swamp; (2) cones fell from the tree, were more

or less buried in the mud, and several seeds in each cone germinated; and (3) numerous seeds fell from the cones which remained on the trees and germinated in close proximity.

Many seedlings and saplings in Little Cypress Swamp were measured. Although the height varied from four inches to eight feet, the great majority of these small cypresses were less than two feet in height. There was a large gap in size between saplings eight and nine feet high and small trees one foot in circumference. There was an abundance of trees with circumference measurements larger than two feet.

Thousands of cypress seedlings have appeared each year in the swamp lands of southwestern Indiana. Perhaps their destruction has

Fig. 3—Two of the tallest "knees" observed by the writer in Little Cypress Swamp.

been brought about in one or more of the following ways: (1) almost every spring large portions of this area have been flooded and the logs floating over the seedlings and saplings may have broken the trunks or removed the tops; (2) possibly in winter large pieces of moving ice have broken the young trees; and (3) many acres of this land have been drained and the outer portions of the swamp may have become too dry during certain seasons for the survival of a large number of seedlings. No count of the many broken saplings was made but there was sufficient evidence that the bald cypress seeds germinted and that the seedlings grew under favorable conditions. During recent years the majority of the young cypresses have been destroyed by some factor or combination of factors. The number of young cypress trees in the swamp was noticeably small.

Discussion of Experimental Methods. The experimental work with cypress seeds and seedlings was done in the greenhouse at Indiana University from September, 1929, to August, 1930. An attempt was made to imitate as many of the swamp conditions as possible. The seeds were selected from cones which were collected in Evansville, Indiana, September 23 and October 21, 1921, by the late Prof. A. J. Bigney. All cones received were in the green stage. The phases of the exprimental work included in this paper concern various methods of seed germination.

Moist Atmosphere. On October 29 two culture dishes were filled with water and each was placed on a large piece of glass. Around

Fig. 4—Two cypress seedlings in cotyledon stage. The seeds germinated in moist atmosphere.

one of the vessels was placed cones and seeds from the September collection; around the other, cones and seeds from the October collection were arranged. These were covered with a thin layer of sphagnum. After a bell jar was placed over each preparation, they were set aside on a shelf in the greenhouse. The first seedlings, (Fig. 4), appeared January 3 and in the culture containing seeds collected in October. During the next two months a total of 24 germinations occurred. No seedlings appeared in the culture containing seeds from the September collection until February 17. During the following three weeks there was a total of 37 germinations.

As soon as the hypocotyls were perpendicular, the cotyledons horizontal, the root systems well started, the seedlings were transferred to soil in flower pots. The pots were then placed in crocks which were filled with water so that the seedlings could grow in a water-saturated soil, (Fig. 5). (Daily growth records of all seedlings were made but data concerning growth experiments are not sufficiently complete for publication at this time.)

Water Germination. On October 29 four cones, four seeds attached to sporophylls, and 12 seeds without sporophylls were selected from the September collection. The same procedure was used with the October collection. Each selected group was floated on water in a crock. Three germinations in the September collection occurred about three and one-half months after the experiment was started. Approximately six to

Fig. 5—Illustration of method by which seedlings were grown in water—saturated soil.

eight months after the seeds were floated, nine seeds from the October collection germinated.

As soon as the radicles and cotyledons were well developed, the seedlings were placed in a crock containing a layer of dirt and covered with water. The radicles continued growing in the soil and the seedlings produced foliar shoots beneath the surface of the water.

Sphagnum and Soil. Two hundred seeds were selected from the October collection. On March 20, 100 of these seeds were planted in a box containing ordinary soil. The remaining 100 seeds were planted in a box which contained four alternating layers of sphagnum and dirt. The contents of both boxes were kept well saturated with moisture. The first seedlings appeared in each box about the same date, approximately three or four weeks after planting. Nineteen seeds

germinated in the sphagnum and dirt and 38 in the box containing only soil.

Two hundred seeds selected from the September collection were treated in the same manner. The first seed germinated in the mixture of sphagnum and dirt about one and one-half months after planting, and in dirt alone about one month after planting. There was a total of 22 seedlings in dirt and sphagnum and 37 in the soil. From these data based upon 400 seeds the number of germinations in the soil about doubled that in the mixture of soil and sphagnum.

Depth of Planting. Thirty-six seeds were selected from each collection and 12 of each were planted two centimeters beneath the soil surface, 12 of each four centimeters beneath the surface, and 12 of each at a depth of eight centimeters. The pots were placed in crocks of water so that the soil could be kept uniformly moist. Although the total number of germinations was small, three strong seedlings developed from the seeds planted at a depth of eight centimeters.

Flooding Experiment. One seedling was selected which was growing nicely in a flower pot. On February 19 this pot and seedling were placed in a battery jar and the plant covered with two inches of water. Measurements of the foliar shoots were made and the needles counted. On April 3, the measurements and the count were repeated and it was found that no change had occurred. At this time the depth of water was decreased so that the tips of the foliar shoots extended above the water. The water was maintained at a constant level and by May 12 the foliar shoots had increased their length 2.2 and 2.5 cms. and had produced 35 and 34 new needles, respectively.

This experiment was continued by moving 10 potted seedlings to an outdoor pool. During the earlier part of the experiment the tips of the foliar shoots were exposed above the surface of the water and the amount of growth was recorded weekly. After several weeks of rapid growth the pots were lowered so that the plants were beneath the surface of the water. Measurements were made weekly but no growth was observed. Thus it seemed that the cypresses could live under water for several weeks but during that time no measurable growth occurred.

Transplanted Seedlings. To determine the possibility of this species growing farther north in Indiana several seedlings have been transplanted from the swamps and from the Indiana University greenhouse to various more northern habitats. The seedlings in all places, including the locality farthest north (85 miles south of Chicago), have been growing very nicely.

On the east side of the Indiana University greenhouse there is a bed of 60 to 75 cypress saplings. They have grown from seeds germinated in the experiments previously discussed, between December, 1929, and August, 1930. At this time the average height of these trees is between two and one-half and three feet. The largest primary stem measures[1] 25 mms. (one inch, caliper measure) in diameter four inches above the ground. The average diameter by caliper measurements, just

[1] This fact was received in a letter from Prof. D. M. Mottier, Nov. 2, 1931.

above and just below the cotyledon scars, at the time of transplanting was approximately two and one-half millimeters. This increase in circumference has taken place during the last year (summer of 1930 to that of 1931).

Dunn Meadow Cypress Trees. On August 31, 1931, a survey was made by the writer concerning the number of cypress trees in Dunn Meadow along Jordan River on the Indiana University campus, the number of "knees", and the general moisture conditions of the habitat. This group consists of 12 trees which range in circumference, at the base of tree, from three feet and one inch to five feet and nine inches. When measured three feet above the ground the range is from one foot and eleven inches to four feet and five inches. A brief summary of the investigation follows. (1) Six of the 12 cypress trees had "knees." (2) Forty-one "knees" were counted. Thirty-nine of these were found on roots of the trees growing in the low moist ground and two were on trees in drier soil. (3) "Knees" varied in height from one and one-half inches to five inches. (4) There seemed to be no correlation between the size of the tree and the production of "knees" nor between the size of tree and the number of "knees" produced. (5) There is no record of cone production by these specific trees.

SUMMARY

1. Seeds of *Taxodium distichum* collected in southern Indiana in September and October germinated in approximately three months.

2. Seeds germinated in a moist chamber, in water, in soil alone, and in a mixture of soil and sphagnum.

3. Healthy and strong seedlings developed from seeds planted at a depth of eight centimeters.

4. As the length of time between the collecting of the seeds and the planting, (rest period), increased, the period of time required for germination became less.

5. In consideration of the number of seeds planted the percentage of germination was low.

6. Approximately the same number of germinations resulted from the seeds collected in September as from those gathered in October.

7. Apparently no growth occurred while seedlings were submerged but upon emergence, growth was resumed. The seedlings lived under water but made no noticeable growth unless the growing points of the shoots were above the water.

8. Although the bald cypress in Indiana does not grow naturally north of Knox county, this species has been transplanted successfully to northern portions of the state (85 miles south of Chicago). (Two large trees are growing in Greencastle.)

9. Based upon numerous observations made in the swamps and in Dunn Meadow, Indiana University campus, there seems to be no correlation between the size of the tree and the production of "knees" or the size of the tree and the number of "knees" produced. The "knees" did not seem to be characteristic of the younger and the smaller trees.

10. The seedlings under observation had from four to eight cotyledons. Four and eight were rare, five and seven were frequent, and six was the most common.