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George W. Wendel

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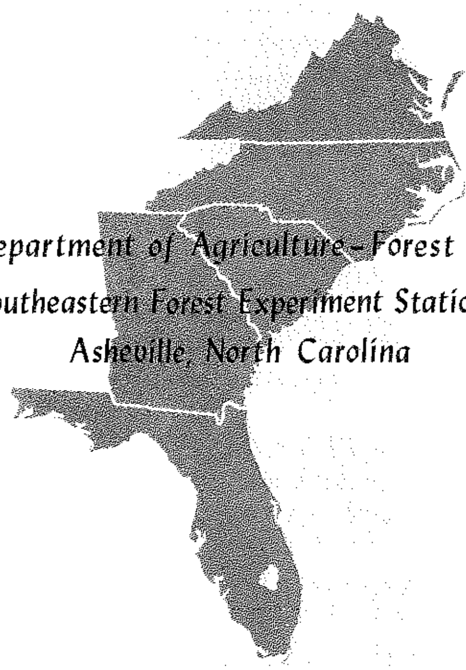

U.S. Department of Agriculture - Forest Service
Southeastern Forest Experiment Station
Asheville, North Carolina

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INTRODUCTION

During the most severe burning conditions practically all of the living understory vegetation on pocosins may be consumed by fire (9). Even under less severe conditions leaves and branch tips are readily consumed. Whether the moisture content in the living vegetation is high, as it is in the spring, or low, as in the winter, exerts a strong influence on fuel flammability and fire behavior. The moisture content in live pocosin fuels is generally higher than in dead fuels; however, the moisture content of individual plant species and the seasonal moisture changes are not known. This paper reports on the moisture content fluctuations for one year in four common understory plants in North Carolina pocosins: common gallberry (*Ilex glabra*), redbay (*Persea borbonia* (L.) Spreng.), swamp cyrilla (*Cyrilla racemiflora* L.), and switch cane (*Arundinaria tecta* (Walt.) Muhl.) (figures 1 to 4).

The primary purpose of this study was to determine the time of occurrence and magnitude of the yearly extremes in moisture content in these species and the patterns of seasonal change. A secondary purpose was to ascertain if moisture content in common gallberry growing on a mineral soil differed from moisture content in common gallberry growing on an organic soil. No attempt was made to correlate the results of this study with specific fire behavior patterns because the relations are not well understood.

Limited studies with other species in the Pacific Northwest (5) and northern Rocky Mountains (7) have shown that the moisture content in various shrubs and grasses decreased during the normal summer fire season. Reifsnyder (6) reported that the lowest moisture content in the older leaves of mountain laurel (*Kalmia latifolia* L.) in Connecticut occurred in the spring and fall, the normal fire seasons in the area. In general, moisture content in living and dead fuels is inversely proportional to the rate of fire spread (1, 2, 4) and, therefore, the extent of curing in green fuels should be considered in any system for rating forest fire danger (3).

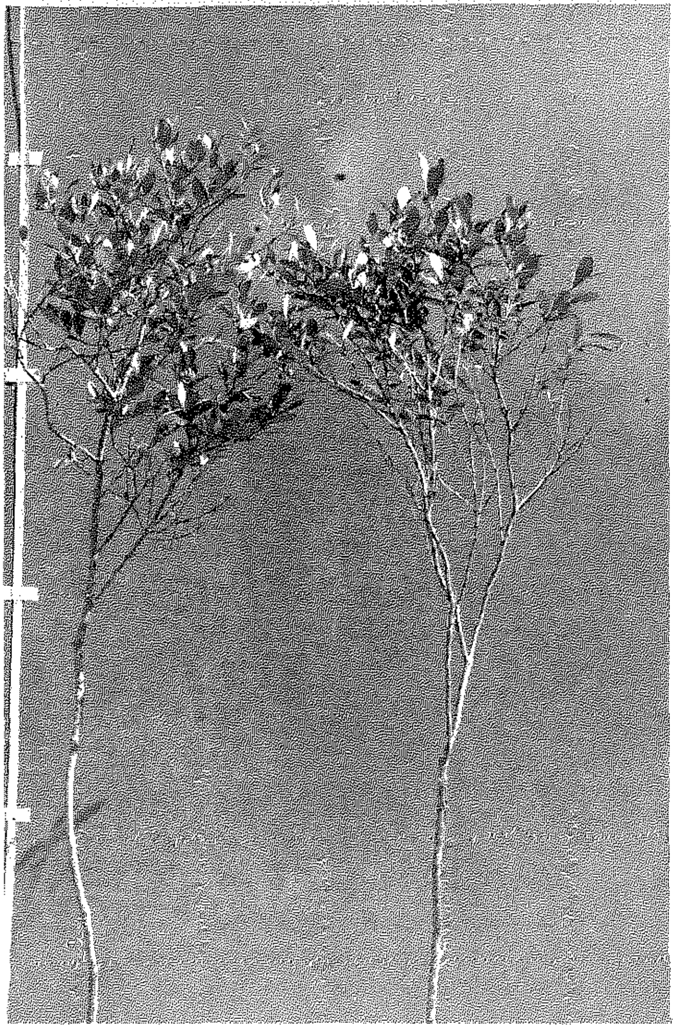

Figure 1.--Common gallberry.

Figure 2.--Redbay.

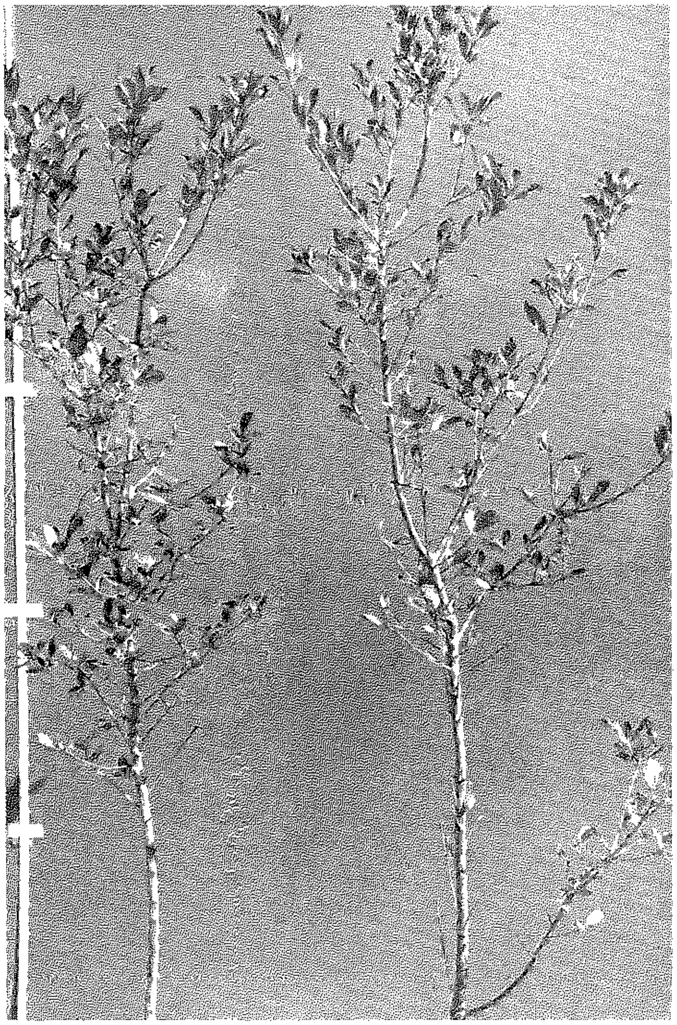

Figure 3.--Swamp cyrilla.

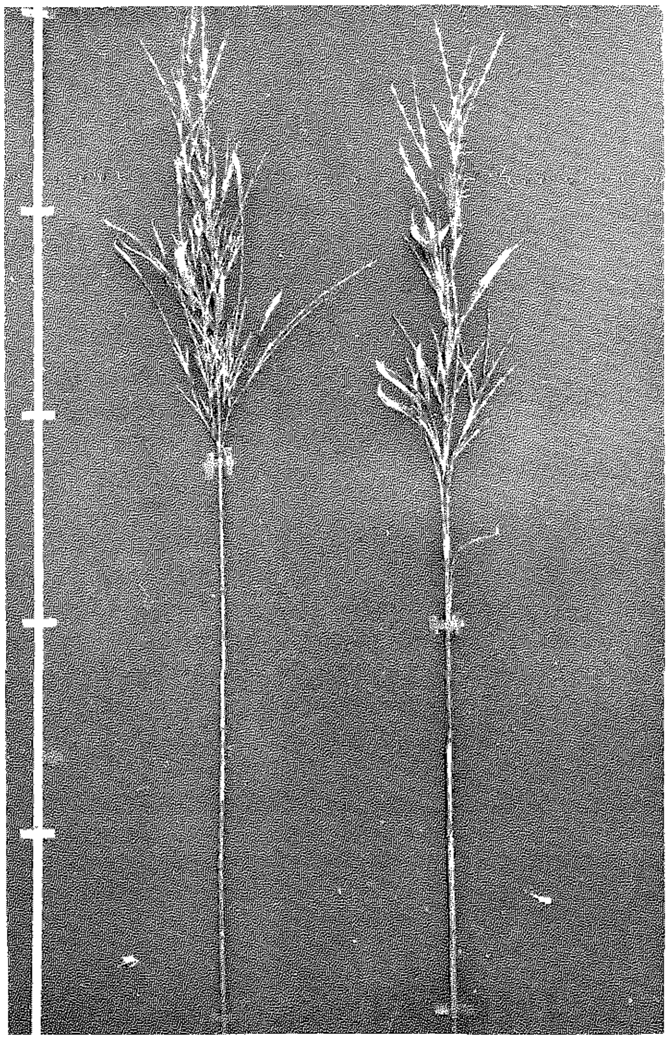

Figure 4.--Switch cane.

THE STUDY AREA

All sampling was done on Hofmann Forest in Jones and Onslow Counties, North Carolina. The organic soil sampling areas are characterized by wet, poorly-drained mucky peat soils, 1 to 3 feet deep, with an organic matter content of 25 to 90 percent. The overstory is a low-density pond pine (Pinus serotina Michx.) stand with a dense switch cane or shrub understory. The mineral soil is a fairly well-drained sandy loam with an open, switch cane-shrub understory and an overstory of scattered pond pine (table 1).

Ground water level, precipitation, and temperature records were obtained from the Maysville weather station, approximately 3½ miles from the sampling areas. Staff gage readings taken intermittently in soil auger holes in the sampling areas showed the same trends as the well recorder data.

Monthly precipitation during the study was near or above the 9-year average, except for May and June, which were 1.90 inches and 2.75 inches, respectively, below the average (fig. 5) (8).

Maximum and minimum temperatures were about normal during the course of the study.

A prolonged dry period occurred between April 12 and June 28; during this time the maximum depth to the water table was 4 feet. The water table did not drop below 3 feet for any extended period during the remainder of the year.

SAMPLING PROCEDURE

Five whole plant[1/] samples of each species were collected at weekly intervals during the first 9 months. Sampling was intermittent for the remainder of the year and varied from 1 to 3 weeks between samplings. Samples of each species were collected at nearly the same time each sampling day to minimize the effects of diurnal variation in moisture content. Criteria for selecting each sample plant were height and crown form (table 1).

The foliage was separated from the woody parts and the moisture contents, based on ovendry weight of each component and for the whole plant, were determined.

1/ Above-ground portion, exclusive of roots.

Table 1.--Descriptions of species and sampling sites

Species	Criteria for selecting sample bushes	Site
Common gallberry (Ilex glabra)	Bushes 3.5 to 4.0 feet tall, generally clump grown. Stems usually clear for 2.5 feet, symmetrical crowns.	Mineral soil, with humus layer $1\frac{1}{2}$ inches deep underlain by fine sand. Fair internal drainage. Organic soil, 2 to 3 feet deep peaty muck, mineral content 10 percent. Poorly drained.
Redbay (Persea borbonia (L.) Spreng.)	Shrubs 3.5 to 4.0 feet tall, 2- to 3-year-old sprouts. Stem diameter at ground level $\frac{1}{2}$ inch.	Organic soil. Same site as common gallberry.
Swamp cyrilla (Cyrilla racemiflora L.)	Shrubs 4.0 to 5.0 feet tall, single stems finely branched at top, symmetrical crowns.	Organic soil, similar to that for redbay.
Switch cane (Arundinaria tecta (Walt.) Muhl.)	At least 2-year-old canes, 4.0 to 5.0 feet tall, growing in a medium density cane brake.	Organic soil, 8 to 12 inches deep. 25 percent organic matter by loss on ignition.

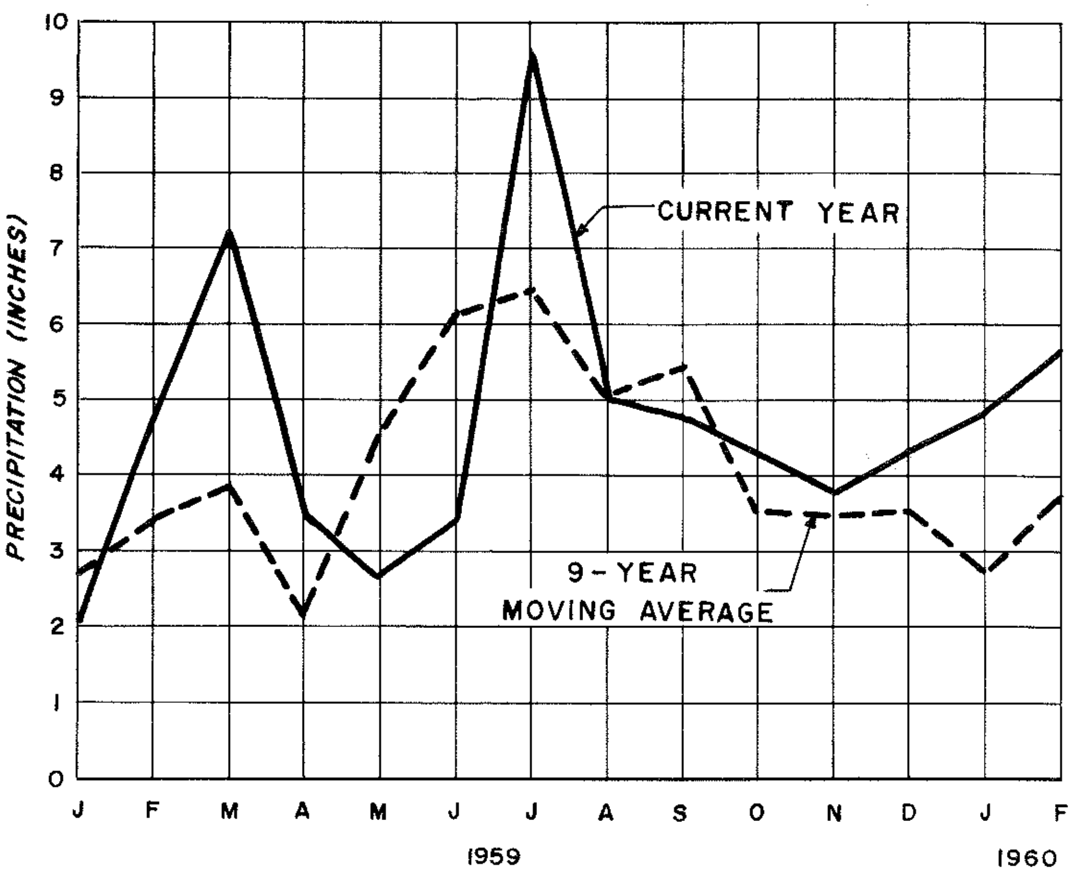

Figure 5.--Comparison of monthly precipitation during the study period and the 9-year moving average (1951-1960), recorded at the Maysville, North Carolina, weather station.

MOISTURE CONTENT FLUCTUATIONS

Whole plant moisture content in all species except common gallberry on both sites increased gradually from the end of March until a maximum was reached in late May and early June (fig. 6). The moisture content increase in common gallberry began in early May, with the maximum occurring in June on the dry site and in July on the wet site. A gradual decrease in moisture content occurred during the rest of the year in all species. By January 1960 the whole plant moisture contents had reached levels similar to those of February 1959. Yearly trends were statistically highly significant for all species.

Foliage and stem moisture content for all species followed the same pattern as the whole plant except that foliage moisture contents invariably were higher and stem moisture contents lower.

SITE EFFECTS

An analysis of variance showed a highly significant difference in whole plant moisture content between sites and with time for common gallberry growing on the mineral soil and on the organic soil (table 2). The significant interaction of site with time indicates that the moisture content of common gallberry on the two sites did not follow the same general pattern in the spring and early summer as in the late summer and fall (fig. 6).

DISCUSSION

The moisture content in the foliage, stems, and whole plants varied widely within and between species with time. The moisture content in cyrilla foliage ranged from a high of 322 percent to 104 percent, in switch cane from 190 percent to 54 percent, in gallberry from 143 percent to 96 percent, and in redbay from 138 percent to 56 percent. Redbay and common gallberry are evergreen shrubs, swamp cyrilla is practically deciduous, and switch cane leaves die in the winter but remain on the canes until spring. These leafing characteristics probably account, in part, for the wide ranges in foliage moisture content.

During a 10-week drought period in the spring, the moisture content in all species continued to rise. Except for a slight recharging of the water table in May, a general fall in the water table was recorded from April 12 to June 28. Evidently the low water table did not reduce soil moisture enough to affect plant moisture content.

Figure 6.--Seasonal trend in moisture content in whole plant, stems, and foliage of four species of pocosin vegetation, Hofmann Forest, North Carolina. Each point is the average of five samples.

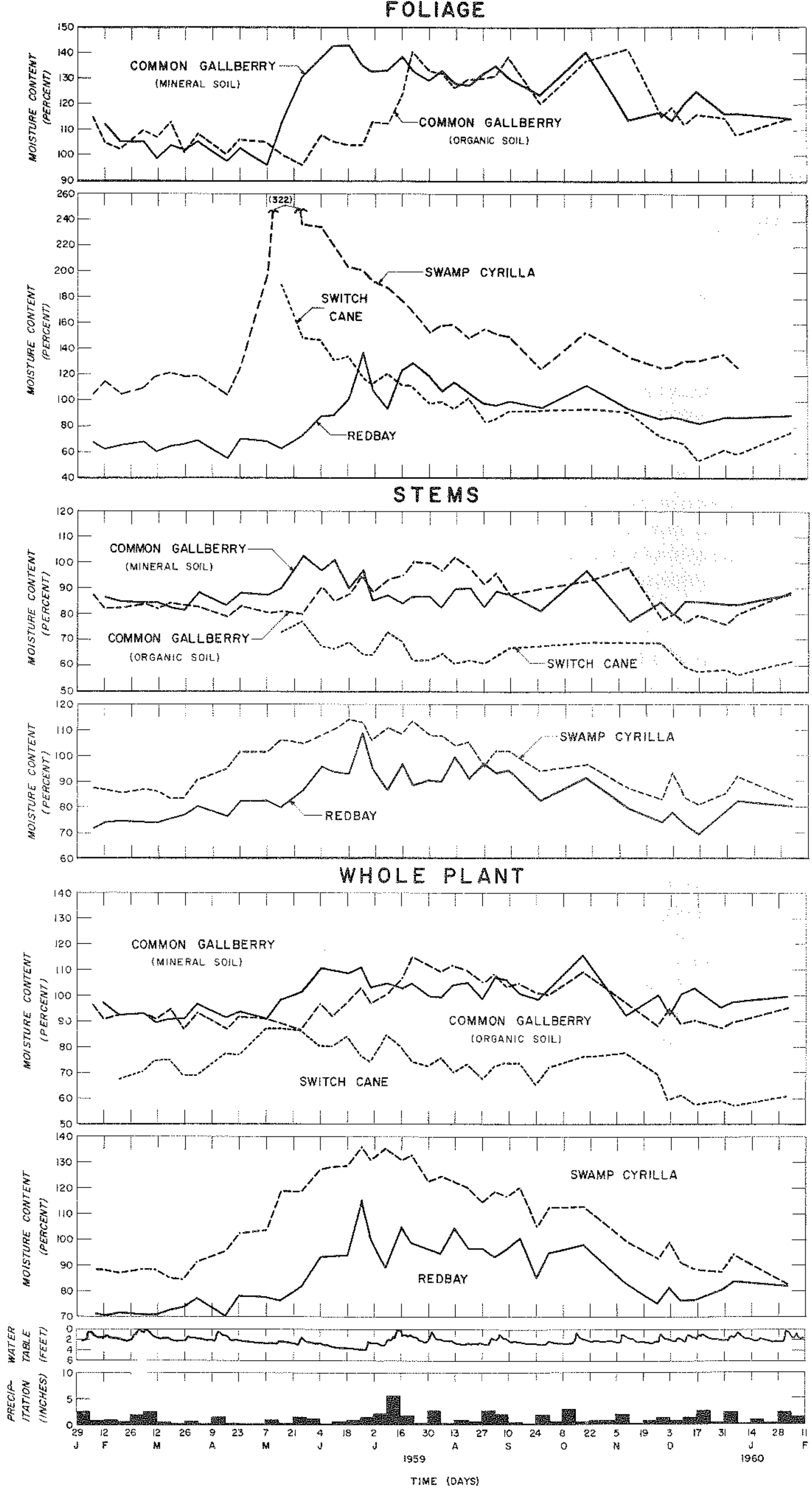
FOLIAGE
MOISTURE CONTENT (PERCENT)
COMMON GALLBERRY (MINERAL SOIL)
COMMON GALLBERRY (ORGANIC SOIL)
(322)
SWAMP CYRILLA
SWITCH CANE
REDBAY
STEMS
COMMON GALLBERRY (MINERAL SOIL)
COMMON GALLBERRY (ORGANIC SOIL)
SWITCH CANE
SWAMP CYRILLA
REDBAY
WHOLE PLANT
COMMON GALLBERRY (MINERAL SOIL)
COMMON GALLBERRY (ORGANIC SOIL)
SWITCH CANE
SWAMP CYRILLA
REDBAY
WATER TABLE (FEET)
PRECIPITATION (INCHES)
1959
1960
TIME (DAYS)

Table 2.--Analysis of variance, moisture content of whole plant common gallberry growing on a mineral soil and on an organic soil

Source of variation	Degrees of freedom	Sum of squares	Mean square
Site	1	620.9	13.43**
Time	37	16,629.1	9.72**
Site x Time	37	6,030.8	3.53**
Error	304	14,047.8	
Total	379	37,328.6	

** Highly significant, 1 percent level.

There is some evidence to suggest that the significantly higher moisture content in whole plants of common gallberry on the dry site in the spring and summer may not be characteristic. A freeze on May 16 partially killed much of the new growth on the wet-site gallberry, thus reducing the total foliage moisture content. Common gallberry on the dry site was not affected by the freeze.

During 1959 the lowest moisture content in the four species occurred in the spring and late fall, also the seasons of greatest fire occurrence in eastern North Carolina.

SUMMARY

The moisture content fluctuations in the foliage, stems, and whole plants of common gallberry, redbay, swamp cyrilla, and switch cane growing on an organic soil pocosin were determined for one year, as well as the moisture content in common gallberry growing on a mineral soil.

Statistical tests revealed highly significant differences in moisture content with time for all species. The moisture content in common gallberry on the organic site was significantly greater than that on the mineral site. This difference may have been caused by a reduction in new growth on the organic site as a result of a freeze in May.

A continuous fall in the water table during a 10-week period in the spring did not bring on a decrease in whole plant moisture content.

The periods of lowest vegetation moisture content coincided with the seasons of greatest fire occurrence in eastern North Carolina.

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