Tree diameter increment in the subtropical moist life zone of Puerto Rico.

Compendio. El incremento periódico anual del DAP en un rodal, previamente entresacado, localizado en el bosque montano alto (bosque de "colorado") en el sudeste de Puerto Rico, creció a un promedio de 0.25 cm/año durante 27 años. El incremento a largo plazo era doble de cualquier otro registrado en otro bosque de "colorado" en la isla.

The Cubuy tract in the Caribbean National Forest was purchased in 1936. At that time, it was mostly farmland with some trees along steep streambanks. Farming continued on the tract until about 1950.

In 1937-40, *Tectona grandis, Swietenia macrophylla, Calophyllum calaba, Cordia alliodora,* and *Petitia domingensis* were planted, and in 1946, *Tabebuia heterophylla*. Plantations of these species and secondary forests cover the area today.

The Cubuy tract, ranging from 300 to 550 m in elevation, is the only portion of the Caribbean National Forest mapped within the Subtropical Moist Forest Life Zone (4). Mean annual rainfall, well distributed through the year, is 2 000 mm. Mean annual temperature is 19.5°C, and potential evapotranspiration is estimated at 1 150 mm/yr.

The soils on the Cubuy tract are shallow to moderately deep, well-drained Caguabo clay loams (1), derived from tuffaceous sandstone and lava (2). Puerto Rico contains 116 000 ha of shallow clay loams suitable for commercial timber production within the Subtropical Moist Forest Life Zone. More than 32 000 ha are currently reforested farmland similar to the study area.

The purpose of this study was to determine periodic annual DBH increment (PAI) over 16 years by species, crown class, and topographic position, and to compare the data with similar studies conducted elsewhere in the Luquillo Forest. All species listed in Figure 1 produce valuable timber suitable for furniture or construction (6). Knowledge of diameter growth is important for management of these stands.

Methods

This study was pursued within the general framework of a pilot management project designed to increase timber production by eliminating species whose wood is currently not marketable and by thinning for select "crop trees" (3).

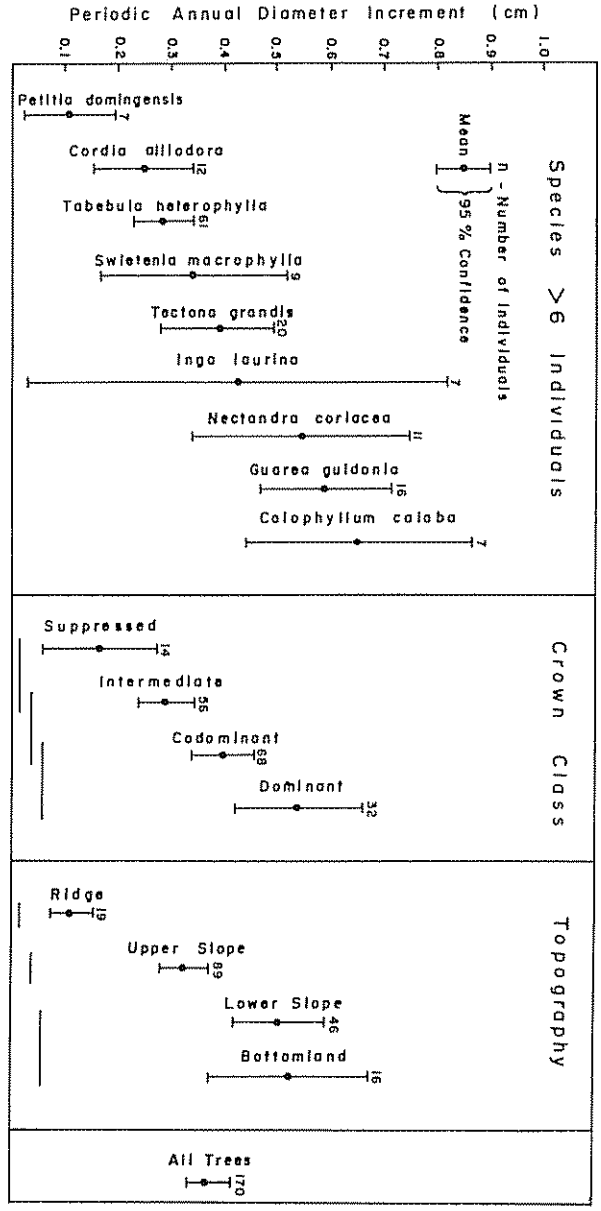

Fig. 1. Periodic annual diameter increment by species, crown class, and topography in the Cubuy tract of the Caribbean National Forest. Horizontal lines at bottom of chart connect means not significantly different according to multiple range tests (Tukey's Omega procedure; Steel and Torrie 1960)

In 1959, 100 circular 0.08 ha plots were established throughout the Cubuy tract. Topographic position (i. e. bottomland, lower slope, upper slope, ridge), species, DBH for crop trees ≥ 9 cm and crown class (dominant, codominant, intermediate, suppressed) were recorded for each plot. In 1975, 20 of the plots, selected by topography in the same proportion as the original 100, were surveyed again. Trees were located and remeasured.

PAIs were calculated for species with ⩾ 7 individuals, for all trees, by crown class, and for each topographic position. Multiple range tests using Tukey's Omega procedure (7) were conducted by crown class and topographic position.

Results and discussion

The PAI for all stems was 0.37 cm/yr (Figure 1), a value that closely approximates the 0.38-0.42 cm/yr range reported for all crop trees in nearby Subtropical Wet Forest (3).

The PAI by species ranges from a low of 0.11 cm/yr for *Petitia domingensis* through a high of 0.65 cm/yr for *Calophyllum calaba* (Figure 1). *Tabebuia heterophylla* appears to grow slowly throughout the Luquillo Forest, averaging 0.29 cm/yr in Cubuy, and ranging from 0.18 to 0.35 cm/yr elsewhere (3). *Guarea guidonia*, a large native Meliaceae with valuable timber, averaged 0.59 cm/yr in Cubuy, and 0.81 cm/yr elsewhere in the Luquillo Forest. *Inga laurina*, the remaining species for which comparative crop tree data area available, averaged 0.42 cm/yr in Cubuy and ranged from 0.43 to 0.58 cm/yr elsewhere in the forest.

Growth is positively correlated with an increase in crown dominance. PAI by crown class ranged from 0.54 cm/yr for dominants to 0.17 cm/yr for suppressed stems. Moreover, topographic position has a significant effect on PAI. Trees on ridges and upper slopes average 0.12 and 0.33 cm/yr, respectively, while trees on lower slopes and in bottomlands average 0.54 and 0.55 cm/yr (Figure 1). This is presumably due to greater soil depth and available moisture in lower topographic positions.

In comparison, typical PAIs in undisturbed stands in the Subtropical Wet Forest of the Luquillo mountains are only about 0.15 cm/yr (8); whereas in thinned stands PAIs average about 0.35 cm/yr (9).

In summary, it appears that the PAIs of crop trees in the thinned Cubuy tract are about equal to the PAIs of crop trees in thinned Subtropical Wet Forest. Differences in species composition and past land use, however, suggest a need for more detailed studies.

Summary

Periodic annual diameter increment on a previously thinned small plot in upper montane forest ("colorado" forest) in southeastern Puerto Rico averaged 0.25 cm/yr over 27 years. Long-term increment was twice that recorded for other colorado forests on the island.

September 10, 1980.

RALPH SCHMIDT*
PETER L. WEAVER**

* Southern Forest Experiment Station, Institute of Tropical Forestry P. O. Box AQ. Río Piedras. PUERTO RICO.

** Research forester at the Institute of Tropical Forestry, Río Piedras PUERTO RICO.

Literature cited

1. BOCCHECIAMP, R. A. Soil Survey of Humacao of Eastern Puerto Rico. U. S. Department of Agriculture Soil Conservation Service in cooperation with the U. P. R. College of Agricultural Sciences. 103 p. + tables. 1977.

2. BRIGGS, R. P. and J. P. AKERS. Hydrologic map of Puerto Rico and adjacent islands. U. S. Department of the Interior Geologic Survey Hydrologic Investigations Atlas HA–197. Washington, D. C. 1965.

3. CROW, T. R. and P. L. WEAVER. Tree growth in a moist tropical forest of Puerto Rico. U. S. Department of Agriculture Forest Service Research Paper ITF–22, 17 p. Institute of Tropical Forestry, Río Piedras, Puerto Rico. 1977.

4. EWEL, J. J. and J. L. WHITMORE. The ecological life zones of Puerto Rico and the U. S. Virgin Islands. U. S. Department of Agriculture Forest Service Research Paper ITF–18, 72 p. Institute of Tropical Forestry, Río Piedras, Puerto Rico. 1973.

5. HOLDRIDGE, L. R. Life Zone Ecology. Tropical Science Center. San José, Costa Rica. 1967. 206 p.

6. LONGWOOD, F. R. Puerto Rican woods; their machining, seasoning, and related characteristics. U. S. Department of Agriculture Forest Service Handbook No. 205, 98 p. Government Printing Office, Washington, D. C. 1961.

7. STEEL, R. G. D. and J. H. TORRIE. Principles and Procedures of Statistics. McGraw-Hill Book Company, Inc. New York, New York. 1960. 481 p.

8. WADSWORTH, F. H. Forest management in the Luquillo Mountains, I. The setting. Caribbean Forester 12:93-114. 1951.

9. WADSWORTH, F. H. Forest management in the Luquillo Mountains, III. Selection of products and silvicultural policies. Caribbean Forester 13:93-119. 1952.

Regulación química de la floración y fructificación en ajonjolí (*Sesamum indicum* L.).

Abstract. The object of this research was to increase the harvested seed in sesame (*Sesamum indicum* L.). Microscopical observations showed that seeds mature far before the capsules open so it is possible to fasten plant maturity without interrupting seed development.

Best results were obtained with the mixture of ethephon 25 ppm + paraquat 3%, both applied at "field harvest point" when plants begin to defoliate at the basis of branches. This treatment increased seed (weight) 40% over the control treatment because plants were harvested and threshed the same day, 4 days after treatment, instead of harvested and left to dry out in the field during 2 weeks after the traditional way. The treatment makes feasible the mechanical harvest of sesame.

Also folcistein (Ergostim) was tried. Applied at a 42% at budding and again 15 days later determined and increase in seed (weight) of 66% over the control treatment. This was due to a better flower setting as shown by counting flowers and fruits at several dates.

Una de las principales limitantes en la producción de semilla de ajonjolí es la desigual maduración y dehiscencia de las cápsulas que obliga a grandes insumos en la recolección y cosecha (10). Para evitar este problema se han intentado métodos culturales y genéticos (3, 11) pero se ha encontrado que la característica de cápsula indehiscente se asocia con otras características negativas que determinan bajo rendimiento y problemas en la cosecha mecánica (3).

La aplicación de fitorreguladores abre vías metodológicas para controlar el problema. En la maduración de los frutos juega un importante papel el etileno, que puede aplicarse en forma exógena como ethephon y que si bien se ha usado principalmente en la tecnología de frutos carnosos también tiene efectos en frutos secos como el del algodón (7, 8). Algunos desecantes como el paraquat también actúan sobre la maduración y se han usado en cultivos diversos incluso oleaginosos como girasol y colza (11).

Una manera indirecta pero efectiva de reducir pérdidas en la cosecha consiste en promover una mayor floración o bien evitar la caída de flores o frutillos. A este respecto se han probado muchos fitorreguladores. Uno de los más nuevos es la folcisteína que ha mostrado eficiencia (1, 9) pero de la cual aún falta experimentación más amplia tanto básica como tecnológica.

Materiales y métodos

La investigación se llevó a cabo en los laboratorios y en el Campo Agrícola Experimental del Instituto Tecnológico y de Estudios Superiores de Monterrey (México) del 1° de junio de 1979 al 20 de agosto de 1980. El objetivo básico fue aumentar el rendimiento de semilla cosechada en ajonjolí. Para ello se efectuó: 1) Un análisis del proceso de maduración del fruto, 2) un experimento sobre el efecto del ethephon (ácido 2, cloretil fosfónico) producto que actúa sobre la maduración liberando etileno en el interior de la planta, y del paraquat (1,1 dimetil-4,4 dicloruro (cation) de dipiridilio) producto desecante por oxidación de los tejidos vegetales, 3) un experimento sobre el efecto de la folcisteína (Ergostim) (derivado del ácido tiazolidín-4 carboxílico) bioestimulante de reciente aparición. En todos los experimentos se usó ajonjolí (*Sesamum indicum* L.), cv. Moreliano de hábito indefinido, porte alto y muy ramificado.

Análisis de la maduración del fruto y semilla

Metodología

Se tomaron 30 plantas al inicio de la floración; cada 5 días se tomaron 3 cápsulas de cada planta: una típica del tercio inferior, otra del tercio medio y otra del tercio superior. Las cápsulas se observaron al microscopio de disección para ver la formación de la semilla y de las líneas de dehiscencia. A los 10, 20 y 30 días del desarrollo se tomaron cápsulas para seccionarse en micrótomo rotatorio y observarse al microscopio óptico teñidas con safranina-verde rápido; otras se trataron con floroglucina y HCl 25% que tiñe selectivamente la lignina.