Fällen gegen 1 streben müssen. Aus den Bestimmungsgleichungen wurde eine Abschätzung des maximalen Anstieges der Verwandtschaftsgrade abgeleitet.

Unter der Annahme von Zufallspaarung wirkte sich die Aufhebung der Ortsgebundenheit in einer (allerdings nur schwachen) Erhöhung der Inzuchtgrade aus. Der für die explizite Berechnung von Venvandtschaftsgraden aus den hergeleiteten Gleichungen nötige Aufwand kann als relativ gering bezeichnet werden.

Schlagworte: Verwandtschaft, Ortsgebundenheit.

Summary

In view of the heterogeneous neighborhood conditions within a plant stand of finite, constant size whose individual~are stationary, we computed the coefficients of relationship as well as the coefficients of inbreeding for all the single places. Given arbitrary probabilities of fertilizaton, it showed that both parameters increased steadily from generation to generation, but didn't necessarily converge to 1 in all cases. From the determining equations we derived an evaluation of the maximum increase of the coefficients of relationship. Under the assumption of random mating, the removal of stationarity caused a slight raising of the coefficients of inbreeding. Using the derived equations, the expense required for computing coefficients of relationship is relatively low.

Anmerkung

Die zur Stützung der theoretischen Ableitungen vorgenommenen Simulationen und Berechnungen wurden durch eine Beihilfe der Deutschen Forschungsgemeinschaft gefördert.

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Assam and Burma Ecotypes of Pinus kesiya Flower Differently in Zambia

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Introduction

Pinus kesiya Royle ex Gordon (Burley, 1972) has a wide, disjunct distribution in Southeast Asia (synonym *Pinus insularis*, map 38 in Critchfield and Little, 1966). Whether it should be classified as a single species of several distinct ecotypes, or as two or more species, is unresolved.

Taxonomic studies have utilized the many seed sources of P. *kesiya* planted in Zambia (Guldager and Greenwood, In press). A source from Assam and one from Burma were compared in this study. Wood characteristics of the two seed sources differ statistically, although the differences are small (Burley, 1970; Burley, Adlard, and Waters, 1970; Burley and Andrew, 1970). Leaves and cones differ between the two and between them and seed sources from Thailand, Viet Nam, and the Philippines in a manner suggesting a latitudinal cline (Burley, *et al.*, 1972; Hans, 1972). However, Hans recommended that ecotypes from Assam, Burma, and Thailand be considered as a group and that this be given a separate rank within the species. Jones (1967) lumped Assamese and Burmase ecotypes for silvicultural purposes, presumably because of similar slow growth in relation to other ecotypes (Guldager and Greenwood, In press) and not because of taxonomic identity.

Materials and Methods[2])

A line of seven trees was selected at random from a possible seven lines (excluding surrounds) in each of three plots of each seed source in a replicated provenance trial of P. *kesiya* planted in November, 1963. The trees are located at 12.5° south latitude and 1200 meters above sea level. Climate is upland, tropical wet and dry (Trewartha, 1968), with rains occurring from November through April, and little or no rain from May through October. Flowering was recorded at 9 to 20 day intervals from January 25 to November 2, 1967, the fourth year after planting. The numbers of female strobili receptive to pollination (Pattinson, Burley, and Geary, 1969) and clusters of ripe catkins, i. e., shedding or almost shedding pollen, were estimated on each tree (Geary, 1972). The females recorded were, in general, a new lot at each date because of the short period of receptivity for an individual, and therefore, the quantities could be summed from date to date to produce cumulative numbers for analyses. But ripeness of individual clusters of catkins often overlapped from one date to the next, so their numbers could not be summed cumulatively. The numbers of trees with flowers were compared by chi-square and quantities of flowers were compared by analysis of variance.

Results and Conclusions

During the last half of the wet season and the early part of the dry season (February—June), trees from Assam flowered lightly to moderately, while trees from Burma flowered only slightly (*Figure* 1). There was a period of a few weeks in early winter in which flowering on trees from Assam was inhibited, but in which flowering on Burmese trees was increasing. Heavy flowering of both seed sources occurred through most of the last four months of the dry season (July—October). Approximately equal quantities of female flowers were produced by the two seed sources from July through October, but the quantity of catkin clusters

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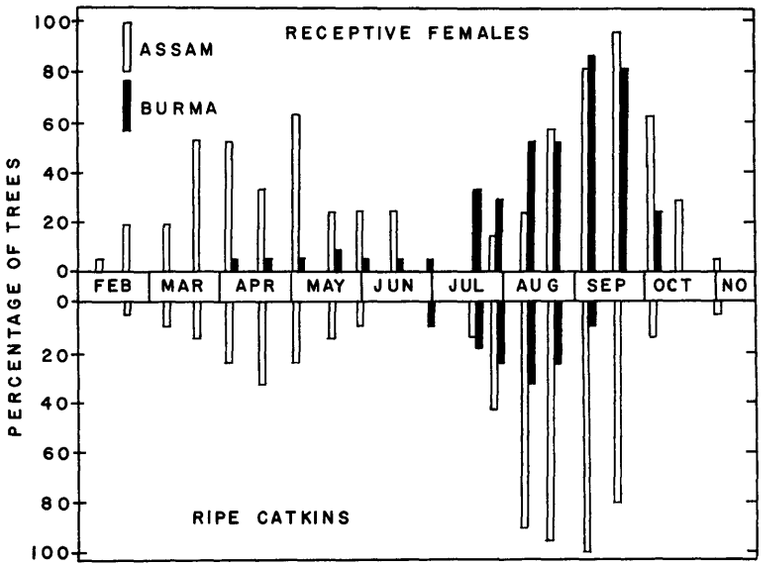

Figure 1. — Percentage of trees bearing receptive females and ripe catkins by dates of observation. — The seasonal trends in amount of flowering per tree followed very closely the seasonal trends in percentage of flowering trees.

was greater on Assamese trees. The differences in flowering noted were supported statistically, whether measured as number of trees in flower or quantities of flowers.

Assamese trees differed from Burmese chiefly by a much longer flowering season and by more clusters of male catkins. The Assamese seed came from 25.5° N latitude and 915 to 1830 meters a.s.l., and the Burmese seed from 20.5° N latitude and 1070 meter a.s.l. Therefore, a distinct physiological difference could be expected. The test plots were only single samples of the gene pools, but if they are representative, then flowering, wood, foliage, and cone evidence, plus the long disjunction, confirm them as distinct ecotypes and suggest that the two might be classified as distinct taxons.

Abstract

In a replicated provenance trial of *Pinus kesiya* in Zambia, seed sources from Assam and Burma differed in flowering: the Assamese trees had a much longer flowering season and produced many more clusters of male catkins. This difference in flowering, the long disjunction, and differences in wood, needles, and cones, suggest that not only should Assam and Burma ecotypes be recognized, but that these be classified as distinct taxons.

Key words: *Pinus kesiya*, phenology, flowering, geographic variation, physiological variation.

Zusammenfassung

In einem Provenienzversuch mit *Pinus kesiya* mit Wiederholungen in Zambia unterschieden sich die Herkünfte von Assam und Burma in der Blütezeit. Die Bäume aus Assam hatten viel längere Blühdauer und viel mehr männliche Blütenstände. Diese Unterschiede und andere beim Holz, den Nadeln und Zapfen weisen darauf hin, daß man nicht nur von Assam- und Burma-Ökotypen sprechen, sondern diese als distinkte Taxons klassifizieren sollte.

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