Research Note

A Health Problem in Mature stands of *Pinus taeda* in the Eastern Transvaal

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Pinus taeda L. is one of the three major pine species planted in the Eatern Transvaal Forest Region. It was extensively used for afforestation by the Department of Forestry during the 1930's but apart from a few stands established in the 1950's it was not planted on a large scale again until genetically improved seed became available in the late 1960's. Recently it has been planted on an increasing seale by both the Department and private growers.

Due to uneven age-class distribution and the current timber marketing problems many of the original plantings of the 1930's have not yet been clearfelled and 40 to 50 year old stands are widespread throughout the region. It was in these stands that unhealthy crowns were noticed during the course of a field survey for a site factor evaluation project in 1976. As this crown failure was found to be quite widespread it was decided that an investigation was warranted.

SYMPTOMS

The most typical symptom is a gradual shedding of needles commencing at the branch tips and continuing until the crown is completely bare, resulting eventually in the death of the tree. Death many be delayed for some time after complete defoliation. Occasionally epicormic regrowth of needles takes place along the branches but the branch tips remain bare, giving the crown a tufted, scraggly appearance *(Fig. 1)*. Abnormal production of undersized cones in the upper crown frequently takes place *(Fig. 2)*. Such undersized cones have also been noticed on old ramets in *P. taeda* seed orchards. Although needles may sometimes turn yellow they will seldom persist on branches until dead.

The unhealthy crowns may be almost universal through a stand (Tweefontein Block F, Tweefontein Compt. B 48) but usually they are scattered. In extreme cases they occur in patches with many trees already dead (Tweefontein Compt. B 46, Mac Mac E 4, Spitskop B 12a). Dominant trees are as susceptible as other classes.

Some root mortality was found to occur.

P. elliottii and *P. patula* are so far unaffected *(Fig. 3)*.

RATE OF SPREAD

A visual classification of crown health was applied to each of the 128 plots laid out in these mature stands as part of the site factor evaluation survey carried out early in 1976 and the data noted for later analysis.

FIG. 1. Typical **P. taeda** *crown in advanced stage of decline (Tweefontein, age 46)*

It was apparent from height growth then attained that the onset of decline must have been fairly recent. Also at that time the problem appeared to be largely confined to soils derived from the Dolomite Series.

Two years later many of the plots were re-assessed for crown health and the indications are that the decline is spreading. Stands which had been completely healthy in 1976 now showed signs of crown failure. An example is Compt. B 64 at Tweefontein which in 1976 was one of the healthiest-looking *P. taeda* stands in the whole region. Decline was now no longer confined to dolomite soils only, but was noticed on shale soils of the Pretoria Series at Ceylon (upper Block F) as well as on quartzite soils derived from the Black Reef Series (Spitskop B 9).

RELATIONSHIP WITH SITE FACTORS

The relationship between taeda decline and site conditions is not clear. One would expect the problem

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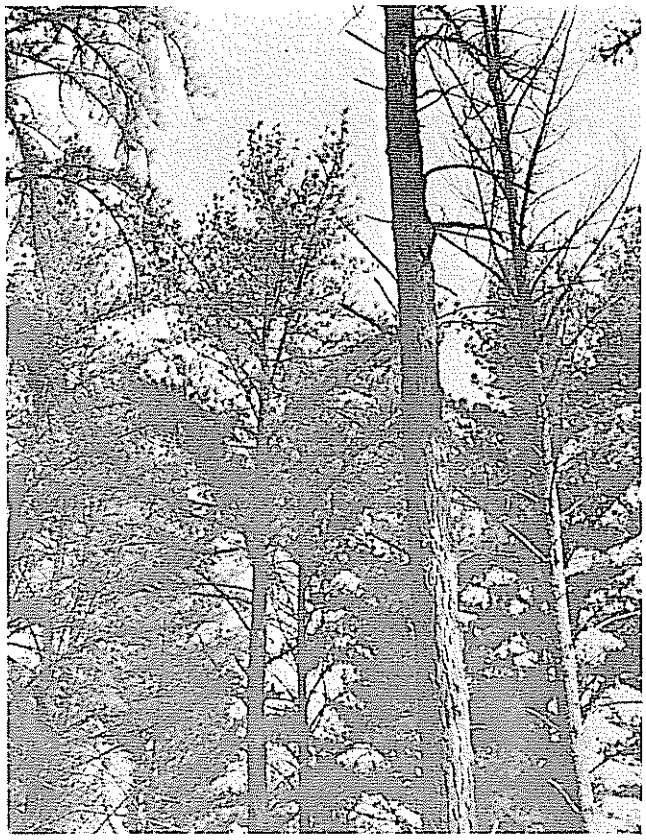

FIG. 2. Excessive cone production in tree at left. Tree at right already dead (Tweefontein).

FIG. 3. Declining P. taeda *crown amongst healthy* P. elliottii *in a mixed stand (Tweefontein).*

to occur on the poorer sites first, but the reverse is usually the case. The most rapidly declining stands are vigorous ones on relatively good dolomite soils at Brooklands, Tweefontein, Mac Mac and Blyde State Forests.

As moss is always present on the forest floor in the worst affected areas it was thought that wetness of the site might be a contributing factor. Poorly drained soils as reflected by mottling or gleying in the profile are extremely rare in the Eastern Transvaal forest areas. The wettest soils to be found are of the Griffin form (yellow apedal B over a red apedal B), with an occasional Clovelly form (yellow apedal B) (Schafer & Schutz, in press). That wetness plays a rôle appears to be confirmed by the advanced stage of taeda decline to be found on a Clovelly (Spitskop Compt B 12a) and on a Griffin (Tweefontein Compt B 46). In the latter case tree health improves as the soil changes to a Hutton form (red apedal B, implying good drainage) in a southerly and easterly direction. However, this theory is refuted by severe cases of decline to be found elsewhere on Hutton soils as at Mac Mac Compt E 14.

In accordance with the previous policy of applying lighter thinnings to first quality stands, most of the old *P. taeda* compartments give the appearance of being overstocked. Although the sites on which taeda decline is at its worst are not overstocked by standards applicable at age 20 (they vary between 150 and 200 s/ha), the narrow crowns found at their present age of 40 to 50 years would tend to indicate overstocking. High stand densities may therefore be a contributing factor towards decline in health, a fact which could be confirmed by monitoring the CCT experiment at Mac Mac but which does not yet show signs of decline.

Although the classification of crown health applied in the 1976 survey was somewhat objective, analysis of the data (currently being prepared) will confirm whether there is a relationship between decline and any of the large number of site factors and stand conditions recorded during the survey.

PATHOGENS

On a recent visit to the U.S.A. the senior author was struck by the similarity between taeda decline in

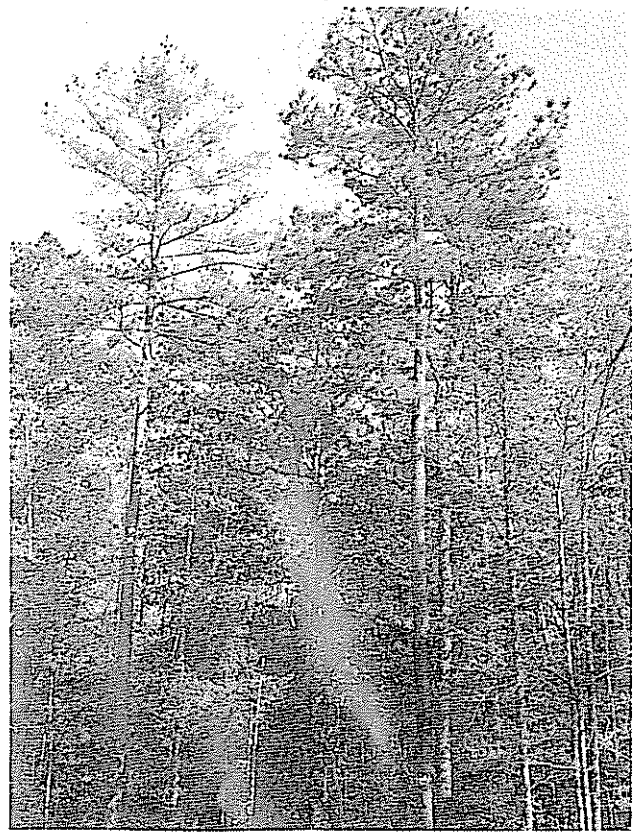

FIG. 4. Loblolly decline in Louisiana (tree at left: healthy tree at right) (Photo by P.L. Lorio, U.S. Forest Service).

the Eastern Transvaal and what is known as "loblolly decline" in the South-eastern U.S.A. As seen in southern Louisiana and explained by Lorio (1966, 1971, 1972, 1973), the symptoms of loblolly decline fit those of the Eastern Transvaal taeda decline almost exactly *(Fig. 4)*. The problem in Louisiana is common in stands 40 years or more in age on soils with a high clay content subjected to alternating wet and dry cycles. It does not occur on lower coastal plain soils which are permanently wet and of sandy texture. Declining trees are usually large dominants or co-dominants with all the symptoms of crown failure, excessive cone production, root mortality, etc., to be found in the Eastern Transvaal. These symptoms fit those of little leaf disease, (caused by *Phytophthora cinnamomi* Rands), as found on eroded topsoils in the Piedmont, and this root pathogen together with various *Phythium* spp. have been isolated from the soil at the base of declining trees in Louisiana. However, the relationship between loblolly decline and site is a complex one. Declining trees are also more susceptible to southern pine bark beetle attack *(Dendroctonus frontalis* Zimm.).

A preliminary examination of the Eastern Transvaal stands for the presence of fungal pathogens has been undertaken. *Phytophthora cinnamomi* was not present in dead roots or soil associated with the declining trees sampled. A fungus similar to *Verticicladiella wagenerii* Kendrick, the causal organism of a root disease of pines in the U.S.A. (Wagener & Mielke, 1961: Kendrick, 1962) was isolated from rotting roots. The degree of root rot however, was insufficient to have resulted in the symptoms observed.

Although there appeared to be an acceleration in decline following a severe hailstorm at Tweefontein in 1978, *Diplodia pinea* (Desm.) Kickx was not found associated with a symptom which may have led to this decline.

Further investigations into the possible rôle of pathogens will continue.

The black aphid *(Cinara cronartii)* may play a contributing rôle but it is apparent that taeda decline must have commenced before the first aphid invasion took place.

LONGEVITY OF *Pinus taeda*

In the apparent absence of a pathogen causing the decline, the question arises whether *P. taeda* stands in the Eastern Transvaal could be dying of old age.

In the U.S.A. the harvest cut in managed stands is usually made when trees are 40 to 60 years old. Mean annual increment culminates somewhere between 30 and 50 years, and decay in heartwood begins to be a problem after 60 or 70 years. Wahlenberg (1960) considers loblolly pine to be old at 100 years. He further states that many may reach 150 and exceptional ones 300 years of age (Shoulders, 1978. Pers. comm.).

In the light of this evidence it would seem unlikely that *P. taeda* in the Eastern Transvaal could be dying of old age at the tender age of a mere 40 to 50 years, but when consideration is taken of the very much faster growth rate of the species in South Africa than in the U.S.A., coupled with the generally overstocked stand conditions, this possibility does not seem so remote after all. If this were indeed the case it would be possible to confirm it by a study of the correlation between decline and increasing stand age. Unfortunately the complete absence of stands in the 25 to 40 year age class precludes this. Stands younger than 25 show no signs of ill health.

CONCLUSIONS

The absence thus far of any obvious site factor or pathogen as a cause of this problem is perplexing. Until fresh evidence comes to light one is forced to conclude that stands of *Pinus taeda* in the Eastern Transvaal at their present stocking are declining as a result of overmaturity at 40 to 50 years.

This implies that in the Eastern Transvaal *P. taeda* should not be grown on a rotation of longer than 40 years. Where it is possible to predict that clearfelling would have to be delayed beyond 40 years due to marketing or age class distribution problems, a further thinning at 30 years seems advisable.

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