SELECTION OF SPECIAL-PURPOSE SPECIES: EFFECT OF PESTS AND DISEASES*

IAN NICHOLAS and ERROL HAY

Ministry of Forestry, Forest Research Institute,
Private Bag 3020, Rotorua, New Zealand

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ABSTRACT

Special-purpose timber species are being grown in New Zealand for high-quality end-uses, especially furniture, joinery, and veneers. The main species are *Acacia melanoxylon* R. Br., *Juglans nigra* L., *Cupressus macrocarpa* Hartw., *C. lusitanica* Mill., *Eucalyptus regnans* F. Muell., *E. delegatensis* R. Baker., *E. saligna* Smith., *E. fastigata* Deane & Maiden, and *E. botryoides* Smith. These species suffer attack from a range of wood- and foliage-damaging insects and fungi; however, none is severe enough to restrict a species' growth, lower its wood quality, or limit its planting. Foliage-attacking insects have increased in the last decade, with the eucalypts being the main hosts because of the close proximity to Australia and the favourable wind flows. Success has been achieved with biological control programmes on two pests which were potentially limiting for eucalypt planting. Fungal health problems, although apparent at times, have yet to prove to be major limiting factors. Further research is required to evaluate the effect of insect damage on the end wood product. Current experience in growing special-purpose species indicates that the original species selection is still sound from the health perspective.

Keywords: special-purpose species; forest health; forest insects; pathogens; *Acacia melanoxylon*; *Eucalyptus botryoides*; *Eucalyptus delegatensis*; *Eucalyptus regnans*; *Eucalyptus fastigata*; *Eucalyptus saligna*; *Cupressus lusitanica*; *Cupressus macrocarpa*; *Juglans nigra*.

INTRODUCTION

The term "special-purpose species" originated from a New Zealand Forest Service workshop held in 1979. A special-purpose species is defined as "a species producing timber with special wood properties required for those uses where radiata pine is not entirely satisfactory". Therefore, the timber of special-purpose species will be complementary to that of *Pinus radiata* D. Don (radiata pine), not an alternative. To place special-purpose species in perspective, the existing resource size is small; for eucalypts it is less than 1.5% of the exotic softwood area (Fry 1983), with other genera being considerably less than this. As a result of the 1979 workshop, a policy promoting the planting of a select number of species for special end uses (Table 1) was developed (New Zealand Forest Service 1981).

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TABLE 1–Special-purpose species and their main uses

Species	Uses
Acacia melanoxylon	Furniture, veneer, turnery
Cupressus macrocarpa	Exterior joinery, boat building
*C. lusitanica**	Exterior joinery, boat building
Eucalyptus botryoides	Furniture, handles
E. saligna	Furniture, handles, turnery, veneers
E. fastigata	Furniture, handles, turnery, veneers
E. delegatensis	Turnery, veneers
E. regnans	Furniture, veneers
E. nitens †	Veneer, furniture, turnery
Juglans nigra	Furniture, veneers, turnery

* Not on original list but since given special-purpose status
† Not on original list but maintained as research species

At the 1979 workshop, forest diseases and insects were not considered in terms of specific species but more generally in terms of the potential health hazards of species diversification. For the eucalypts in the policy list the most definite statement was that more pests could be expected from across the Tasman, while for the other species generalisations were made (Alma 1979). Chou (1979) made the point that the introduction of new material for the evaluation of untested species could pose a threat to pine health by bringing in harmful agents.

The rationale behind growing special-purpose species is one of producing a specialist wood crop as economically as possible. For each species the quality of the wood produced and the species' growth rate are important management elements. Health problems will influence the species' management and must be put into perspective with the philosophy of the policy; does the risk of health problems outweigh the opportunities of producing specialised wood products? Ten years after the Special Purpose Species Workshop we are re-examining the same health issues but with much more experience behind us, from both the management and the research points of view. If we were to draw up the list of species again, how different would it be?

Perhaps the easiest way to answer this is to look at the health issues of the four genera in the special-purpose species list.

ACACIA SPP.

A number of insects and fungi cause damage to the wood and foliage of *A.melanoxylon* (Australian blackwood) and other wattles, although they do not limit the planting of any species.

Wood-damaging Agents

Ghost moth (*Aenetus virescens* (Doubleday)).

Ghost moth caterpillars tunnel into the stem and feed on the cambium at the entrance. The entry hole sloping upwards to prevent water penetration is covered by a fibrous silken web (Alma 1977a) to disguise it from predators. There is very little rot associated with the ghost moth hole. In 1978 a study of all 69 known *A. melanoxylon* stands in the North Island showed ghost moth attack in only five of the stands (Forest Research Institute 1979, pp. 9–21). According to a detailed study, attack lessened as trees grew older and larger; when diameter at breast height exceeded 16 cm attack was much reduced. However, those trees with faster growth rates were prone to attack (A. Kuperus unpubl. data). The same author concluded that "Blackwood appears to be a low preference host". This led to the management conclusion that the effect of ghost moth attack was no different from that of a branch occlusion in the defect core. Some authors reviewing *A. melanoxylon* (e.g., Gleason 1986) failed to realise that ghost moth is restricted to the North Island and incorrectly cited it as a national problem.

Pinhole borer (*Platypus apicalis* White)

Pinhole borer attack has been observed in some *A. melanoxylon* trees planted adjacent to native forest (Milligan 1979). Observations in the South Island suggested that faster-growing trees are more prone to attack (R.H. Milligan pers. comm.) but this has not been verified. Difficulties in studying this insect are hampered by the young age of the resource, but such a project should be considered. Pinhole borer makes a series of holes and therefore causes degrade in the timber. The full impact of the damage to the wood has not been studied.

Foliage-damaging Agents

Psyllids and leaf miners

The foliage of *A. melanoxylon* is often ragged at the phyllode margins, generally from attack by the leaf miner *Acrocerops alysidota* (Meyrick). A sooty mould fungus grows on the sugary secretions of the psyllid *Psylla acaciae* Maskell, which gives the phyllode a black sooty appearance. It has been suggested that the lack of apical dominance in the species is a result of repeated insect damage to the growing tip (T. Faulds pers. comm.). This theory has been tested in a trial at the Forest Research Institute in which *A. melanoxylon* has been sprayed with insecticide at regular intervals in the nursery and in the field. Results from the nursery showed that control of psyllids by insecticides improved growth over 18 months but there was no difference in seedling form. This study showed that by August (late winter) psyllids leave the plants and leaf miners leave the phyllodes, and are therefore not transferred to the planting site on the seedlings (G. Sandlant pers. comm.). To date, visual differences in the field between sprayed and control plots are not significant. The cost and difficulties of the spray regime make it unlikely it would be standard practice in the forest.

The selection of good form trees in the tree breeding programme could include selecting for insect resistance, although it is not possible to determine this at present. More work is required on the population dynamics of psyllids and leaf miners on *A. melanoxylon*.

Rusts (*Uromycladium* spp.)

Acacia melanoxylon becomes infested with the rust fungus *Uromycladium robinsonii* McAlpine which causes pustules on the leaves and twigs, with resultant dieback in severe cases. A small survey undertaken in 1987 of the incidence of rust in a trial area at Rotorua showed an increase in trees with minor dieback compared with the previous year. Disease levels fluctuate from season to season. Although foliage dieback of up to 80% of a 4-year-old plantation has been noted (Dick 1985), the rust infection does not appear to be a significant problem, although it needs further monitoring to better understand its effects on growth rate.

Silverleaf (*Chondrostereum purpureum* (Persoon ex Fries) Pouzar)

Concern that pruning may induce silverleaf was expressed by Gisborne foresters in 1983. A small study by the forest health officer looked at five trees with large form-pruning scars. Difficulty in identifying stain and heartwood confused the results, although in one isolation *C. purpureum* was identified (Y. Langridge pers. comm.). No further reports of this problem have been made.

Fireblight beetle (*Pyrgoides orphana* (Erichson))

The recent interest in growing *A. dealbata* Link in New Zealand requires a note of caution. Although this species is a rapid grower, in Tasmania it suffers catastrophic attacks from fireblight beetle which periodically defoliates stands, limiting the potential of the species (Elliott & de Little 1984). The effects of this possible damaging agent must be considered before a large research or planting programme is initiated. This is especially important for growing species on longer rotations for sawn timber, rather than the less-risky shorter rotations for pulp or firewood.

JUGLANS NIGRA

Juglans nigra (black walnut) in New Zealand does not have any major health problems at present. A number of minor infections do occur, but cause only minimal damage.

Walnut blight

Juglans nigra is not affected by the bacterial disease *Xanthomonas juglandis* (Pierce) Dowson which causes considerable damage to *J. regia* L. in some parts of the country. A series of genetic trials that includes imported *J. nigra* seedlots and Hinds walnut (*J. hindsii*) from California have shown interesting health trends. On nearly all North Island sites *J. hindsii* has performed very poorly, due largely to the incidence of the blight. However, in trials planted in drier climates it has been much healthier.

Canker

In the genetic trial series mentioned above, a stem canker became evident when the trees were about 4 years old. Despite many attempts, this has yet to be positively identified by Forest Research Institute pathologists who consider the stem cankers to be the result of physical injury. Analysis of the disease by seedlot shows a significant interaction between seedlot and disease. The most susceptible seedlots at the major trial sites have been *J. hindsii* and a mixture of New Zealand and imported seedlots. The thinning of these trials, now under way, means that the susceptible seedlots will be removed and hence seed from less-susceptible seedlots will be available soon. The canker problem appears to diminish with age; once trees are older than 7 years there is little evidence of previous canker damage.

Leaf blight

While the *J. nigra* genetic trials show that seedlots imported from the southern range of the species in the United States are generally more vigorous than New Zealand seedlots, the importation of seed is strongly advised against. *Juglans nigra* in the United States is prone to an anthracnose disease (*Gnomonia leptostyla* (Fr.) Ces. & de Not) which, if introduced into this country, would be as devastating to *J. nigra* as poplar rust is to *Populus* spp. Anthracnose induces premature leaf fall, and tree growth declines markedly as a result. The *J. nigra* genetic trials in New Zealand will be converted to seed orchards. The retention of the best seedlots, including the better American ones, will mean there is less reason to introduce new material.

CUPRESSUS SPP.

The cypresses growing in New Zealand are relatively free from pests and disease, except for one main problem—canker.

Cypress canker

Cypress canker is caused by two species of *Seiridium*—*S. unicorne* (Cooke & Ellis) Sutton and *S. cardinale* (Wagener) Sutton & Gibson. Chou (1979) warned about the debilitating effect of cypress canker in some plantations in other countries, e.g., Kenya. A full study undertaken in New Zealand (van der Werff 1988) showed that in forest plantations the canker has been of little significance. This may well be a consequence of diseased trees being removed in thinning operations and thus the older trees show less sign of the disease. The interaction of canker and pruning is one yet to be solved. In the early 1980s foresters of the New Zealand Forest Service in Auckland believed that pruning at an early age encouraged the disease, thus they did not start low pruning until trees reached age 8 years. Research studies have given intriguing results. A first study on pruning of *C. lusitanica* at ages 3 and 4 showed that, although pruning increased the incidence of canker, it was not of major silvicultural significance. After 7 years, 47% of the pruned and 39% of the unpruned trees had canker, but only 17% of the pruned and 11% of the unpruned trees had canker severe enough to cause crown dieback (M. Self pers. comm.) In this trial it is likely that thinning will remove the cankered trees and the health of the stand would improve. *Cupressus lusitanica* is reported by Chou (1979) to be more resistant to cypress canker than *C. macrocarpa,* an observation not supported by van der Werff's study.

EUCALYPTUS SPP.

Eucalypts have been planted in New Zealand for over a hundred years. The success of many of these early plantings was variable to say the least. Many of the species grown were easily established and very vigorous growers, although their wood properties and utilisation potential in New Zealand were unknown. Some of the more well-known failures have been:

Eucalyptus globulus Labill which was ravaged by a variety of insects, especially blue gum chalcid (*Rhicnopeltella eucalypti* Gahan), gumtree weevil (*Gonipterus scutellatus* Gyllenhal), gumtree scale (*Eriococcus coriaceus* Maskell) (Bain 1977a, b; Zondag 1977), and, since the 1920s, eucalyptus tortoise beetle *Paropsis charybdis* Stal.

Eucalyptus viminalis Labill, *E. ovata* Labill, and *E. macarthurii* Deane et Maiden which are preferred hosts of *P. charybdis*.

Therefore eucalypts have acquired a reputation as insect fodder which is illustrated by the ugly stag-headed older trees seen throughout the New Zealand landscape. With this knowledge, species for future planting were selected from the hundred or so species already introduced into New Zealand (Ecroyd 1986; New Zealand Forest Service 1981) taking into account the vigorous growth potential, the suitability for the production of quality timber, and those species that were healthy. Hence, only five eucalypt species were promoted for afforestation in the Special Purpose Species policy and over the last 10 years these five species have generally been free of major health problems. *Eucalyptus nitens* Maiden was maintained as a research species because of its wide site tolerance and vigorous growth rate although it is prone to severe insect attack, especially defoliation by *P. charybdis*.

Potentially Limiting Insect Pests

Currently the six main species suffer attack from insects, although only three defoliating pests and one wood borer could be considered potentially limiting.

Eucalyptus tortoise beetle (*Paropsis charybdis*)

Of the six main eucalypt special-purpose species, only *E. nitens* exhibits major damage from this beetle (Bain 1977c). For this reason *E. nitens* has remained a research species rather than a commercial one. At an early age *E. nitens* has a distinct juvenile foliage which is not susceptible to attack. However, the beetle and larvae attack and chew the adult foliage. The severity of the attack often depends on the proximity to other stands and on population levels of the insect. The effects of the defoliation on the subsequent growth of the tree have not been evaluated although it is obvious that the growth of some trees has been severely restricted. Also, it is apparent that *E. nitens* in the South Island is healthier than in the North Island.

At present there is a biological control programme under way which is providing very encouraging results (Forest Research Institute 1990). A parasitoid of *P. charybdis* eggs (*Enoggera nassaui* (Girault)) has become established on a range of sites around the country. Currently the control it has achieved is up to 85% over these test sites. If this success continues it will allow *E. nitens* to become more widely planted as a first-choice special-purpose species.

Leaf mining sawfly (*Phylacteophaga froggatti* Riek)

This recent import into New Zealand was first identified at Auckland airport in 1985 and has since spread throughout the northern half of the North Island (Kay 1986). The principal hosts of this insect are *E. nitens*, *E. saligna*, and *E. botryoides* with defoliation damage being commonly confined to the bottom 3 m of the tree. On some trees complete defoliation has occurred but as yet none has been killed. The effects of defoliation on the growth of the trees have not been assessed. There is also a biological control programme under way using an imported *Bracon* sp. This parasitoid has become well established in several places, e.g., Tauranga and Hamilton, with initial results being very promising (W. Faulds pers. comm.).

Eucalypt gall wasp (*Ophelimus* sp.)

This is a more recent import than the sawfly, observed at Wellington in 1987. The main hosts are *E. saligna*, *E. botryoides*, and *E. grandis* Hill ex Maiden (not considered an important eucalypt in New Zealand). A few attacks have been so severe that trees have been killed. The main zone of defoliation is the upper half of the crown. At present *Ophelimus* sp. is restricted to Wellington, Hutt Valley, Horowhenua, and Manawatu. As yet there are no plans to investigate any control measures although a monitoring programme is in place to assess the damage and rate of spread (D. Kershaw pers. comm.).

Pinhole borers (*Platypus apicalis* White and *P. gracilis* Broun.)

Abortive attack from these native pinhole borers results in the formation of kino veins and pockets within the wood (Milligan 1979). A minor mill study indicated that all boards from a faster-grown tree had kino degrade, whereas the slower-grown trees had about 3% of the boards affected Kino (a red-coloured tannin exudation) is released as result of damage to the living wood tissue and can often be seen oozing down the trunk of the tree. Most species are attacked by *Platypus* spp. although the *E. saligna* in the study referred to did not show gum pockets or large kino rings when internally assessed. Members of the ash group of eucalypts (*E. regnans*, *E. delegatensis*, and *E. fastigata*) can produce large kino veins and pockets as a result of wounding by any agency. The results of a pinhole survey carried out by Forest Research Institute entomologists (G. Sandlant pers. comm.) indicated that:

(a) Where eucalypts are sited close to native forest areas the likelihood of attack is very high, even if population levels of *Platypus* spp. are low. While some risk exists with planting eucalypts on exotic cutovers or away from native areas, it is certainly reduced because of the much lower levels of *Platypus* spp. This led to a recommendation that eucalypts should be planted at least 5 km from native forest areas containing pinhole borer.

(b) It appears that trees with a diameter greater than 20 cm are the preferred size although the attack is distributed over a range of diameters.

Non-limiting Insect Pests

There are a number of other insects that cause damage to eucalypts. One wood borer and two defoliators are common, but the damage they cause is not serious enough to prevent the planting of eucalypts.

Ghost moth (*Aenetus virescens*)

The damage to the wood caused by this insect often looks worse than it really is. The ghost moth caterpillar bores a **7**-shaped hole in the trunk of the tree (Alma 1977a). The subsequent timber degrade is confined largely to the central defect core, which is not used for high-quality end-uses. Many species of eucalypts suffer from ghost moth holes, although the degree of infestation is variable. Factors contributing to the intensity of attack are (a) proximity to native vegetation, (b) stem size, e.g., the larger the stem the less likely the attack. Attacks have been recorded on material up to 30 cm in diameter although it is more common for multiple wounds to occur on smaller piece sizes (5–20 cm). Ghost moth occurs only in the North Island. Young *E. saligna* coppice growth is particularly susceptible but, because firewood is one of the main uses of this small material, the damage is of little concern.

Gum emperor-moth (*Antheraea eucalypti* Scott)

This defoliator occurs sporadically on some of the main eucalypt species (Alma 1977b). However, the attack is infrequent and dependent on locality; much of the spread (confined to the North Island and Nelson) of this pest has been from schools (from which it is released after projects!). Damage is seldom severe enough to warrant undertaking any spray programme to control population levels.

Eucalyptus leafroller (*Strepsicrates macropetana* Meyrick)

The leafroller feeds on the leaves, buds, and flowers, ultimately skeletonising the leaf (Nuttall 1983). Most of the main eucalypts are affected to some degree, although the variation over different seasons can be quite marked. The resulting leader is tatty and unsightly; however, the damage, while it may reduce growth a little, is seldom worse than it looks.

Natural population control of *A. eucalypti* and *S. macropetana* seems to occur before these build up to a level where attack is extensively damaging.

Fungal Attack

There are a number of potentially limiting fungi that effect eucalypts. These are mainly leafspots which cause sporadic and generally minimal damage to various eucalypt species; however, one can cause leader dieback.

Mycosphaerella cryptica (Cooke) Hansford

This disease causes irregular-shaped spots on the new leaves and cankers on the infected shoots of young trees. The result of this attack is shoot dieback and premature leaf fall from the infected branches. After repeated infections trees are usually stunted or multileadered. The main species affected are the ash group (*E. delegatensis, E. regnans, E. fastigata,* and *E. fraxinoides*) as well as *E. nitens*. The trees are attacked usually during the early years of growth. Warm and moist conditions encourage infection although this can be prompted by the species being mis-sited—e.g., *E. delegatensis* at Rotoehu Forest, a cold climate species planted in a warm coastal situation. There is a marked variation in susceptibility within species as some provenances are more resistant—e.g., for *E. regnans* and *E. delegatensis* the Tasmanian provenances are best (Dick & Gadgil 1983). The disease is generally of nuisance value only as the stunted or badly malformed trees are usually removed during any thinning operation.

Silverleaf (*Chondrostereum purpureum*)

Silverleaf has been isolated from stain and decay in the wood associated with pruning wounds of eucalypts. Evidence suggests that the rot does not spread outside the central pruned zone and therefore is confined to the lower density wood which is usually boxed out during sawing, although young trees have been killed by the disease. A series of trials has investigated the use of fungicides to limit the infection of silverleaf spores on the pruning wound. As can be seen from the results of these trials (Table 2), *C. purpureum* infection through the pruning wound cannot be prevented. However, flush pruning of branches before they get to 2.5 cm in diameter, during winter, and with an application of a fungicide, may reduce infection. Additionally, rot was present in the unpruned treatments included in Trials 1 and 3.

Silverleaf is a problem in fruit orchards and has been the subject of research over the last 20 years (Dye 1967, 1974). Results from that research provide useful information on which to base pruning recommendations for eucalypts. The fungal spores are released all year round, with the main controlling factor on spore release being rain and a rise in relative humidity above 90%. High levels of spores were found after rain but not after dew. Based

TABLE 2 –Eucalypt pruning trial results*

	Trial 1†	Trial 2‡	Trial 3§
Species	*E. delegatensis*	*E. delegatensis* *E. fastigata* *E. regnans* *E. saligna*	*E. delegatensis* *E. fastigata* *E. nitens* *E. regnans* *E. saligna*
Variable tested	Pruning season • spring • summer • autumn • winter Branch diameter • large • small Stub length • flush (0 cm) • 15 cm • 30 cm	Chemical wound spray (nine fungicides) Mycelial suspension of fungus • with • without	Seven sites Pruning season • summer • winter • unpruned control Captafol spray • with • without
Results and recommendations	Least infection after autumn & winter pruning Infection least in flush-pruned stub	Winter pruning Less infection in branch < 2.5 cm Spray 2% aqueous suspension Captafol	No difference between summer and winter Positive correlation between wound size and infection Captafol significantly reduces infection Rot significantly less in unpruned control

* For discussion on the incidence and effect of rot as a result of infection through pruning wounds *see* McKenzie & Glass (1989)
† Gadgil & Bawden (1981)
‡ Forest Research Institute (1982) pp. 46–7
§ P. D. Gadgil pers. comm.

on these results and the trial results reported in Table 2, it is now suggested that eucalypts should be pruned during fine dry weather. This allows the surface of the pruned stub to dry out and not become a primary source for silverleaf infection.

CONCLUSIONS

If we were to draw up the list of species again, how different would it be?

With 10 years' experience of managing special-purpose species, no single health problem has been sufficiently debilitating to warrant removal of a species from the policy list. In fact the opposite may be likely; *E. nitens* may be promoted (because of the biological control of *P. charybdis*) as a better cold-hardy species than, say, *E. delegatensis*.

Because the special-purpose species resource in New Zealand is small and most of it immature, it is difficult to determine the utilisation consequences of the attack of some wood-damaging pests or diseases. From the available information it would seem that pinhole damage on eucalypts is the most serious. This is best overcome by siting stands away from sources of *Platypus* spp. populations. The loss of growth from defoliation by pests has not been quantified, but where stands are well sited and correctly established most species continue with more than acceptable growth rates. As suggested at the workshop in 1979, the threat of insects from across the Tasman is serious. It is important that new insect arrivals are closely monitored for rate of spread and degree of damage to trees. Where appropriate, control measures should be identified, evaluated, and promptly implemented.

All the special-purpose species have acknowledged health problems; the final question is whether the health constraints are of sufficient importance to make the growing of some species an unjustifiable risk.

Many of these problems require more research to identify their impact on silviculture and utilisation of the species. Only with the information based on this research can forest managers and researchers place the problem in perspective. A change in emphasis to more market research on special end-uses may give the opportunity to refine the species list but, if the next 10 years are similar to the last 10, the future special-purpose species list could be very similar to the current one.

The contribution that a specialist wood resource can make to the future timber industry in New Zealand is not yet proven but one of exciting opportunities. Such a resource will allow future markets to be exploited in a manner not possible with products from one species as is likely with the current reliance on *Pinus radiata*.

Thus the balance between a need for high-quality timber products and acceptable growth makes the continued planting of special-purpose species of national or regional importance.

It is the authors' opinion that the health risk associated with the planting of special-purpose species is more than offset by the opportunities presented by growing a high-quality wood resource for specialist wood end-uses.

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