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Alphitonia zizyphoides (toi)

Rhamnaceae (buckthorn family)

***doi*, *doi damu*, *doi selawa* (Fiji); *navasvas* (Vanuatu); *toi* (Samoa, Tonga, Wallis and Futuna, and Niue); *toi*, *manee* (French Polynesia)**

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IN BRIEF

Distribution Widely distributed and moderately common in the South Pacific islands.

Size Typically 20–25 m (66–82 ft) tall at maturity.

Habitat Tropical, humid, 1800–4000 mm (70–157 in) rainfall, lowland to lower montane forests, 5–700 m (16–2300 ft) elevation.

Vegetation Wide range of tree species of early successional forest.

Soils Very wide range of well drained soil types.

Growth rate On good sites, 2–3 m/yr (6.6–10 ft/yr) during the first 3–4 years, thereafter reducing to 1–2 m/yr (3.3–6.6 ft/yr).

Main agroforestry uses Improved fallow, windbreak, woodlot.

Main products Timber, fuelwood, and traditional medicine.

Yields Timber yields are estimated at 12–16 m^3/ha/yr (172–229 ft^3/ac/yr).

Intercropping Mainly occurs in such systems as a result of natural regeneration.

Invasive potential Potentially invasive outside of its natural range.

Natural regeneration of toi (about two years old) in mahogany trial plot, Shark Bay, Santo, Vanuatu. It has grown much faster than the planted mahogany and survived two cyclones.

INTRODUCTION

Toi (*Alphitonia zizyphoides*) is a fast growing tree to 20–30 m (66–100 ft) tall. It is native to the South Pacific region from Vanuatu to French Polynesia, where it occurs in lowland and lower montane forest associations, including secondary forests and the margins of closed forests. In these regions, annual rainfall is high, with a distinct summer wet season (November–April) and a cooler dry season (May–October). The species has a very wide edaphic range, with best development on fertile, well drained, medium-heavy, neutral, friable volcanic ash soils overlying limestone.

Locally it is valued in traditional medicines and for its wood, which is excellent for construction, including posts and rafters, for making canoes, and as a hot-burning fuel. It is very widely used in traditional medicine; the bark and bark sap are used to treat various diseases and ailments. Its leaves were formerly used as soap.

Toi is important ecologically as a component of secondary forest developing on disturbed sites, including abandoned garden places. The species has great potential for enrichment planting in fallow areas, and for agroforestry plantings. Its main drawbacks are its typically poor stem form in open-grown situations, its generally small size, and the low durability of its wood when in contact with the ground. It is likely to have a moderately high weed potential due to its pioneer characteristics.

DISTRIBUTION

Native range

The species is widely distributed and moderately common in the South Pacific islands, from Vanuatu in the west, through Fiji, Tonga, Wallis (ʻUvea) and Futuna, Samoa, American Samoa, Niue, Cook Islands to the Society Islands (French Polynesia) in the east. Toi mainly occurs in lowland and lower montane forest associations below 500 m (1640 ft) elevation.

It is found on most high islands and a few atolls throughout the Vanuatu, Fijian, Samoan, and Tongan archipelagoes: Aneityum, Tanna, Erromango, Efate, Paama, Malekula, Espiritu Santo, Pentecost, and the Banks Group (Vanuatu); Viti Levu, Vanua Levu, Taveuni, Ovalau, Kadavu, Beqa, Gau, Yasawa, and the Lau Group including Kabara, Lakeba, Moala, Totoya, Vanua Balavu (Fiji); Savaiʻi, Upolu, Tutuila (Samoa and Amercian Samoa); Vavaʻu, Haʻapai group, Tongatapu, and ʻEua (Tonga). It is now rare but scattered on the Cook Islands, including on Mount Ikurangi (Rarotonga). It is unclear whether the species also occurs in the Solomon Islands.

Current distribution

The species is not known to have been planted outside of its native range.

BOTANICAL DESCRIPTION

Preferred scientific name

Alphitonia zizyphoides (Spreng.) A. Gray

Family

Rhamnaceae (buckthorn family)

The genus *Alphitonia* has not been assigned to any of the tribes of Rhamnaceae, because the relationship with other genera could not be resolved (Richardson 2000). Kellermann (2002) groups it with its most closely related taxon *Granitites intangendus* (F. Muell.) Rye into an "Alphitonioid Clade."

Non-preferred scientific names

Rhamnus zizyphoides Solander ex Forst. f.
Rhamnus zizyphoides Spreng.
Alphitonia excelsa (Fenzl) Benth.

Common names

doi (pronounced ndoi, main name in common use); *doi damu*, *doi selawa* (Fiji)
navasvas (Vanuatu)
toi (Samoa, Tonga, Wallis and Futuna, and Niue)
toi, *manee* (French Polynesia)

Other local names in Vanuatu include: *napoth* (Aneityum), *vilvile* and *nevilvil* (Banks), *aurie* and *vihumeri* (Santo), *neho* (Malekula), *dove* and *ondova* (Pentecost), *reha* (Paama), *nampou* (Erromango), *nafa* and *nahmah* (Tanna).

Size

A medium-sized to large tree, typically 20–25 m (66–82 ft) tall at maturity with a 10–15 m (33–49 ft) crown diameter, although there is an extreme height range of 3–30 m (10–100 ft) in different habitats. The diameter at breast height (dbh) is typically 30–50 cm (12–20 in) in mature specimens, but it can reach up to 65 cm (26 in) above buttresses. The average bole length is 10 m (33 ft), with a maximum of 18 m (59 ft). A stunted form reaching only 1–2 m (3.3–6.6 ft) in height has been reported from harsh sites in Niue. The related *A. franguloides*, which perhaps ought to be considered as a variant or subspecies of toi, develops into a large woody shrub to small tree from 0.5 to 20 m (1.5–66 ft) in height at maturity.


Left: Flowers and leaves, Viti Levu, Fiji. PHOTO: HILDEGUND BLANK **Right: Fruits, Santo, Vanuatu.** PHOTO: L. THOMSON

Form

Canopy and bole form is highly variable depending on the site. In young specimens the crown is monopodial, with spirally arranged, horizontally held branches. In open situations the lower branches persist and canopy form is variable, with low, heavy, spreading branches. In more closely-grown forest situations the lower branches are shed and the bole form is good, reasonably straight, and cylindrical.

Flowers

The flowers are arranged in short, 3–10 cm (1.2–4 in) long, axillary/near-terminally positioned, flat-topped clusters. Individual flowers are bisexual, small, whitish/light green, fragrant, and arranged in fives. The calyx is about 5–6.5 mm (0.2–0.25 in) across. The sepals are light green with fine, silvery hairs, while the petals are white: both sepals and petals are about 2 mm (0.08 in) long. Flowers have been recorded throughout the year in Fiji, but the main season in Vanuatu is January–March. The age to first flowering is unknown but is expected to be 3–4 years.

Leaves

The leaves are simple, alternately arranged, oblong-ovate to lanceolate, 5–18 cm (2–7 in) long x 3–6.5 cm (1.2–2.6 in) wide, shiny dark-bright green on the upper surface, and tomentose light grayish-green below. There are 10–15 pairs of secondary nerves. The leaves are usually rounded at the base (whereas the related *A. franguloides* usually has an acute leaf base). The petioles (1.5–2.5 cm [0.6–1 in] long) are first covered with orange-brown hairs which later turn blackish-green. Specimens from the Cook Islands have more ovate leaves, whereas those from Samoa are more lanceolate.

Fruit

The fruit is a globose to broadly ovoid drupe about 6–9 mm (0.24–0.36 in) in diameter, with a conspicuous ring-like calyx scar; it turns from green to purplish green and then to brown-black at maturity. In fully mature fruits, the spongy exocarp/mesocarp flesh dries and falls away, exposing two arillate seeds, each enclosed by a hard case.

The age to first fruiting is about 4–5 years under good growing conditions. In Vanuatu, the main fruiting season is August–September, but fruits may be collected as early as June. In Samoa, fruits have been mainly collected in September, but some fruits may be collected throughout the year, with old fruits often persisting on the tree.

Seeds

The seeds are smooth, brown, flattened, and oval, about 4 mm (0.2 in) long, and more or less enclosed by a loose, reddish brown aril. The main mode of dissemination is by soft-beaked birds such as pigeons, doves, honeyeaters, silvereyes, and trillers.

Similar species

Alphitonia zizyphoides is part of a species complex that includes *A. excelsa* (Fenzl) Benth. (in Southeast Asia, PNG, and Australia), *A. franguloides* A. Gray (in Fiji), *A. marquesensis* F. Brown (in the Marquesas Islands, French Polynesia), and *A. ponderosa* Hillebr. (in Hawai'i). *A. zizyphoides* and these closely related species are considered by some botanists to represent a single highly variable taxon.

A. excelsa differs from *A. zizyphoides* in its leaf characteristics, including texture (thin compared with distinctly coriaceous or leathery), leaf-base (cuneate to somewhat

narrowed compared with rounded-cordate), and shape (lanceolate-oblong to lanceolate compared with ovate-lanceolate).

A. franguloides is only recorded from higher elevation and drier habitats in Fiji. Its range in morphological characters overlaps those of *A. zizyphoides*, but the leaves and flower parts of *A. franguloides* are generally smaller (i.e., the leaf blade is 3–10 x 1.5–4 cm [1.2–4 x 0.6–1.6 in]) and the leaf blade is usually acute at the base.

A. marquesensis is endemic to the Marquesas Islands. It can be distinguished from *A. zizyphoides* by the obtuse subcordate leaf base, acute but not acuminate leaf apex, more persistent tomentum, and larger flowers.

A. ponderosa is a rare but broadly scattered Hawaiian endemic found in dry forests at lower elevation on the six main Hawaiian islands. It differs from *A. zizyphoides* in its larger, indehiscent (or slowly dehiscing) fruits 14–18 mm (0.6–0.7 in) in diameter.

GENETICS

Variability of species

The species displays moderately high levels of morphological variation for vegetative and floral characters. Smaller growing forms have been reported from Niue and Fiji (with the latter described as *A. franguloides*). The genetic structure of populations of the closely related *A. ponderosa* was examined by Kwon and Morden (2002).

Known varieties

No varieties or subspecies have been formally described.

ASSOCIATED PLANT SPECIES

Toi is a pioneer and early secondary species regenerating following disturbance in different forest associations. It is mainly found in secondary forest, but some large individuals can persist for many decades in closed forest types. It is also found in gardens, recently fallowed areas, and mature fallow forests and woodlands/savannas. In Fiji it is reported to be locally abundant in both dense and drier forest types, in scrub thickets, and on reed-covered hills. In the Society Islands it is mainly found in lower montane forests of medium stature.

Associated species commonly found

The species occurs with a wide range of tree species associated with early succession forest.

Vanuatu *Endospermum medullosum*, *Flueggea flexuosa*, *Macaranga* spp.

Fiji *Endospermum macrophylla*

Left: Seedling leaves, Santo, Vanuatu. Right: Seedling, Niue. PHOTOS: L. THOMSON

Tonga *Bischofia javanica*, *Calophyllum neo-ebudicum, Canarium harveyi*, *Dendrocnide harveyi*, *Dysoxylum tongense, Elaeocarpus tonganus*, *Elattostachys falcata*, *Fagraea berteroana*, *Ficus* spp., *Maniltoa grandifolia*, *Podocarpus pallidus*, *Pometia pinnata*, *Rhus taitensis*, *Santalum yasi*, *Syzygium dealatum*, and *Tarenna sambucina*.

Samoa *Adenanthera pavonina*, *Bischofia javanica*, *Cananga odorata*, *Dysoxylum* spp., *Elattostachys falcata, Garuga floribunda, Hibiscus tiliaceus, Macaranga stipulosa, Neonauclea forsteri, Rhus taitensis*, and *Terminalia richii*.

Society Islands (French Polynesia) *Hernandia moerenhoutiana*, *Metrosideros collina, Fagraea* spp., *Canthium* spp., and *Wikstroemia* sp.

Wallis and Futuna *Acalypha grandis, Cerbera manghas, Commersonia bartramia, Decaspermum fructicosum, Geniostoma rupestre, Hibiscus tiliaceus, Homolanthus nutans, Macaranga harveyana, Melastoma denticulatum,* and *Morinda citrifolia.*

ENVIRONMENTAL PREFERENCES AND TOLERANCES

Climate

The climate in its native habitats is tropical, lowland to lower montane, and humid. Tropical cyclones of varying intensity, including the most severe categories, occur at periodic intervals in most parts of its range, mainly from November to March. Temperatures are warm to hot throughout the year, and frosts are absent. Rain falls with a distinct summer maximum from November to April. The period from May to October is cooler and drier.

Elevation range

5–700 m (16–2300 ft)

Mean annual rainfall

1800–4000 mm (70–157 in)

Rainfall pattern

It grows in climates with a summer rainfall pattern.

Dry season duration (consecutive months with <40 mm [1.6 in] rainfall)

0–2 months

Mean annual temperature

24–26°C (75–79°F)

Mean maximum temperature of hottest month

29–32°C (84–90°F)

Mean minimum temperature of coldest month

17–24°C (63–75°F)

Minimum temperature tolerated

10°C (50°F)

Soils

The species has a very wide edaphic range, with best development on fertile, well drained, medium-heavy, neutral, friable volcanic ash soils overlying limestone.

Soil texture

Grows in light, medium, and heavy texture soils (sands, sandy loams, loams, sandy clay loams, clays, clay loams, and sandy clays).

Soil drainage

Toi requires free drainage.

Soil acidity

It prefers acid to neutral soils (pH 4.0–7.4).

Tolerances

Drought

It is likely that some populations that have evolved in tougher, lower-rainfall sites and on shallow soils will be tolerant of droughts lasting for several months.

Full sun

The tree is a pioneer species with most rapid growth in full sunlight.

Shade

All age classes grow best in full sunlight, and are tolerant of only light shade (e.g., up to 25% maximum)

Fire

No information available.

Frost

Likely to have limited or no frost tolerance (although the related *A. excelsa* is exposed to several light frosts per year in cooler parts of its Australian distribution).

Waterlogging

The species is not found naturally on waterlogged sites and accordingly is likely to have little tolerance of poor drainage.

Salt spray

It is sometimes found growing near to the sea (e.g., within

Mature specimen showing good self-pruning characteristics in closed forest situation, Niue. PHOTO: L. THOMSON

100 m [330 ft]), and is likely to have moderately high tolerance of salt spray.

Wind

In Vanuatu, both saplings and trees in open areas have been observed to have excellent tolerance of strong cyclonic winds.

Abilities

Regenerate rapidly

The species has the ability to regenerate rapidly on disturbed, open areas, growing quickly in the first few years.

Self-prune

Self-pruning varies with light regime. Trees growing in open areas or on the forest edge usually retain branches near ground level, and these become quite thick with age. In shaded situations and inside plantations the species has excellent self-pruning characteristics.

Coppice

Unknown, but the related *A. excelsa* coppiced poorly in trials in Queensland, Australia.

Pollard

The species is likely to pollard reasonably well.

GROWTH AND DEVELOPMENT

On good sites (fertile soils and high rainfall), toi displays rapid early height and diameter growth.

Growth rate

On good sites height growth rates can reach 2–3 m/yr (6.6–10 ft/yr) in the first 3–4 years, thereafter reducing to 1–2 m/yr (3.3–6.6 ft/yr). On less fertile soils and more exposed coastal sites early growth is about 1 m/yr (3.3 ft/yr). At 8–9 years, toi attained an average height of 16–20.6 m (52–68 ft) and dbh of 20.6–21.7 cm (8.1–8.5 in) with high survival (70–98%) in trial plantings at Shark Bay Research Station, Santo, Vanuatu (Smith 2004).

Yields

The yield of timber/wood is unknown, but is likely to be in the range 12–16 m^3/ha/yr (171.6 ft^3/ac/yr).

Rooting habit

The rooting habit is unknown, but a related species, *A. petriei*, is reported to have a well developed taproot.

PROPAGATION

The main method of propagation is nursery production of seedlings and transplanted wildlings. Cuttings of the closely related *A. excelsa* strike readily, suggesting that vegetative propagation may also provide a useful means of propagating selected germplasm of toi.

Seedlings

Seed collection

The mature dry fruits, with seeds showing, are collected from the tree canopy, typically in August–September. There are 8900 dry fruits per kg (4000 fruits/lb), with two seeds per fruit.

Seed storage

The seed is orthodox and may be successfully stored for many years in hermetically sealed containers under cool, dry conditions.

Seed pretreatment

Soaking in water for 12–24 hours is reported to improve the germination rate in older seed batches (e.g., more than 10 months old). For the closely related *A. ponderosa*, nicking or partial abrasion of the seed coat has been found to speed germination.

Growing area

Seeds may be sown in trays in a protected, well lit or sunny situation. They are covered with a thin (e.g., 2–3 mm [0.08-0.12 in]) layer of sand, loamy soil, or potting medium.

Germination

Germination may commence about 7–16 days after sowing, but some seedlots take several months to germinate. Seedlings should be pricked out and transplanted to individual containers at the cotyledon or four-leaf stage.

Media

Seedlings grow well in a well drained and fertile soil (e.g., loam) or potting media.

Time to outplanting

Seedlings are ready for outplanting after about 16–20 weeks in the nursery and when they are about 25 cm (10 in) tall, with basal stem diameter of about 4–5 mm (0.16–0.2 in).

Guidelines for outplanting

Very good growth (>2 m/yr [6.6 ft/yr]) and high survival (>95%) are expected from well hardened, healthy seedlings planted early in the wet season.

DISADVANTAGES

The main limitations for this species are poor stem form, heavy branching when planted in the open, the potential for weediness, and limited awareness and appreciation of the species in the timber and building industries.

Potential for invasiveness

The species is a potential invasive outside of its natural range. Given that members of the *A. excelsa* group, including *A. zizyphoides*, are widespread throughout the Pacific islands (and neighboring parts of Asia and Australia), there is an opportunity to plant it (or a very similar species) within its area of natural distribution and eliminate any potential hazard as an environmental weed.

Susceptibility to pests/pathogens

There are no records of pests and diseases causing serious damage to plants of toi. Plants frequently suffer minor damage from leaf-eating insects, and leaf-spot fungi may attack younger plants. Recorded diseases and pests include nematodes (*Ditylenchus* sp., *Helicotylenchus mucronatus*, *Meloidogyne* sp., *Paratylenchus tui* and *P. brachyurus*, *Radopholus similis*, *Xiphinema brevicolle*, *Xiphinema ensiculiferum*), arthropods (*Dysmicoccus nesophilus*, *Icerya seychellarum*), and fungi (*Mycovellosiella* sp.).

Host to crop pests/pathogens

It is not known to be a host of any agricultural crop pests or pathogens.

AGROFORESTRY/ENVIRONMENTAL PRACTICES

Mulch/organic matter

Toi has not explicitly been planted to provide mulch, but rapid growth, combined with a fairly quick turnover of leaves in the canopy, would suggest that it has good potential to build organic matter, especially if grown together with legumes.

Weed control

On Santo (Vanuatu), mature stands of toi established at closer spacings (e.g., 1000 stems per ha [405 stems/ac]) have greatly reduced or eliminated, presumably through shading, the rampant native big-leaf vine, *Merremia peltata*.

Crop shade/overstory

The tree casts an intermediate level of shade, which would be too heavy for most crop species but ideal for somewhat shade-tolerant crops such as cardamom, cocoa, coffee, *Morinda,* soursop, and *Xanthosoma.*

Alley cropping

Branches become heavy and wide spreading in open situations, and the species is considered unsuitable for alley

cropping systems.

Homegardens

Toi is suitable for inclusion in homegardens, but it mainly occurs in such systems as a result of natural regeneration and not deliberate planting.

Improved fallows

The species has excellent potential for planting or inclusion in improved fallow systems due to its rapid regeneration and biomass production. Its presumed deep rooting habit would help facilitate cycling of mineral nutrients from lower soil profiles.

Living fences

The species is not known to be used for living fences and is not well suited to such a purpose due to its spreading habit (and inability to be grown from large branch cuttings).

Windbreaks

The species has good resistance to cyclones and would be well suited for inclusion as an upper-mid-level layer of mixed-species windbreaks of wide dimensions (e.g., greater than 50 m [164 ft] across).

Silvopasture

The species is likely to grow well in silvopastoral systems but would not have any specific advantages that would favor its use.

Animal fodder

The leaves and young shoots of closely related *Alphitonia* species are consumed by cattle but have been found to have low digestibility and nutritional status.

Woodlot

Toi has good potential for growing in larger woodlots, mainly for production of sawn wood, fuel wood, and traditional medicines. A disadvantage of cultivation in smaller woodlots would be the poor form of edge trees; for small woodlots a different species could be planted for the outer row(s).

Native animal/bird food

The fruits are especially attractive to fruit-eating birds, including pigeons.

Host plant trellising

The species is not planted to provide trellising support for climbing crops.

Bee forage

The related *A. excelsa* is reported to be a good source of nectar for bees.

Fish/marine food chain

The crushed leaves and fruits of the related *A. excelsa* were used as a fish poison by Australian aborigines.

Coastal protection

The species is not generally planted for coastal protection but could be used in mixed plantings for such purposes.

Ornamental

Toi is an attractive, fast-growing, and moderately long-lived tree with good ornamental potential.

Fuelwood plantation trial of toi, Santo, Vanuatu. PHOTO: L. THOMSON

USES AND PRODUCTS

Toi is a widespread, moderately abundant tree that is highly regarded as a source of timber, fuelwood, and traditional medicine, both in former times and today. The timber is used in house construction and for the manufacture of tools, weapons, and handicrafts. Toi is one of the premier fuelwoods of the Pacific islands; its habit of shedding dried, lateral branches provides a convenient source of high-quality fuelwood. It is one of the most important species in traditional medicine, and its bark is widely used in various herbal remedies, often in combination with other species, for treatment of a wide range of ailments. The leaves may be crushed and rubbed in water to provide a soap and shampoo, but this use has been largely sup-

planted in post-European times with the ready availability of soap and shampoo.

Medicinal

The bark is boiled, often along with the bark of other tree species, to produce a decoction for treating numerous ailments (including stomachaches, constipation, coughs, headaches, menstrual pain, prolapsed rectum in postpartum women). The sap is used to treat earache, swelling, fever, and cancer. A phenolic compound in the bark, alphitol, has been shown to have anti-inflammatory activity.

Bark, Santo, Vanuatu. PHOTO: L. THOMSON

Timber

The wood is used for house construction (including building members, posts, flooring moldings, and paneling) and furniture.

Fuelwood

The wood makes an excellent fuelwood and is a preferred species for such purposes. The naturally shed lateral branches are ideal for burning.

Craft wood/tools

Used throughout Polynesia to make tools (such as tapa mallets and digging sticks), tool handles, weapons (clubs and spears), and carved artifacts (including kava bowls).

Canoe/boat/raft making

The wood was used for making both canoes and canoe paddles.

Cosmetic/soap/perfume

The crushed leaves foam up in water and were commonly used as a soap. The leaves and flowers, together with those of *Colubrina asiatica* and *Citrus macroptera*, were used to make a shampoo in Samoa.

Other

Fruits of the closely related *A. excelsa* are reported to be eaten by Australian aborigines.

COMMERCIAL CULTIVATION

The species is mainly used in the local subsistence economy and is yet to be grown and traded on any large commercial scale. The three commercial products are timber, fuelwood, and bark.

Timber The species produces an attractive, reddish-brown, medium-density hardwood (air-dry density is 610 kg/m^3 [38 lb/ft^3]). The wood has good technical properties, and is easy to saw, finish, and season. The sapwood is immune to *Lyctus* attack, but the heartwood is not durable and is not recommended for use in high-decay situations, including ground contact.

Fuelwood The wood dries quickly and burns moderately quickly, producing good heat. Accordingly the branch wood (and trunk) is a highly preferred fuelwood. In some areas, such as on Santo in Vanuatu, the wood is collected, bundled and sold as fuelwood in local markets.

Bark The bark is cut and peeled from trees and commonly used in traditional medicines throughout it native range. In Tonga the bark is collected from trees on the outer islands, such as ‘Eua, for supply and use in traditional medicines on Tongatapu (where the tree is now almost eliminated by overharvesting).

Spacing

For joint production of timber, fuelwood, and medicine, a close, initial spacing is recommended in order to encourage a straight bole form and self-pruning. The area required for semi-commercial production and local home use for timber, fuelwood, and medicine, would be 0.1–1 ha (0.25–2.5 ac). For larger scale commercial production of a general-purpose or utility sawn timber, a much larger plantation area of several hundred to several thousand hectares may be needed to supply a modern sawmill.

Management objectives

Weeding should be undertaken frequently, as needed, in the first 2 years prior to canopy closure. From about age 3–6 years, the smaller or misshapen trees could be commercially thinned to provide fuelwood and the bark stripped, dried, and used/sold for medicine.

Left: Toi plantation, Santo, Vanuatu, showing reasonably good bole form and self pruning of inner rows. Right: A volunteer toi in an agroforestry setting in Samoa growing among root, fruit tree, and timber crops. PHOTOS: L. THOMSON

Growing in polycultures

The species appears to grow well in monocultures. The form of border trees is poor and accordingly it is preferable to plant outside edges with a different species.

Estimated yield

The yield of timber/wood in both monoculture and mixed systems is unknown, but is likely to be in the range 12–16 m^3/ha/yr (172–229 ft^3/ac/yr).

INTERPLANTING/FARM APPLICATIONS

Example system

Location

Various islands of Vanuatu.

Description

In the traditional system of managed natural regeneration, the straightest and best-formed saplings are weeded to keep them free of climbers and occasionally high-pruned to produce clear boles.

Crop/tree interactions

Trees provide some shelter and protection for surrounding crops, including crops such as banana.

Spacing/density of species

Spacing is variable, with 5–50 trees per hectare (2–20 trees/ac).

PUBLIC ASSISTANCE AND AGROFORESTRY EXTENSION

Extension offices for agroforestry and forestry in the Pacific: http://www.traditionaltree.org/extension.html

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Alphitonia zizyphoides (toi)

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