Species Profiles for Pacific Island Agroforestry
www.traditionaltree.org

April 2006
ver. 2.1

Flueggea flexuosa (poumuli)

Euphorbiaceae (spurge family)

***mamafua* (Solomon Islands); *namamau* (Vanuatu); *pou* (Rotuma, Fiji); *poumuli* (Samoa, Tonga, 'Uvea); *poutea* (Futuna)**

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PHOTO: T. POULI

Stand of planted poumuli trees, Samoa.

IN BRIEF

Distribution The natural range extends from the Philippines to the Solomon Islands and Vanuatu; introduced into several Pacific islands, most notably Samoa.

Size Typically 10–16 m (33–52 ft) tall at maturity.

Habitat Lowland, humid tropics, 0–350 m (0–1150 ft), mean annual temperatures of 22–28°C (72–82°F), annual rainfall of 1500–5000 mm (60–200 in), uniform.

Vegetation Plays an important environmental role in re-vegetation of various types of disturbed sites.

Soils Wide range of soils including coralline, red clay, poorly drained, and coastal soils.

Growth rate On good sites, greater than 1.5 m/yr (5 ft/yr) for first 5–10 years, then less than 0.75 m/yr (2.5 ft/yr).

Main agroforestry uses Mixed-species woodlot, windbreak, homegarden.

Main products Timber, fuelwood, traditional medicine.

Yields Wood yields are estimated to be about 4–6 m^3/ha/yr (57–86 ft^3/ac/yr).

Intercropping Commonly planted with a wide variety of other species in fields and homegardens.

Invasive potential While it is potentially invasive outside of its natural range, it appears to have very limited potential to become abundant or a problem in little-disturbed native forest communities or on farmlands.

INTRODUCTION

Poumuli (*Flueggea flexuosa*) is a small to medium tree typically 10–16 m (33–52 ft) tall. It occurs naturally in the Philippines, eastern Indonesia, the Solomon Islands, and northern Vanuatu. It occurs in primary forest and dense shrublands at low altitudes, and it is often a pioneer species in river floodplains, fallow fields, and abandoned coconut plantations. In the Solomon Islands the tree has a restricted habitat in lowland coastal forests on coralline soils and beside rivers on poorly drained sites. It is considered a recent introduction in many parts of the South Pacific and is being increasingly planted in central/southern Vanuatu, New Caledonia, Fiji, Rotuma, Wallis and Futuna, Tonga, and Samoa. In these countries poumuli may infrequently and lightly colonize disturbed sites adjacent to where it is planted.

Top: Poumuli is often planted along roads and farm boundaries in Samoa. Bottom: Seedlings (at lower left) are often planted in mixed-crop areas, as here, together with breadfruit, banana, taro, and coconut. PHOTOS: C. ELEVITCH

Poumuli is traditionally an important source of durable, round timber throughout its natural range. A major attraction for re-planting is its production of naturally durable logs on short rotations, e.g., 6–7 years for fenceposts and 12–15 years for construction poles. The species is well suited for planting in various agroforestry systems including boundary plantings for property demarcation, planted fallows, and in plantations mixed with other tree and food crops. In Vanuatu and the Solomon Islands, poumuli is considered by villagers to be a good candidate for agroforestry initiatives for small-scale plantations and community forestry. In the Solomon Islands, the tree has potential as a tree crop in a canarium nut/rattan (*Canarium indicum*/*Calamus* spp.) farming system. It is also being evaluated in agroforestry trials, together with kava and vanilla, in Tonga. The species may have a role as a nurse or intercrop for other valuable, long-rotation timber species, such as whitewood (*Endospermum medullosum*) and mahogany (*Swietenia macrophylla*), or as a shade tree for cacao (*Theobroma cacao*). As a locally common lowland pioneer species, the tree plays an important environmental role in revegetation of disturbed sites.

A possible disadvantage is that it has some potential to become an environmental weed. However, field observations suggest that the species appears to have only a very limited ability to invade undisturbed and more closed forest types and farmed lands, and these few trees are likely to be sought out and utilized for timber by local human populations.

DISTRIBUTION

Native range

The natural range of poumuli extends from the Philippines through eastern Indonesia to the Solomon Islands and Vanuatu (absent from PNG). In Indonesia the species has

been only rarely recorded, having been found on Mangole Island in the Sulu group and Vogelkop Peninsula in Irian Jaya. It is widespread in the Solomon Islands, including Shortlands, New Georgia group, Choiseul, Isabel, Guadalcanal, Malaita, Ulawa, San Cristobal, Santa Ana, and Santa Cruz group (Chaplin 1993). The precise southern limit of it natural range is unknown but is thought to be the southeast Solomons (Santa Cruz islands) or northern Vanuatu (Banks Group).

Current distribution

In Vanuatu the range has been extended by planting in recent times, and the tree now occurs from the Banks group, Espiritu Santo, Malo, Maewo, Pentecost, Epi, and Paama through to Erromango (Wheatley 1992, Siwatibau et al. 1998). Poumuli is considered to be either an ancient, usually Polynesian, or quite modern introduction in many parts of the South Pacific, including central/southern Vanuatu, New Caledonia, Fiji (Rotuma, Viti Levu, and Ovalau), Wallis and Futuna, Tonga, and Samoa (Airy Shaw 1980, Smith 1981). The origin of poumuli in Samoa has been the subject of speculation. This species was not recorded as being in Samoa in the late 1800s in old German lists of useful plants of Samoa. It is uncommonly found in indigenous Samoan forests, being restricted mostly to areas around human settlements. Poumuli is the most favored timber for posts used in traditional Samoan houses or meeting places (fale) and it is widely planted around homes and along boundary lines. Given that it is the most popular house post in Shortlands and Choiseul, together with the fact that Shortlands, Choiseul, and Samoa were under German administration during the past century, one can speculate that seeds from either Shortlands, Choiseul, or other former German territories near Shortlands (e.g., Bougainville and New Britain) were taken to Samoa and planted for production of durable round timber. The carriers of these seeds could possibly have been Samoan missionaries or colonial German agriculturalists or administrators.

BOTANICAL DESCRIPTION

Preferred scientific name

Flueggea flexuosa Muell.-Arg.

Family

Euphorbiaceae (spurge family)

Non-preferred scientific names

Securinega flexuosa (Muell. Arg.) Muell. Arg.
Securinega samoana Croizat.
Casearia disticha sensu Setchell, non A. Gray.

Common names

Solomon Islands

mamufu'a (Kwara'ae, Kwaio, To'oabita; Malaita)
mamafua (Kwaio, To'oabaita, Santa Ana, Kahua)
mamahuana (Shortlands)
mamahua (Ulawa; Kahua, San Cristobal)
mavua (Nginia, Guadalcanal; Bugotu, Santa Isabel)
mavuana (Roviana, Marovo, Kusage in New Georgia Group)
urama (Varisi, Choiseul)
uraka, vuraka (Choiseul)
nyia punabe (Ayiwo)
nganimau, nonimua (Santa Cruz group)
pomou (Vaiakau)

Vanuatu

namamau (Bislama language)
nemema (Loh, Torres Islands)
womomo (Vanua Lava, Banks Islands)
mamou (Gaua, Banks Islands)
mamava, momova (Maewo)
memewa, malaus, nvokor, nvakor, nvacur (Santo)
vumamau (Malo)
namalau (Malekula)
neinyelongi (Ipota, Erromango)

Polynesia (introduced)

poumuli (Samoa, Tonga, 'Uvea)
poutea (Futuna)
pou (Rotuma, Fiji)

Other regions

anislag (Philippines: Filipino)
katamangan (Philippines: Manobo)
malagau (Philippines: Butuan)

Size

Poumuli is a small to medium-sized tree, 10–16 m (33–52 ft) tall, very rarely attaining 25–30 m (82–98 ft). Mature specimens typically attain a diameter at breast height (dbh) of about 20–30 cm (8–12 in), up to a maximum of 50 cm (20 in).

Typical form

In younger specimens the crown is narrowly columnar to conical with many small straight, radiating, horizontal branches. Older trees typically have straight, clear boles for up to 6 m (20 ft), sometimes with indistinct buttresses. With age, branching develops a less regular appearance,

and the canopy may exhibit an oblong or more spreading form.

Flowers

Male and female flowers are borne on separate trees (dioecious). The masses of small, light greenish-yellow flowers are arranged in short axillary clusters all along the twigs. Both male and female flowers have 5 sepals but no petals. Male flowers have 3–5 stamens, a disk composed of 5 glands, and a sterile pistillode, while female flowers have an annular, crenate disk and a globular, superior ovary.

Leaves

Leaves are simple, alternate, oblong-elliptic, with a rounded or tapered base and prominent, pointed, often recurved tip, shiny dark green above and light green below, 8–14 (–18) x 3–5 (–8) cm (3.1–5.5 [–7.1] x 1.2–2 [–3.1] in). Young leaves are light green. Venation consists of a midvein with 5–7 pairs of side veins, curving forward steeply and almost or just meeting well inside the margin. Petioles are 5–10 mm (0.2–0.4 in) long and may be either red or green (Wheatley 1992, Siwatibau 1998).

Fruit

Fruits are small, globose berries, 3–5 mm (0.12–0.2 in) in diameter, which ripen from light green, through reddish-green to dark purple-black at full maturity (Wheatley 1992, Foliga and Blaffart 1995, van Welzen 1998). There are 3000–8000 fruits per kg (1350–3600 fruits/lb). Poumuli plants commence fruiting from age 2–3 years onwards.

Seeds

There are 4–6 angular seeds about 1 mm (0.04 in) long in each fruit. There are about 300,000 seeds per kg (136,000 seeds/lb) (Chaplin 1993).

Rooting habit

Trees have a well developed, near-surface, lateral root system.

Similar or look-a-like species

Poumuli is a distinctive plant species at all stages of growth. It may be confused with *Glochidion*, e.g., in Vanuatu (red namamau), Fiji (molau), and Samoa (masame).

Key characteristics of poumuli include:

- straight trunk and narrow crown, with tiered layers of thin horizontal branches in young plantation specimens
- longitudinally shallowly, furrowed, light brown-gray bark

Top: Flowering twig (male plant). Bottom: Ripe fruits on twig (female plant). PHOTOS: T. POULI

- simple, elliptic light green leaves, with red petioles in seedlings
- small whitish flowers and fleshy reddish berries (in female trees) borne in axillary clusters all along the twigs.

It is distinguished from *Glochidion* species (which are also in the family Euphorbiaceae) by:

- the presence of a sterile pistillode (ovary, style, stigma) in male flowers
- its fleshy fruits (compared with capsular in *Glochidion*).

GENETICS

Variability of species

The species is expected to have considerable intra-specific variation given its extensive and disjunct natural distribution. In Vanuatu and the Solomon Islands, two morpho-

logical types can be distinguished based on the color of the petiole and the veins on the underside of the leaves (Chaplin 1993, Siwatibau et al. 1998).

ASSOCIATED PLANT SPECIES

The species occurs mainly in more open types of lowland tropical forest, including secondary forests and near-coastal thickets.

Macaranga spp. and whitewood (*Endospermum medullosum*) are frequently associated species in its native habitats. As an introduced species in Pacific islands, it is planted together with species such as coconut (*Cocos nucifera*), breadfruit (*Artocarpus altilis*), citrus (*Citrus* spp.), mahogany (*Swietenia macrophylla*), and tropical almond (*Terminalia* spp.).

ENVIRONMENTAL PREFERENCES AND TOLERANCES

Climate

This species is adapted to the lowland, humid tropics. The regions of its natural occurrence are uniformly warm to hot throughout the year.

Elevation range

0–350 (–900) m (0–1150 [–2950] ft); planted 600–900 m in Samoa

Mean annual rainfall

1800–4500 mm (70–175 in), reasonably uniformly distributed

Rainfall pattern

Poumuli prefers climates with summer, bimodal, or uniform rainfall patterns.

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

0–3 months

Mean annual temperature

22–28°C (72–82°F)

Mean maximum temperature of hottest month

29–32°C (84–90°F)

Mean minimum temperature of coldest month

19–24°C (66–75°F)

Minimum temperature tolerated

12°C (54°F)

Soils

Poumuli naturally occurs on a wide range of soils including coralline, red clay, somewhat poorly drained soils, and various coastal soils. It exhibits excellent growth and stem form on fertile, bouldery, volcanic clay loams in Samoa.

Soil texture

Tolerates light to heavy soils (sands, sandy loams, loams, sandy clay loams, clay loams, sandy clays, and clays).

Soil drainage

It prefers freely draining soils but tolerates soils with impeded drainage.

Soil acidity

Neutral to acid soils (pH 4.0–7.4).

Special soil tolerances

It is not especially well adapted to shallow, infertile soils, and is intolerant of saline/brackish soils and soils that are waterlogged or shallowly inundated for more than a few weeks.

Tolerances

Drought

The species is recorded as being somewhat drought tolerant in Samoa, tolerating dry spells of 3–4 months once plants are well established.

Full sun

It prefers full sun.

Shade

It will grow satisfactorily with up to about 30% shade.

Fire

On Savai'i (Samoa) it has been reported to be intolerant of fire. Young plants (seedlings and saplings) are normally killed by severe fires, while mature trees usually survive low-intensity ground fires.

Frost

The tree is considered frost-sensitive; it does not naturally occur nor has it been planted in areas experiencing frost.

Waterlogging

It is likely to tolerate only short periods (measured in weeks) of waterlogging or shallow inundation in poorly-

aerated soils, but it may grow satisfactorily in better-aerated, lighter-textured soils with somewhat impeded drainage.

Salt spray

It is tolerant of light salt spray but should not be planted in exposed seaside locations.

Wind

Poumuli has, overall, good resistance to steady winds and cyclones. On well drained soils, the tree is expected to resist storm damage mainly because of the strong bole, low stature, and evenly distributed crown with no large branches. In Samoa, the main damage from moderately intense cyclones is associated with defoliation and breakage of side branches, and trees recover well within 6–9 months. However, the tree is uprooted easily in the Solomon Islands (Chaplin 1993), and on Vava'u, Tonga, a high proportion of trees in trial plots were defoliated and died following cyclone Waka in 2002.

Abilities

Regenerate rapidly

The species is capable of regenerating rapidly, especially on cleared, fertile sites, and with human assistance (including weeding and re-transplanting wildings).

Self-prune

In Samoa self-pruning starts at about age 3–4 years. Poumuli has good self-pruning characteristics, with the lower branches progressively being shaded out, dying, and eventually being shed. They can be easily removed by knocking them off using the back of a cane knife. Cyclonic winds may also hasten the process of self-pruning, breaking branches from mid- and upper canopy positions.

Coppice

In Samoa, if stumps are cut very low (to allow for maximum utilization) then mature trees exhibit limited coppicing ability. If plants are cut at a height of more than 1 m (3.3 ft) above ground level, then even mature (10-year-old) trees may coppice very well. In the Solomon Islands, coppice shoots have been reported to develop from cut stumps.

Pollard

Canopies generally recover fairly well following cyclone damage, so trees would be expected to regrow after pollarding. Pollarding is not practiced, because trees have a fairly narrow canopy for many years and up to the time when they can be harvested for poles and posts.

GROWTH AND DEVELOPMENT

Poumuli can be characterized as a "sprinter," growing rapidly in the early years before slowing down from age 10–20 onward. Thereafter, growth, particularly in trunk diameter, is slow.

Growth rate

Height growth commonly exceeds 1.5 m per year (5 ft/yr) for the first 5–10 years, then falls away dramatically as plants reach near full height (about 17–20 m [56–66 ft]). On fertile sites in Samoa, trees averaged 3.0–3.3 m (10–11 ft) annual height growth and 2.7–4.7 cm (1.1–1.8 in) dbh increase per year in the first 3 years. In the Solomon Islands, it exhibits rapid diameter growth up to about 7–8 years; thereafter, diameter growth slows dramatically in more closely planted configurations.

Flowering and fruiting

Flowering and fruiting commence at about age 2–3 years, although flowering may commence within 18 months of field planting. In Samoa, female plants may often be found bearing flowers and fruits in the same umbel, and flowering/fruiting is thought to occur year round. Recorded flowering months include January and May–November, with fruiting recorded in March, May–August, and November. In Vanuatu, the species also flowers and fruits year-round. In the Philippines it has been observed flowering in January and May–June and fruiting in January and May.

Yields

Yields have not been well documented but are estimated to be about 4–6 m^3/ha/yr (57–86 ft^3/ac/yr) during the rapid growth phase to age 8–10 years. Trees at spacing of 400/ha (162/ac) would produce about 800 pieces of 3 m (10 ft) length poles and the same number of smaller diameter posts for fencing over an 8–10 year rotation.

Reaction to competition

During the first few years after planting poumuli grows well at close spacings; that is, it is not especially sensitive to competition.

PROPAGATION

Poumuli is regenerated from seed in several different ways:

- nursery-raised seedlings (usually by forestry departments)
- transplanted wildlings—the most common method for villagers in Samoa (70–90%)

- natural seedling regeneration: protecting and weeding such plants
- direct-seeding—in Vanuatu, seed is sometimes broadcast over newly planted food crop gardens to supplement natural regeneration (Wheatley 1992).

Propagation of seedlings

Seed collection

In Samoa seeds/fruits may be collected throughout the year, with the main period in Vanuatu being from the end of April to July. Mature dark-colored fruits are collected directly from the canopy or by lopping off small branches and picking the ripe fruits.

Seed processing

Ripe fruits should be soaked in water overnight and then depulped by rubbing and washing over a fine mesh sieve to remove the pulpy material. Seeds should be sown in potting mixture and shallowly covered to about 1–2 mm (0.04–0.08 in) depth. First germination occurs in 2–5 weeks.

Seed storage

Seeds are orthodox, i.e., they retain viability when dried and stored. They may be kept for many years in airtight containers under refrigeration (4˚C [39˚F]).

Germination

Seeds do not require scarification prior to sowing. Sow in a well drained, neutral, fertile loamy soil. The tiny seedlings grow very rapidly and can be transplanted into final nursery pots at the two- or four-leaf stage (about 10 days after germination). Seedlings prefer full sun.

Time to outplanting

Under normal growing conditions, seedlings are ready to plant out in 16–20 weeks. The ideal seedling height for outplanting is about 25 cm (10 in).

Guidelines for outplanting

Poumuli is a light-demanding species, although it can be established under an open canopy of other species such as coconut. Plants grow at a moderately fast rate after outplanting, especially on fertile soils with good weeding.

DISADVANTAGES

Potential for invasiveness

Has a very limited potential to become an environmental weed. In most cases this would not be the case: the species appears to have only a limited ability to invade undisturbed and more closed forest types and farm lands, and any such trees are likely to be sought-out and utilized for timber by people.

Poumuli has been adopted as a beloved tree of Samoa. PHOTO: T. POULI

Susceptibility to pests/pathogens

Generally low susceptibility to pests and diseases. Brown root rot (*Phellinus noxius*) was observed on Kolombangara in the Solomon Islands (Chaplin 1987). Plantings may require protection from termites.

Host to crop pests/pathogens

The tree is not known to be a host for crop pests and pathogens.

AGROFORESTRY/ENVIRONMENTAL PRACTICES

Soil stabilization and improvement

The tree appears to be useful for soil stabilization. It can be expected to improve soil organic matter, but it is not generally planted with this purpose in mind.

Pest control

When planted together with mahogany in the Solomon Islands, the mahogany appears to suffer less damage from shoot borer (*Hypsipyla robusta*) than in pure stands. This may be due to higher numbers of predators attracted into the mixed stands and eating and reducing the population of shoot borer moths/larvae.

Crop shade/overstory

The species is well suited to provide varying levels of shade (depending on planting spacing) for a wide range of crop species. In the Solomon Islands it is considered to have good potential as a shade tree for cacao (*Theobroma cacao*) because it:

- is a long-lived, small, even-canopied tree
- provides a valuable round timber product in small or large dimensions appropriate for village use
- is a host for ants (*Oecophylla smaragedina*) which control a bug (*Amblypelta cocophaga*) that feeds on new shoots and young pods of cacao
- is not as susceptible to brown root rot (*Phellinus noxius*) as are other shade trees, such as *Leucaena,* and therefore is less likely to spread the disease onto cacao.

Alley cropping

Poumuli is an excellent species for growing in wide-spaced alleys, and it has been used successfully on Santo, Vanuatu, in this role.

Homegardens

The species is commonly included in homegardens in Samoa; it is well suited to such plantings due to its compact, low stature, wind firmness, and attractive appearance.

Improved fallows

Poumuli is not known to have specific soil-improving attributes, other than general attributes of trees such as cycling of mineral nutrients from deeper soil layers to crop root zone, and addition of organic matter. However, it is an economically attractive planted fallow and income-generating crop during crop fallow periods as it can be harvested at a relatively early age, e.g., 7–8 years.

Living fences

The tree is little used for live fencing (as it cannot be propagated by large branch cuttings), but it would be well suited to this purpose, due to its longevity and narrow crown.

Fence posts

Cut stems make durable fence posts and are widely used for this purpose. Both early thinnings, e.g., 5–7-year-old plants, and the narrow, upper stem sections of older trees may be utilized for fence pots.

Boundary markers

A useful boundary marker due to its longevity and compact crown, it is commonly planted along farm boundaries in Samoa.

Windbreaks

Poumuli makes an excellent narrow, low windbreak, especially younger trees with more dense foliage, up to about 10 years of age.

Silvopasture

The tree is not known to be included in silvopastoral systems, but it ought to be suitable for providing some shade and as a windbreak.

Animal fodder

Grazing animals do not normally eat the foliage. However, young seedlings may have their leaves eaten by cattle.

Woodlot

It is very widely planted as a woodlot species in Samoa for production of *fale* poles. It may be planted in pure woodlots or mixed with other exotic and native species.

Native animal/bird food

The fruits (small berries) may be produced almost year-round and are consumed by various fruit-eating birds wherever it is found.

Wildlife habitat

The tree provides excellent habitat and a food source for many bird species, both insect- and fruit-eaters, e.g. white-eye, Pacific pigeon, and fruit doves, as well as flying foxes.

Bee forage

The species flowers heavily over a long period, and the flowers are well visited by honey bees. They appear to be an excellent food source for bees, providing both pollen and nectar. It is considered a tree of moderate importance for apiaries in the Solomon Islands (Forster et al. 1988), but the quality of honey produced by bees feeding on nectar of poumuli is yet to be determined.

Coastal protection

The tree may be included in less exposed portions of coastal protection plantings.

Ornamental

Poumuli is an attractive tree with ornamental potential.

USES AND PRODUCTS

Poumuli is highly regarded throughout the South Pacific for production of highly durable timber, being especially favored for building construction uses, especially as round fence posts and construction poles. Its moderately rapid growth, good bole form, and wood and non-wood uses make it a promising tree for agroforestry plantings, including those on infertile soils. In the Solomon Islands and Vanuatu, the species grows rapidly and straight without big branches and is widely exploited for local uses. Traditional non-wood product uses in Melanesia include herbal medicines and a dye.

In Samoa the tree is extensively planted in rural gardens and house yards, and has become the main source of logs for posts and rafters in construction of traditional Samoan houses. It is also often planted as a border tree in Samoan villages, including boundaries and along roads. The species has potential as an intercrop species along with high-value timber species, such as whitewood (*Endospermum medullosum*), mahogany (*Swietenia macrophylla*), and sandalwood (*Santalum* spp.), and would itself be a valuable component of the crop. In some places the tree has moderate importance for honey production, providing both pollen and nectar to honey bees during the flowering season.

Top: Poumuli is commonly planted in homegardens at close spacing, here with pineapple, ginger, bananas, yams, and coconut. PHOTO: C. ELEVITCH
Bottom: Harvesting logs, Samoa. PHOTO: T. POULI

Medicinal

A medicinal drink made from the rasped bark is used to treat fever in the Solomon Islands (Maenu'u 1979). The shredded root is used medicinally in New Guinea. It is also used in traditional medicine in Vanuatu.

Timber

Poumuli yields a heavy heartwood; the density has been variously recorded as 900 kg/m^3 (56 lb/ft^3) on a dry weight basis, 770 kg/m^3 (48 lb/ft^3) at 12% moisture content (m.c.) (Kininmonth 1982), and 810–935 kg/m^3 (50.5–58 lb/ft^3) at 15% m.c. (van Welzen, 1998). The heartwood is pale yellowish brown or reddish brown, and sometimes hardly distinguishable from the pale sapwood, present as a 1–3 cm (0.4–1.2 in) wide band (Chaplin 1993, Walker 1948). The grain is straight and the texture moderately fine. Although very hard and strong, the timber is easily worked, resistant to drywood termites and fungi, and very well suited for service in ground contact. The sapwood is not durable in the ground but is non-susceptible to *Lyctus* attack. Uses include house poles, fence posts, ground posts, and light aerial members in house construction, bridges, and marine piles (Henderson and Hancock 1988, Wheatley 1992, Chaplin 1993, Martel & Associates 1998, van Welzen 1998).

Fuelwood

The wood makes an excellent, hot-burning fuel (Chaplin and Ngoro 1988, Wheatley 1992, Foliga and Blaffart 1995).

Craft wood/tools

It may be suitable for wooden buttons and other uses where a fine-grained, strong timber is required (Chaplin 1993). In Samoa its uses include:

- wood on which tapa cloth is beaten
- short, sharpened sticks for husking coconuts (Whistler 2000)
- planting sticks for planting taro, other crops, and tree seedlings.

Canoe/boat/raft making

In Samoa the wood is used for making booms for outrigger canoes (Whistler 2000).

Tannin/dye

Leaves of the red-veined form are used to stain *Pandanus* leaves a charcoal color (Chaplin 1993). In Samoa and Uvea (Wallis), the purple juice from the fruit is used as a dye (Smith 1981, Foliga and Blaffart 1995).

COMMERCIAL PRODUCTS

The primary commercial products include wooden posts and poles that are sold in local markets, e.g., Bougainville, Santo in Vanuatu, and Apia, Samoa. Price varies depending on the length and diameter of the log.

Spacing for commercial production

A stocking rate of over 1000 stems/ha (405 stems/ac) at age 6 years is appropriate for pole production (Chaplin 1993, Foliga and Blaffart 1995).

In pure plantations various spacings have been used including 2 x 2 m, 2.5 x 2.5 m, 3 x 3 m, 2 x 5 m, 4 x 3 m, and 4 x 4 m, but currently 5–6 m x 4 m (16–20 x 13 ft) is preferred in order to avoid crown interference at an early age. In Samoa the most common spacing for mixed-species forestry plantings is 8 x 3 m (26 x 10 ft) (Chaplin 1993, Foliga and Blaffart 1995, T. Alatimu pers. comm. 2004)

Management objectives

Producing long, clear, and straight boles for posts and poles is the objective. Removal of lower branches to a height of 3 m (10 ft) at an age of about 3–4 years is recommended for the production of posts. Additional later pruning of side branches up to a height of 6 m (20 ft) may be desirable for production of larger poles. Due to the rare occurrence of multiple trunks, singling has not proved to be necessary.

Design considerations

At close spacing, the species is able to rapidly dominate the site; this reduces weeding requirements, and early thinnings can provide lighter poles such as rafters. Appropriate thinning regimes will need to be developed to ensure the required size of the end product is achieved.

Small on-farm woodlot, Samoa. PHOTO: T. POULI

New planting of poumuli interplanted with taro. PHOTO: T. POULI

Yield

Yields are estimated to be about 4–6 m^3/ha/yr (57.2–85.8 ft^3/ac/yr) during the early years. Processing includes cutting to length and bark removal. The prepared logs are usually sold only in local markets, e.g., within 50 km (30 miles) of production. In recent years in Samoa, poumuli products from West Savai'i have been supplied further afield to markets in 'Upolu.

INTERPLANTING/FARM APPLICATIONS

Example system 1

Location

Siumu, 'Upolu, Samoa.

Description

This is a newly developed system, including small woodlots and boundary marker plantings as part of private and community forestry. The main product is small durable poles, which are harvested at age 8–10 years. The price in 2004 was about WS$15–30 (equivalent to US$5–10) per 3 m (10 ft) length of small pole (10–15 cm [4–6 in] diameter). Most trees yield 2–3 m (6.5–10 ft) poles, and two fence posts (the latter selling for about WS$2–3 each). Whole trees return for about WS$35–60 each.

Crop/tree interactions

The trees provide a windbreak and shelter for adjacent crops. They also minimize the growth of weeds and need for cutting.

Spacing

Spacing varies; when intercropped with cash crops the spacing may be 8–10 m (26–33 ft) between rows and 6 m (20 ft) within rows. In woodlots the most common spacing is 6 x 4 m (20 x 13 ft).

Cacao growing in the understory of poumuli. Tutuila, American Samoa.
PHOTO: C. ELEVITCH

Example system 2

Location

Solomon Islands.

Description

This is a new system under development combining poumuli in a canarium nut/rattan (*Canarium indicum*/*Calamus* spp.) farming system. In this system poumuli provides early shade for both canarium nut and rattan, as well as quicker economic returns while the longer-maturing crops are developing.

Crop/tree interactions

Poumuli provides early shade for establishment of rattan and prevents weed growth. Depending on development of *Canarium* as a shade and support crop for rattan, poumuli could be retained for a variable period and cut at any time to provide durable poles and/or cash income.

Spacing

In this system, poumuli is planted at close spacing, 3 x 3 m (10 x 10 ft), to provide shade from an early age and more stems for later commercial thinnings.

PUBLIC ASSISTANCE AND AGROFORESTRY EXTENSION

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

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Flueggea flexuosa (poumuli)

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Acknowledgments: The author and publisher thank Tito Alatimu, Dale Evans, Tolusina Pouli, Diane Ragone, and Art Whistler for their input. Photo contributions from Tolusina Pouli are greatly appreciated.

Recommended citation: Thomson, L.A.J. 2006. *Flueggea flexuosa* (poumuli), ver. 2.1. In: Elevitch, C.R. (ed.). Species Profiles for Pacific Island Agroforestry. Permanent Agriculture Resources (PAR), Hōlualoa, Hawai'i. <http://www.traditionaltree.org>.

Sponsors: Publication was made possible by generous support of the United States Department of Agriculture Western Region Sustainable Agriculture Research and Education (USDA-WSARE) Program; SPC/GTZ Pacific-German Regional Forestry Project; USDA Natural Resources Conservation Service (USDA NRCS); State of Hawai'i Department of Land & Natural Resources Division of Forestry & Wildlife; and the USDA Forest Service Forest Lands Enhancement Program. This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, and Agricultural Experiment Station, Utah State University, under Cooperative Agreement 2002-47001-01327.

Series editor: Craig R. Elevitch

Publisher: Permanent Agriculture Resources (PAR), PO Box 428, Hōlualoa, Hawai'i 96725, USA; Tel: 808-324-4427; Fax: 808-324-4129; E-mail: par@agroforestry.net; Web: <http://www.agroforestry.net>. This institution is an equal opportunity provider.