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Specialty Crop Production in a Forestry Understory: Olena, Maile, Palapalai and ‘Awa

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Summary

Long rotations of high-value tropical woods such as koa (*Acacia koa*) will require innovative technologies that generate short-term income following the establishment of a new forest. Under the canopies of young forests, there is the opportunity to cultivate a wide range of native and introduced understory plants. The viability of an edible forest mushroom, wood ear or pepeiao (*Auricularia polytricha*), was studied in the first phase of this project. In the second phase we have included ornamentals and medicinals. A study of olena (*Curcuma domestica*) and maile (*Alyxia oliviformis*) cultivation was completed, while research on palapalai (*Microlepia strigosa*) and ‘awa (*Piper methysticum*) is still underway.

Olena appears to be an excellent understory crop for koa tree farms owing to its high tolerance for shade. The average fresh weight yields obtained in this study were 11,472 kg/ha for directly planted plants and 7,951 kg/ha for transplants. This was comparable to yields obtained elsewhere (6,720 to 8,960 kg/ha) under rain-fed conditions. Harvest of the ornamental bracts for flower arrangements could also serve as another source of income.

Maile seeds were collected from plants growing in Kokee (Kauai), Aiea (Oahu), Kapapala (Hawaii), and Keauhou (Hawaii) and planted under 80% shade. Depending on seed source, between 1 and 3 months are required for germination. After three months, the Kokee seedlings had the greatest average height increase (3.2 cm). Differences in amount of fragrance were also noted. The Keauhou seedlings had the highest fragrance rating, followed by the Aiea source. The source with the lowest rating was from Kokee. Several years may be required before harvest owing to the slow growth of maile. We will select for both vigorous growth and fragrance.

Introduction

Koa (*Acacia koa*) is being considered as a long rotation crop for production of its high value wood. However, to make koa production economically viable, supplemental companion crops to provide income before the koa is harvested may be required.

Olena or turmeric (*Curcuma domestica*) is a perennial herb with fleshy, swollen rhizomes, and a striking fragrant white bract. It is best known for its rhizomes which have a deep yellow color, aroma, and flavor. The dried, ground rhizome of olena is used as a spice and is indispensable in the preparation of curries. It is also used as a yellow dye in the textile, food, and pharmaceutical industries. In India, southern Asia, Melanesia, and Polynesia, olena is used in ceremonial cosmetics. Even in Hawaii, olena was used as a spice, to color kapa, and as a medicine to treat ear ache and lung problems (Neal 1965). Olena (Fig. 6) is not known to exist in the wild and has been in cultivation for over 10 centuries (Purseglove et al. 1981). The principal exporter of turmeric is India.

Maile (*Alyxia oliviformis*) is an endemic vine that naturally inhabits lower and middle

Olena rhizomes harvested from Maunawili, Oahu.

forests (Neal 1965). This plant has oval, pointed shiny leaves and has a sweet, pleasing scent; however, plants from different locations exhibit variation in the amount of fragrance and leaf size and shape. In Hawaii, maile is a prized and popular plant with its primary use for leis which are worn during weddings, graduations, and other special occasions. The importance of maile in the Hawaiian culture can be seen by the large number of songs, hulas, chants, and various other compositions that have been written about this plant.

Although most commercially sold maile is imported from the Cook Islands there are local groups who go into the forests to harvest from wild populations (Bornhorst 1996). The latter activity is a potential problem because it is unclear as to how many plants can be taken on a "sustainable yield" basis without threatening wild populations. When indiscriminate harvesting of wild plants occurs, the result may be the erosion of gene pools and eventually the endangerment of species. This has already become an extensive problem in other tropical forests where the harvesting of understory plants from wild populations is a common practice (Foster 1995). A possible solution that may alleviate the pressure put on wild populations is to grow maile as an understory crop in managed tree cropping systems.

This is the second phase of the study where the objective is to develop production systems for understory crops that can be grown under an *Acacia koa* canopy. In addition to olena and maile, palapalai (*Microlepia strigosa*) and ʻawa (*Piper methysticum*) are being evaluated to determine the potential of these plants under young koa canopies.

Materials and Methods

The study was carried out under 5-yr old *Acacia koa* trees at HARC's Maunawili Breeding Station on Oahu. The site was prepared for planting by removing dead koa trees and spraying all weeds with the herbicide Roundup. Following planting, the weeds were manually removed.

Rhizomes of olena were obtained, broken into pieces containing 2-3 eyes, and allowed to dry in the shade for 5 days. After drying, the rhizomes were planted directly into the

Maile from Kokee growing at Maunawili, Oahu.

fieldplots. The remaining rhizome pieces were planted in 4-inch pots in a vermiculite and perlite mixture and grown in the greenhouse. After 5 months, the potted plants were transplanted under the koa trees. A surface application of phosphorus and nitrogen was applied at planting. After 10 and 5 months for the directly planted and potted plants, respectively, 3 plants of each treatment were harvested and weighed.

Maile seeds from Kokee (Kauai), Aiea (Oahu), Kapapala (Hawaii), and Keauhou (Hawaii) were collected. The pulp was removed and the seeds were allowed to dry in the shade. The seeds were planted in pots filled with vermiculite and perlite and placed under 80% shade. Seedlings were transplanted into dibble tubes and remained under 80% shading. Plants ranging in size from 10 to 50 cm were planted at 1 m spacings. An initial fragrance test was done prior to planting by scraping young leaves. Fragrance between seed sources was rated as strong, moderate, and weak. Heights were measured from the ground to the middle of the tallest apical bud at planting and at 3 months.

Palapalai, a delicate native fern, was vegetatively propagated by divisions and grown in the greenhouse for 6 months prior to planting. Upon planting, the ground was manured with the soil conditioner, Amend, which was incorporated into the soil. Two rows spaced at 1 m were installed.

Eight ‘awa cultivars (mahakea, nene eleele, apu, puna green, rahmadel, nene, green moi, and

Palapalai fern vegetatively propagated in the greenhouse then transplanted under a koa stand.

‘Awa propagatedfrom knuckle cuttings.

avalea) were obtained and used to produce tip and knuckle cuttings. Cuttings were first dipped in Zerotal fungicide. Tip cuttings were then dipped in the rooting hormone Dip-N-Gro, planted in a vermiculite and perlite media and placed under mist. Knuckle cuttings were directly placed in the growing media without hormone. Dip-N-Gro was only applied to knuckle cuttings following shoot production.

Results

The olena rhizomes placed directly in the ground following drying, were larger and healthier than the plants grown in the greenhouse and transplanted. The average fresh weight for the directly planted plants was 320.8 g (11,472 kg/Ha), while for the potted plants the average was 221.8 g (7,951 kg/Ha). No diseases such as rhizome rot and leaf spots, commonly found in India, nor pests were observed. Flowers were also produced only on the plants started in the field. As expected, the above ground shoots began the annual die back at maturity (8 mo).

Germination of maile differed between seed sources. The Aiea and Keauhou seeds germinated approximately 1 month after planting; however, the Kapapala and Kokee seeds required 2 and 3 months, respectively. The Keauhou maile produced the strongest scent, followed by the Kapapala and Aiea, and the Kokee plants with the least amount of fragrance. After 5 months following out-planting, survival of the smaller plants were low. The plants grew

very little in 3 months. The Kokee seed source showed a height increase of 3.2 cm, while the average height increase for the Keauhou and Aiea seedlings were 1.3 and 2.0 cm, respectively.

A 2-3 month establishment period was required before the palapalai began producing larger, healthier fronds. The ferns benefited from monthly fertilizations with a weak fish emulsion fertilizer (5-0-0). Survival was excellent at 94% after 5 months.

Preliminary propagation trials for ‘awa utilizing knuckle and tip cuttings of the 9 cultivars were successful. More cuttings were produced for field testing. Rhizome harvest will be made at approximately 1 year.

Discussion

Several plants were screened as understory crops in koa. Ease of cultivation and low maintenance makes olena a prime candidate as an understory crop. The average fresh weights obtained in this study (11,472 kg/ha for direct and 7,951 kg/ha for potted) were either within or above the average fresh weight yields reported elsewhere under rain-fed conditions (6,720 to 8,960 kg/ha) (Purseglove et al. 1981). It should be noted that this is preliminary information and testing needs to be repeated with larger plots and replications for validation. Another possible source of income from the olena may be from the harvesting of the ornamental flowers. Information pertaining to the development of processing techniques and marketing strategies will need to be obtained if olena is to be grown. Because of the slower growth rate of the maile and palapalai, several years will be required before any harvest. Research on the potential of ‘awa as an understory crop was initiated and it is still unclear how ‘awa will respond as an understory crop. If ‘awa is added to the list of crops, marketing information is available through the Association for Hawaiian ‘Awa.

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