Yield and Growth of Macadamia Trees in Response to Mulching with Macadamia Husks

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Macadamia (Macadamia integrifolia, Maiden et Betche) husks, a waste product of the industry, could serve a useful purpose as a mulch (8). However, uncomposted husks have been shown to be toxic to germinating corn (Zea mays L.) seedlings when mixed with vermiculite as a potting medium. In a composting study, unamended heaps of macadamia husks retained potent phytotoxic compounds for at least 209 days (unpublished data). Observations (H. Ooka, personal communication) indicated that mature macadamia trees could be killed with high levels of fresh husks used as a mulch around the base of plants. The objective of this study was to measure the yield, growth, and leaf nutrient levels of macadamia trees in response to increasing amounts of uncomposted husks applied as a surface mulch.

The experiment was conducted on the island of Hawaii in two commercial orchards (M2 and M8) that were located at 463-m and 610-m elevation, respectively. Orchard M2, containing 25-year-old trees, received 628 and 607 mm of rainfall in 1984 and 1985, respectively, and orchard M8, with 18-year-old trees received 653 mm and 754 mm. Herbicides and fertilizer were applied consistent with commercial production practices (7). The soil type at both locations was Puna extremely stony muck (typic Tropofult).

Orchard rows were 9 m apart with mowed grass alleys bordering 3-m weed-free strips maintained below the trees. Experimental units consisted of two trees ("Keauhau") 9 m apart within plots 18.3 m long (total area = 55 m²). Husks were applied (at start and 1 year later) as mulch at 0, 25, 50, and 100 t·ha⁻¹, with a thickness of 0, 20, 40, and 80 mm, respectively. Treatments were replicated four times at both orchards using a randomized complete block design. Growth during 1984 through 1986 was described as the increase in trunk size index (TSI), equal to trunk circumference⁴ / 10 (3). Yield data represent a 2-year cumulative weight of nut in shell (NIS) crop without corrections for moisture levels, since the yield response within single years followed similar trends. Yield data were adjusted using a covariance method (5) based on the initial TSI (3). Two years after the initial treatment with husks, a composite leaf sample (3) was taken from the second whorl of fully expanded leaves of each tree, air-dried, and used to determine leaf nutrient levels (2). Regression analysis was performed on all data to determine the trends in yield, growth, and nutrient levels in response to mulch levels. Correlation coefficients for significant trends were derived from data composed of all trees used in the experiment and not the means of experimental units.

Macadamia NIS yield from from trees at the M8 site increased with increasing mulch levels, but yield at the drier M2 location did not change significantly with increasing mulch levels (Fig. 1, top). The increase in TSI was significantly (5%) reduced only at location M2 as mulch levels increased (Fig. 1, bottom). Quadratic and cubic trends for all data were not significant.

The mean foliar K levels (percent of dry weight) of both orchards showed a significant linear increase (5% level) with increasing amounts of husks (0.66% to 0.75% for 0 to 100 t of husks/ha, respectively). The foliar K increase was attributed to the high levels (1.4%) of K in the mulch material. Soil K levels in another study were higher following mulching with tree bark than for seven other materials (1). Iron levels in M2 showed a highly significant (1% level) linear decrease with increasing amounts of husk (53 to 48 mg·kg⁻¹ for 0 to 100 t of husks/ha, respectively). Iron levels in M8 were not correlated with increasing amounts of husks; however, the mean value of all treatments with husks was lower than the mean of no husk treatments (66 mg·kg⁻¹ for 0 t of husks/ha and 57 mg·kg⁻¹ as the mean for all other levels). Nutrient levels of N, P, Ca, Mg, S, B, and Mn were maintained at suggested values for macadamia trees in Hawaii (7).

The data suggest that mulching with husks improved yield at M8, but reduced growth under the drier conditions at M2. The effect of mulch appears to be complex and related to environmental factors impacting the decomposition and detoxification of husks. Higher rainfall at M8 (13% more than M2) increased leaching and may have increased the microbial decomposition of macadamia husks (4), resulting in greater dissipation of toxicity. Likewise, decreases in plant performance following mulching may be due to a variety of factors (6). Less rainfall at M2 may have extended husk toxicity, resulting in less growth without effect on yield during the test period. Commercial use of husks as mulch can be viewed as a safe means of disposal.

Literature Cited

Fig. 1. Cumulative 2-year yield of macadamia nuts in shell in response to mulch composed of macadamia husks. Husks were applied twice during the 2-year harvest period. Yields are adjusted against a trunk size index (TSI) based on the covariance method. Increase in TSI is for growth during 1984 through 1986. Each point is the mean of eight trees. #Nonsignificant or significant at 5% level, respectively.

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