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A METHOD TO SCREEN WEED-SUPPRESSING ALLELOCHEMICALS IN FLORIDA BIOMASS

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Abstract. **Wood chip mulches derived from woody species grown in Florida are sometimes used for weed suppression in perennial fruit crops, especially in sustainable and organic production systems. A method for testing allelopathic qualities of these materials was developed, including wood chip incubation and filtering followed by bioassays of lettuce seed germination and growth. Eluates of wood chips from red maple (*Acer rubrum* cv. '*Rubrum*' L.), swamp chestnut oak (*Quercus michauxii* Nutt.), red cedar [*Juniperus silicicola* (Small) E. Murray] and sweet bay (*Magnolia grandiflora* L.) highly inhibited germinating lettuce seeds, as assessed by germination percentage, radicle and hypocotyl growth. The effects of eluates from these four species were more than or equal to that found for eluates from wood chips of black walnut (*Juglans nigra* L.) a species with a high level of allelopathic activity.**

In the United States annual estimated waste biomass of urban tree and wood mill residues totaled 38,000 and 5,600 dry metric tons, respectively (National Research Council, 2000). Wood chip mulches from such biomass applied as a pre- or post-plant treatment have been shown to suppress weeds (Autio, 1999), moderate soil temperature (Harris, 1983), soil moisture (Russel, 1939), and increase growth of young pecan trees (Foshee et al., 1996; Smith et al., 2000). Experiments to determine allelopathic activity of woody species and their derived materials have included interplanting corn with black walnut (Jose et al., 1995) and application of plant tissue extracts to weeds growing in the field (Al-Saadawi and Al-Rubeaa, 1985; Al-Saadawi et al., 1985). Other laboratory studies assessing allelopathic activity of cover crops have used germinating lettuce seeds as a test crop because of its high sensitivity to bioactive substances (Fujii and Shibuya, 1992). Our objective was to test a laboratory bioassay for allelopathic chemicals from wood chips of species commonly found in woody biomass waste management operations. Once developed, such a laboratory bioassay could be used to evaluate biomass allelopathic potential prior to longer term field trials.

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Materials and Methods

In a preliminary assay to define a baseline treatment, plumbagin, a napthoquinone analog of juglone found in black walnut (Rietveld, 1983), was applied to lettuce seedlings. Radicle length of seedlings germinated in 0.1 mM and 0.2 mM plumbagin was reduced compared with seedlings germinated in water (Fig. 1).

For initial screening of woody species, 2.5-5 cm-diameter, leafy branches of 13 mature trees species from an Alachua County, Fla. wood resource recovery operation were selected and identified. Other similar wood samples were later taken from potted nursery trees of red maple, southern red cedar, swamp chestnut oak, and sweet bay magnolia) approximately 2-years old. Leaves and wood chips consisting of both bark and wood (5 g fresh weight) were incubated in 50 mL double distilled water for 24 h at 37 °C. The liquid was then filter sterilized through four layers of cheese cloth and a 0.2 micron CN filter unit (Nalge-Nunc International, Rochester, N.Y.). Distilled water (50 mL) was then added to the wood chips, incubated again for 96 h at 37 °C, and filtered as above to produce a second filtrate. Three mL of each filtrate were then added to Whatman #2 paper with 20 surface-sterilized seeds of lettuce (*Lactuca sativa* L. 'Green Ice') obtained from Park Seeds (Greenwood, S.C.) (Fig. 2). Lettuce seed germination and radicle growth were then evaluated for five replicates of leaves and wood chips of each of 13 woody species as compared with a water control.

Results and Discussion

Initial trials with plumbagin showed that germination of lettuce cultivar 'Green Ice' was highly inhibited by this naphthoquinone and radicle growth was most inhibited in a concentration-dependent manner. Browning of root tips was also noted (Fig. 1). In this lettuce bioassay for allelochemicals, radicle, growth inhibition appeared to be a sensitive indicator for allelopathic activity.

Filtrates from selected woody species affected lettuce seed germination and radicle growth differently (Table 1). Swamp chestnut oak and southern red cedar inhibited germination of 50 and 70% of lettuce seeds, respectively, compared with only 5 to 10% inhibition by other species. Compared with black walnut, a species with demonstrated allelopathic qualities, six other species (Brazilian pepper, loblolly Pine, red maple, southern red cedar, swamp chestnut oak, and sweet bay magnolia) considerably inhibited radicle growth (Table 1). Cotyledon length was not significantly inhibited by any treatment (data not shown), compared with a water control. The inhibitory effects of filtrates from 2-year old southern red cedar, swamp chestnut oak, red maple, and sweet bay magnolia were also significantly less than those of mature trees, suggest-

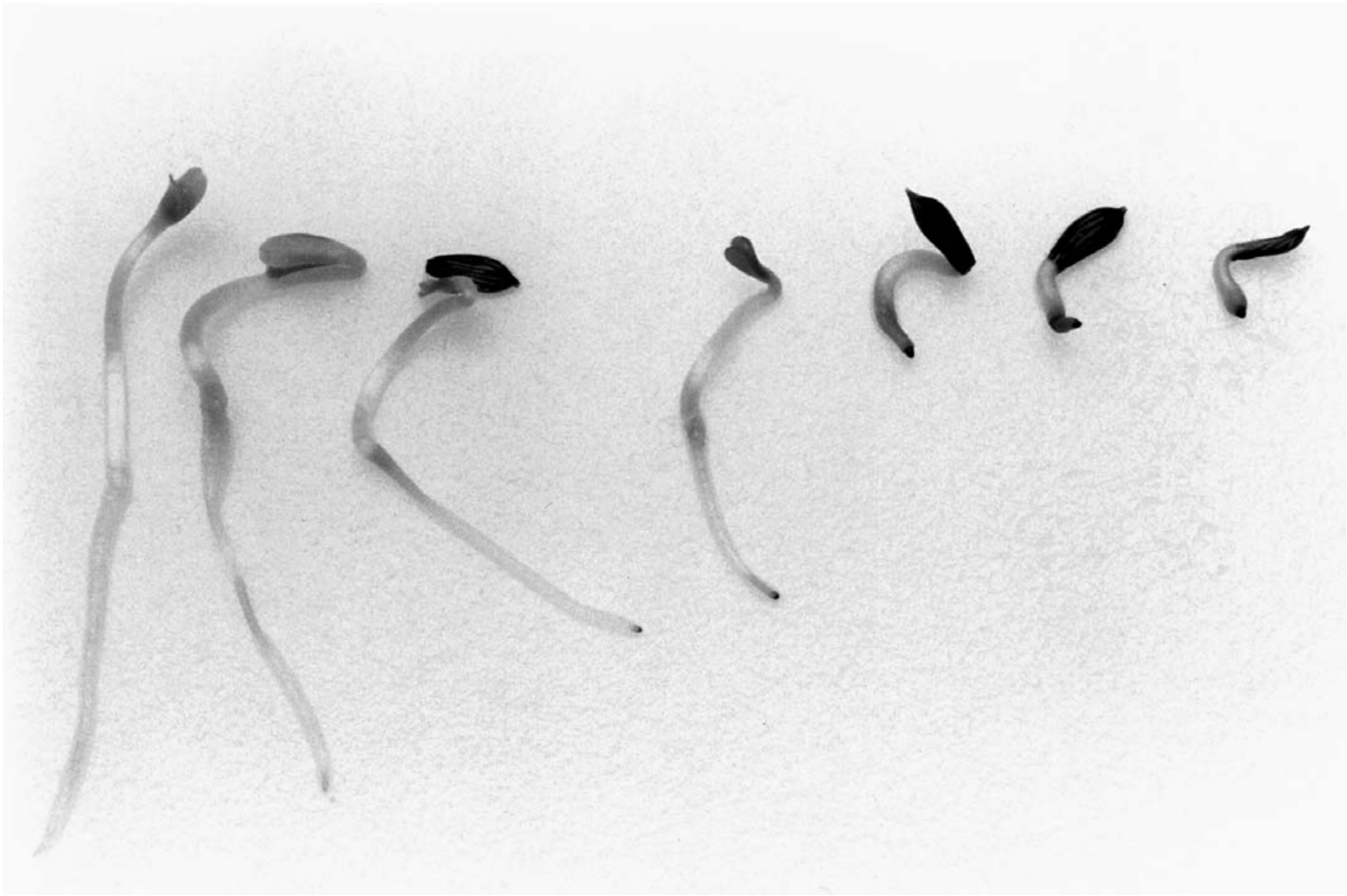

Fig. 1. Lettuce seedling bioassay for allelochemicals. From left to right: the first two seedlings were germinated in water, the second two seedlings and the last three seedlings were germinated in 0.1 mM and 0.2 mM, respectively, plumbagin, a naphthoquinone.

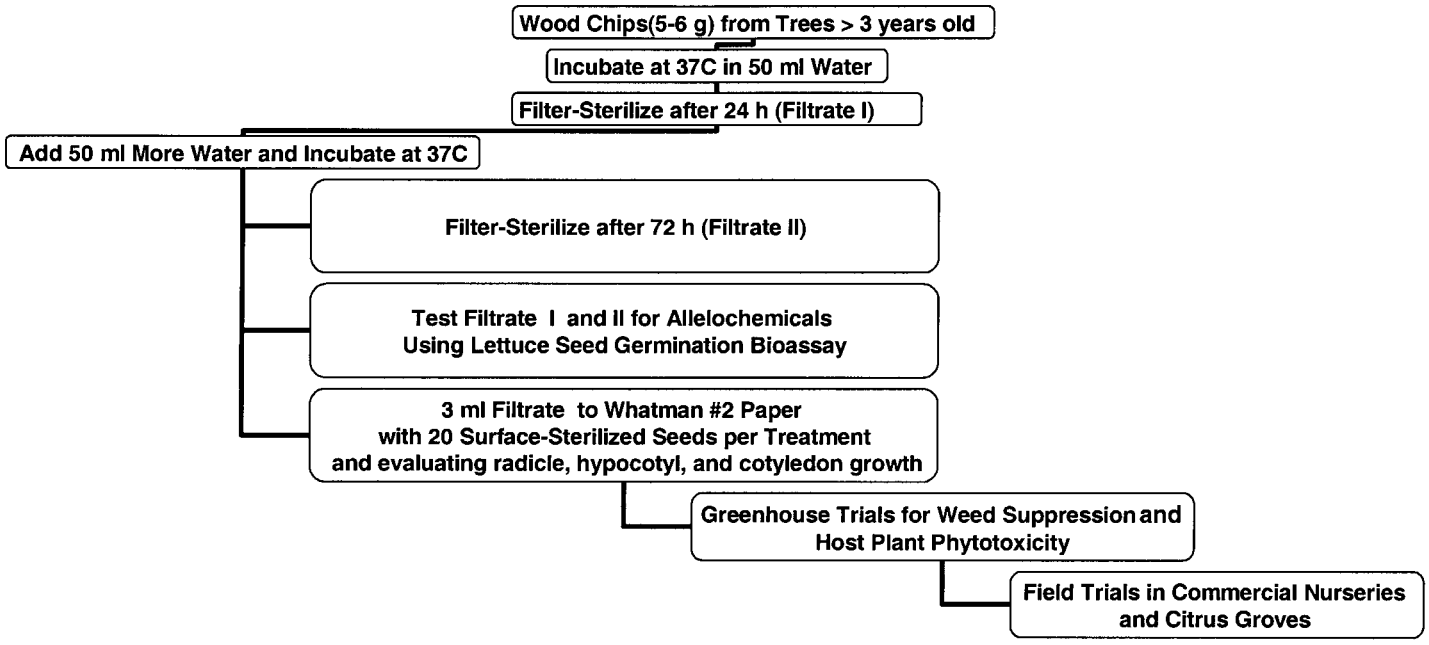

Fig. 2. Testing for water-soluble allelochemicals from wood chips.

Table 1. Evaluation of woody plants for allelopathic activity using a lettuce seed bioassay.[z]

Woody species	Mean lettuce seed germination (%)	Mean radicle inhibition compared with a water control (scale of 0-10 with 0 = no inhibition)
Water	100	0
Black Walnut (*Juglans nigra*)	90	5
Brazilian Pepper (*Schinus terebinthifolius*)	100	5
Camphor Tree (*Cinnamomum camphora*)	95	4
Laurel Oak (*Quercus hemispherica*)	100	2
Loblolly Pine (*Pinus taeda*)	95	4
Oleander (*Nerium oleander*)	95	2
Red Maple (*Acer rubrum*)	95	6
Southern Red Cedar (*Juniperus silicicola*)	70	7
Swamp Chestnut Oak (*Quercus michauxii*)	50	7
Sweet Gum (*Liquidambar styraciflua*)	100	3
Sweet Bay Magnolia (*Magnolia virginia*)	90	6
Sweet Viburnam (*Viburnam odorattisimum*)	95	4
Water Oak (*Quercus nigra*)	100	3

[z]Mean of five replicates of wood chips (5-6 g) of each woody species used.

ing accumulation of allelopathic compounds with tree age (data not shown). Further research will determine if extracts of selected woody species have allelopathic activity against target weed species but not host crop plants in greenhouse tests and field testing in commercial greenhouses and woody plant nurseries.

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