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Nursery Production of Tea Oil Camellia Under Different Light Levels*

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INTRODUCTION

Seeds of camellia (*Camellia oleifera* Abel, Theaceae) have been utilized in China for more than 1000 years (Shanan and Ying 1982). Tea oil is the main cooking oil in China's southern provinces, especially Hunan where more than 50% of the vegetable cooking oil is from camellias. Tea oil is a high quality cooking oil which is comparative to olive oil and it stores well at room temperature. Oil content of the seed is 40% to 50% and oleic acid constitutes up to 88% of the fatty acids (Shanan and Yin 1982; Xia et al. 1993). In the late 1980s and early 1990s the annual production of tea oil in China was about 150,000 tonnes (t)/year (Tang et al. 1993). It is estimated that the need for tea oil in the year 2000 in China will range from 485,000 to 551,000 t/year (Fang 1994). Roughly one-seventh of China's population uses tea oil for cooking (Fig. 1). Young men whose diets were supplemented with camellia oil had different serum HDL-cholesterol levels compared to those supplemented with beef tallow (Hong 1988).

Tea oil is a good raw material for industrial uses and is used to manufacture soap, margarine, hair oil, lubricants, paint, synthesis of other high-molecular weight compounds, and a rustproof oil. Camellia oil has been proven to have its place in all emulsions used in the cosmetology and dermopharmacy fields (Sabetay 1972). Uses include day or night creams, anti-wrinkle compounds, lipstick, hair creams, make-up, anti-sun preparations, rouge, and make-up remover products. Extraction of the fruit hulls also yields useful compounds such as saponin, tannin, and pentosan. Saponin is used as an emulsifying agent in pesticides, for foam-forming fire extinguishers and in detergents (Shanan and Ying 1982). Extracts from the residues of tea oil processing have also been used to feed livestock and are used to formulate pesticides, feeds, and fertilizers. The triterpenoid saponin from camellia has been shown to improve immune function, enhance antibacterial and antiviral activities, and to have antimutation and antioxidation properties in humans and animals (Zhan 1999). Tea oil residues have been used for effective control of the following pests: rice blast, sheath and culm blight of rice, wheat rust, rice hopper, cutworms, cotton aphids, certain scale insects, long-horned beetles, and leeches (Shanan and Ying 1982). Extracts of the seed cake left over after processing are known to deter larval development in insects (Duke and Ayensu 1985). The possibility of developing new biologically-based pesticides exists for this product.

Fig. 1. Tea oil packaged and marketed in Taiwan.

Tea oil is grown in 105 different counties in China, mainly in the provinces of Hunan and Jiangxi. In China *C. oleifera* occurs from 18° to 34° North latitude and grows on acidic soils where January mean temperatures do not drop below 2°C (Shanan and Ying 1982). Extensive provenance trials were conducted in China in the 1960s and 1970s (Fang 1994). Elite plants were selected and numerous local cultivar trials were installed. Families were selected for superior fruit production and selections were made for different parts of China. Since 1990 all research in China on tea oil has stopped due to lack of funding (Fang 1994). Many trials have been destroyed or

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damaged. One critical area identified by Chinese researchers was the need for improved selections since many farms contain only local seedlings. Grafting of superior clones on poor producing seedlings has been shown to improve yields by greater than 50% and to reduce the incidence of anthracnose on fruit (Niankang et al. 1996). Superior clones in other regional tests increased oil production 3–5× compared to local seedling stands (Zhuang et al. 1992). *Camellia oleifera* (Fig. 2) is well adapted to the lower Piedmont and Coastal Plain regions of the southeastern United States, thus offering the possibility of an alternative crop in areas where traditional row crop agriculture is suffering. I have initiated a research program to develop *C. oleifera* as a commercial oilseed crop in the southeastern United States. The objective of this study was to determine: (1) which levels of light exclusion were best for the production of container-grown *Camellia oleifera*, and (2) to determine if photoinhibition had an influence on photosynthetic processes under different conditions.

METHODOLOGY

Seed of *C. oleifera* PI 162475 was obtained from the US National Arboretum in Washington, DC in fall of 1999 and germinated. Treatments in this study consisted of (1) full sun, (2) 30% light exclusion under woven shade cloth, and (3) 55% light exclusion under woven shade cloth. Plants were grown in #1 (3.8 L) containers with a pine bark:sand (8:1 v/v) substrate amended with 1.2 kg m^{-3} dolomitic limestone and 0.9 kg m^{-3} Micromax micronutrients (The Scotts Company, Marysville, Ohio). Individual plants were topdressed with 1.1 oz (30 g) of Osmocote Plus 15.0 N–4.0 P–9.9 K (8–9 month Southern formula, The Scotts Company) at the initiation of the study in April 2000. Dark-acclimated (~30 min) chlorophyll fluorescence measurements were made at room temperature in July using an OS-500 modulated fluorometer (Opti-Sciences, Tyngsboro, Massachusetts). At the termination of the study in November 2000 measurements were made of final plant height, number of shoots, and shoot length. Leaf, stem, and root dry mass were determined after drying at 66°C for 48 hr. Leaf area was measured using an LI-3000 leaf area meter (LI-COR, Inc., Lincoln, Nebraska). Specific leaf area was calculated as leaf area per unit leaf dry mass.

Fig. 2. Flower of *Camellia oleifera*.

RESULTS AND DISCUSSION

Final plant height, leaf, stem, root and plant dry mass, root:shoot ratio, leaf area, specific leaf area, and shoot length all showed quadratic responses ($P < 0.05$) to production light levels (Table 1). Growth was greater for plants grown under 30% light exclusion compared to plants produced in full sun. Plant growth at 55% light exclusion was generally intermediate between plants grown in full sun and 30% light exclusion. Dark-acclimated chlorophyll fluorescence measurements (F_v/F_m) made in July (range 0.77 to 0.78) indicated that photoinhibition was not a problem for plants produced in full sun.

Table 1. Influence of production light level on the growth of *Camellia oleifera* in #1 (3.8 L) containers (*n*=15). All values presented are percent increases relative to plants produced in full sun.

	Percent increase relative to plants in full sun								
Light % exclusion	Final height	Leaf dry mass	Stem dry mass	Root dry mass	Plant dry mass	Root shoot ratio	Leaf area	Specific leaf area	Shoot length
Full sun	0	0	0	0	0	0	0	0	0
30	41	48	45	102	60	40	90	30	160
55	23	20	27	36	26	10	43	17	68

CONCLUSIONS

Container-grown plants of *C. oleifera* can be produced without shading in south Georgia, although optimal growth occurred under 30% light exclusion. It remains to be seen whether plants produced under 30% light exclusion would perform better once transplanted into a field production setting or if photoinhibition during the winter would be a problem for plants grown under light exclusion when placed in full sun conditions. Work is ongoing in an attempt to refine container production standards for this new crop. Germplasm from four different sources has been planted at the Bamboo Farm and Coastal Gardens in Savannah, Georgia to make improved selections and to see how the crop performs in the southeastern Georgia.

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