

## Phalsa: A Potential New Small Fruit for Georgia

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Phalsa (*Grewia asiatica* L., Tiliaceae) is an exotic bush plant considered horticulturally as a small fruit crop but also used as a folk medicine. The ripe phalsa fruits (Fig. 1) are consumed fresh, in desserts, or processed into refreshing fruit and soft drinks enjoyed during hot summer months in India (Salunkhe and Desai 1984). However, phalsa fruit has a short shelf life and is considered suitable only for local marketing (Anand 1960).

The phalsa plant (Fig. 2) is native to the Indian subcontinent and Southeast Asia (Hays 1953; Chundawat and Singh 1980) but is cultivated on a commercial scale mainly in the northern and the western states of India (Hays 1953; Sastri 1956). Around the beginning of the 20th century, it was introduced into the East Indies including the Philippines where it is naturalized at low elevations in dry zones of the island of Luzon. It reached western countries much later in the century. In the United States, a few specimens have been established at the Agricultural Experiment Station at Mayaguez, Puerto Rico, the Tropical Research and Education Center of the University of Florida at Homestead, Florida, and the USDA, ARS, Tropical Horticultural Research laboratory at Miami, Florida but there are no commercial plantings.

### BOTANY

*Grewia asiatica* L., *G. subinaequalis* DC. (syn. *G. asiatica* Mast.), and *G. hainesiana* Hole are the only members of Tiliaceae that yield edible fruits. According to Sastri (1956), phalsa is the most commonly used vernacular name for these fruits in India but there are several names in customary usage including *dhamin*, *parusha*, and *shukri* in Hindi, *dhaman* in Punjabi, *man-bijal* in Assamese, *phalsa* and *shukri* in Bengali, *mirgi chara* and *pharasakoli* in Oriya, *phalsa* in Gujrati, *phalsi* in Maharashtra, *jana*, *nallajana*, *phutiki* in Telagu, *palisa*, *tadachi* in Tamil, *buttiyudippe* and *tadasala* in Kannada, and *falsa* in Pakistan.

### Morphology

The phalsa plant is a large, shaggy shrub (Fig. 2) or a small tree reaching 4 m or more in height (Sastri 1956). The phalsa plants grow to become straggling tall shrubs with rough bark on the stem, and have numerous long, slender, drooping branches where the young branchlets are densely covered with a coating of hairs. The alternate, deciduous, widely spaced, thick, and large leaves are broadly heart-shaped or ovate, pointed at the apex, oblique at the base, measure up to 20 cm in length and 15 cm in width, and coarsely toothed, with a



**Fig. 1.** Freshly harvested phalsa fruits produced at the Agricultural Research Station of the Fort Valley State University, Fort Valley, Georgia



**Fig. 2.** A healthy phalsa bush growing in the field inside a cold protected house at the Agricultural Research Station of the Fort Valley State University, Fort Valley, Georgia

light, whitish blush on the underside. Small (10 to 19 mm across), bright orange-yellow flowers are borne in dense cymes in the leaf axils in late spring. The small fruits, almost round drupes like blueberry and purple, crimson or cherry red in color when ripe, borne on a 2- to 3-cm-long peduncle, are produced in great numbers in open, branched clusters. Individual fruits measure from 1.0 to 1.9 cm in diameter, 0.8 to 1.6 cm in vertical height, and 0.5 to 2.2 g in weight. Fruits ripen gradually on bushes during the summer months. While ripening, the fruit skin turns from light green to cherry red or purplish red finally becoming dark purple or nearly black (Fig. 3). The ripe fruit is covered with a very thin, whitish blush, and becomes soft and tender. The delicate, fibrous flesh is light greenish-white becoming colored purplish-red from seed reaching near the skin. Overripe fruit flesh becomes suffused with purple color later followed by shriveling of fruit skin due to moisture loss. The phalsa flavor is pleasantly astringent but delicious due to very appropriate sugar-acid blend. Large fruits have two hemispherical, hard, buff-colored seeds up to 5 mm in diameter while small fruits are generally single-seeded.

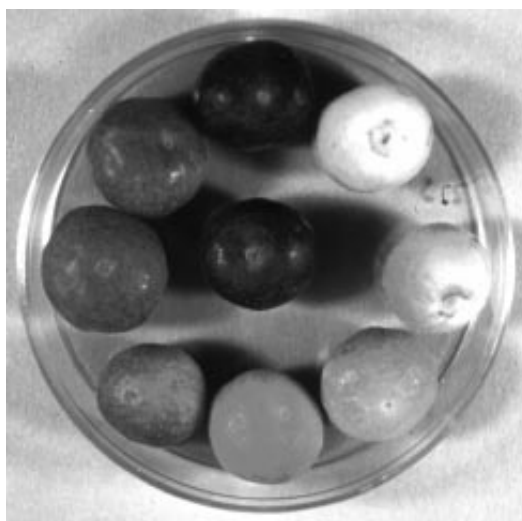
### **Adaptation**

The phalsa is a warm climate fruit plant. In India, this plant grows satisfactorily and produces well up to an elevation of 1,000 m. It can tolerate light frost although at the cost of defoliation; the plant is deciduous and normally loses its leaves slowly in those areas with mild winter season. The phalsa planting flourishes well under variable climatic conditions, requires protection from the freezing cold temperatures. Adequate sunlight and warm or hot temperatures are required for fruit ripening, development of appropriate fruit color, and good eating quality.

The phalsa plant grows vigorously and produces satisfactorily under variable soil types including fine sand, clay or even limestone, when soil fertility is not very poor. Phalsa is often grown in marginal lands close to city markets to facilitate prompt marketing of fruit. Fertilizer application although casual, helps plant health and production. The plant is drought-tolerant, but occasional irrigation during the fruiting season and in dry periods, is profitable for growers.

### **HORTICULTURE**

The tall-growing wild phalsa plants produce fruits which are of marginal quality and are not relished by most consumers. The low-growing dwarf and/or bushy type of phalsa plants which develop a good blend of sugar and acid in the fruit flesh, are preferred for cultivation (Hays 1953). There are no well-known cultivars available but there are local favorites for different growing regions (Sastri 1956; Yadav 1998).



**Fig. 3.** Various stages in the ripening of the phalsa fruits ranging from fully developed green to fully developed ripe (center).

## **Propagation**

Conventional propagation of phalsa plant is by seed. The phalsa plant is readily propagated by rooting of hardwood cuttings as well as layering (Samson 1986). Seedlings produce the first crop of well evolved fruits 12 to 15 months from planting. Seeds stay viable for years and germinate in less than three weeks (Sastri 1956). Wood type and planting date influence rooting of phalsa (Singh et al. 1961). Treatment with auxins (IAA, IBA, NAA) improve rooting of difficult-to-root hardwood cuttings of phalsa (Yadava and Rajput 1969), ground layers, and air layers (Mohammed and Chauhan 1970).

## **Culture and Management**

One-year-old seedlings are usually spaced 2 to 4.5 m apart. Bushes flower progressively during the spring months. Since phalsa bears fruit on current season's growth there is a need for regular but severe annual pruning before the on-set of spring. Annual pruning to a height of about 1 m encourages new shoots and higher yield of marketable fruit than does more drastic trimming (Singh and Sharma 1961). Gibberellic acid has been reported to improve fruit set and increase fruit size (Randhawa et al. 1959). The phalsa plant shows good response to nitrogen applications. High levels of phosphorus supply increase sugar content in the fruit while higher potassium suppresses sugar and promotes acidity. Phalsa is considered stress-tolerant and is commonly grown under neglect (Hays 1953).

Gradual but steady fruit ripening during the summer of only a few fruits in a cluster necessitates frequent harvesting (Salunkhe and Desai 1984). The fruits which resemble blueberry have a very short shelf life, and must be marketed within a day or two. Average fruit yield per bush from a well managed planting varies from 7 to 10 kg during one season.

## **Biotic Stresses**

Leaf-cutting caterpillars attack the foliage at night. A blackish caterpillar causes galls on the growing shoots. Termites often damage the roots. In some areas, leaf spot is caused by *Cercospora grewiae*. At the Fort Valley State University, however, there has been no serious biotic stresses observed on phalsa plants or fruits except that ants were found on some bushes during the fruit ripening periods.

## **Medicinal and Other Uses**

The fruit is astringent and stomachic. Morton (1987) reported that when unripe, phalsa fruit alleviates inflammation and is administered in respiratory, cardiac, and blood disorders, as well as in fever reduction. Furthermore, an infusion of the bark is given as a demulcent, febrifuge, and treatment for diarrhea. The root bark is employed in treating rheumatism. The leaves are applied on skin eruptions and they are known to have antibiotic action.

The fresh leaves are valued as animal fodder. The bark is used as a soap substitute in Burma. A mucilaginous extract of the bark is useful in clarifying sugar. Fiber extracted from the bark is made into rope. The wood is yellowish-white, fine-grained, strong, and flexible. It is used for archers' bows, spear handles, shingles, and poles for carrying loads on the shoulders. Stems that are pruned serve as garden poles and for basket-making.

The flowers have been found to contain grewinol, a long chain keto-alcohol, tetratricontane 22-ol 13-one (Lakshmi and Chauhan 1976). The phalsa seeds produce approximately 5% yield of a bright yellow oil that contains 8% palmitic acid, 11% stearic acid, 13.5% oleic acid, and 64.5% linoleic acid with 3% unsaponifiable (Morton 1987).

## **EVALUATIONS IN GEORGIA**

Beginning in 1994, we have been investigating feasibility of phalsa growing at the Fort Valley State University Agricultural Research Station. The phalsa seeds were obtained from India through the USDA Plant Introduction division. The greenhouse-raised seedlings of Indian phalsa, and seedlings and hardwood cuttings of MIA-12489 phalsa that we received from the USDA-ARS Tropical Horticulture Research Laboratory, Miami, Florida, were established in the field plots during spring 1995. The experimental field plots for phalsa were established inside a 25 m × 40 m cold protection wooden house (Fig. 2) which was covered with

**Table 1.** Plant characteristics of two phalsa lines as observed at Fort Valley, Georgia.

Plant type	Leaves	Flowers	Fruit		Seed weight (g)
			Diam. (cm)	Weight (g)	
<b>Indian</b>					
Shaggy shrub or small tree, bushy appearance, numerous branches	Large thick dark green ovate leaves, pointed apex, coarse teeth, prominent leaf veins	Small flowers, prominent orange petals, light yellow sepals, 10.5 mm diam.	10.45±0.25	0.98±0.43	0.16±0.015
<b>Miami 12489</b>					
Tall shrub or small tree with fewer and stronger branches, light green	Large thick leaf blades, broadly ovate, base oblique, coarsely toothed, white blush underside	small inconspicuous flowers, orange petals, bright yellow sepals, 18.40 mm diam.	14.26±0.38	1.15 ± 0.61	0.23±0.02

6-mil clear polyethylene and was equipped with 6 high-speed fans and 4 electric heaters. Plants were fertilized and irrigated as needed; no controls have been required for insects and disease. Bushes were heavily pruned each February to a height of 30 cm (Yadav 1998).

The green-house raised plants of both Indian and MIA-12489 phalsa lines planted during spring 1995, were established satisfactorily and increased in vigor each year. Plant survival was 70% for the Indian phalsa compared to 50% for MIA-12489 germplasm from Miami, Florida. Selected vegetative and fruiting characters of two phalsa lines are compared in Table 1.

The Indian phalsa bushes had greater flowering and fruiting intensity than the MIA-12489. The peak fruiting period for the 1998 season ranged from July 15 to August 5. The average fruit production from the Indian type was 2.7 kg fruits per bush compared to only a few dozen fruits (approx 25 g) on the MIA-12489 during 1998. Mean fruit diameter for Indian type was 10.5 mm vs. 14.3 mm for MIA-12489, fruit height for Indian phalsa measured from the blossom-end to the stem-end, was 10.1 mm (ranging from 6.8 to 12.8 mm). Mean berry weight was 1.0 g for Indian phalsa and 1.2 g for Miami phalsa. The astringent fruits of the Indian type phalsa had more pleasing flavor but the fruit of Miami phalsa (MIA-12489) was sweeter. The majority of MIA-12489 phalsa fruits had double seeds while only a few large fruits of the Indian phalsa had double seeds. The Indian phalsa had smaller seeds than MIA-12489, which is preferred. Fruits of Indian phalsa stayed fresh for 7 days or longer under refrigeration but spoiled in a few days at room temperatures.

Phalsa juice ferments so readily that sodium benzoate must be added as a preservative (Anand 1960). Analyses made long ago in the Philippines established the following values as reported by Morton (1987): 725 calories/kg edible fruit; moisture, 81.13%; protein, 1.58%; fat, 1.82%; crude fiber, 1.77%; and sugar, 10.27%. Freshly harvested phalsa fruits were frozen and analyzed for 17 nutritional items by a local commercial analytical laboratory (Table 2).

**Table 2.** Nutrient content of phalsa fruits produced at Fort Valley, Georgia.

Nutrients analyzed in 1998	Nutrient values/ 100 g fruit
Calories (Kcal)	90.5
Calories from fat (Kcal)	0.0
Moisture (%)	76.3
Fat (g)	<0.1
Protein (g)	1.57
Carbohydrates (g)	21.1
Dietary Fiber (g)	5.53
Ash (g)	1.1
Calcium (mg)	136
Phosphorus (mg)	24.2
Iron (mg)	1.08
Potassium (mg)	372
Sodium (mg)	17.3
Vitamin A (µg)	16.11
Vitamin B <sub>1</sub> , Thiamin (mg)	0.02
Vitamin B <sub>2</sub> , Riboflavin (mg)	0.264
Vitamin B <sub>3</sub> , Niacin (mg)	0.825
Vitamin C, Ascorbic acid (mg)	4.385

## SUMMARY

Greenhouse-raised seedlings as well as rooted cuttings of phalsa plants were successfully established inside a cold protected polyethylene-covered field structure. Our observations in the Middle Georgia area indicated that growing phalsa is feasible in temperate areas if cold protection is assured. Indian phalsa was more fruitful and had tastier fruits than the MIA-12489 line. Studies to improve plant regeneration and cold hardiness are under way.

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