Plant Propagation Protocol for *Maclura pomifera*
ESRM 412 – Native Plant Production

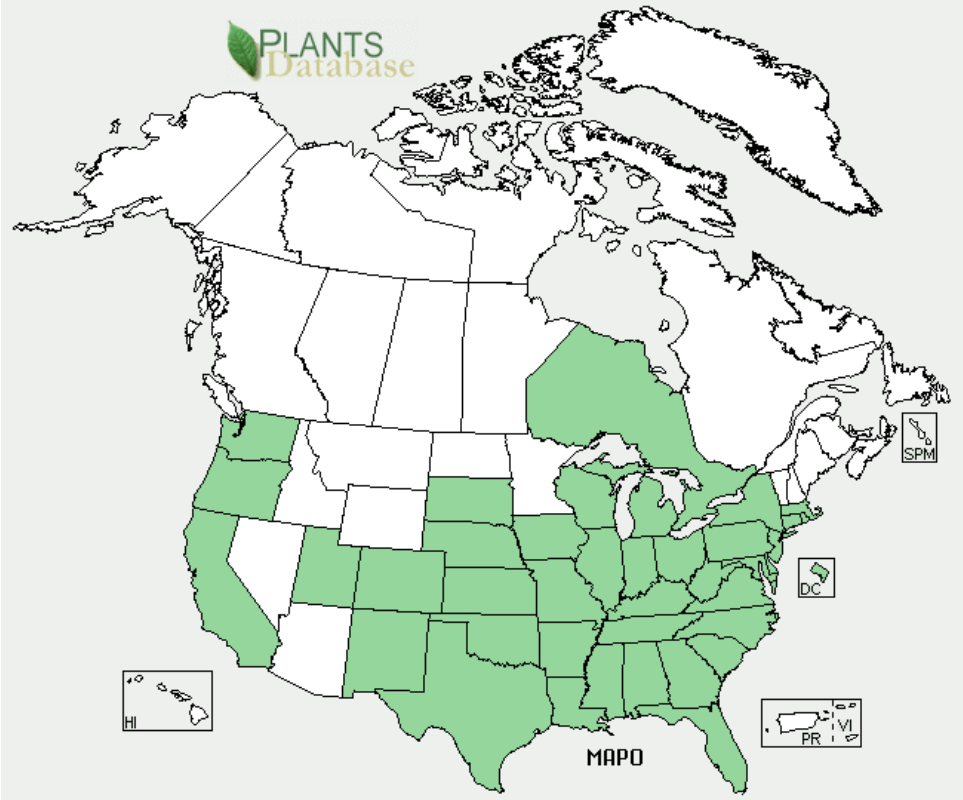

Fig. 1 – North American Distribution Map from USDA PLANTS Database [1]

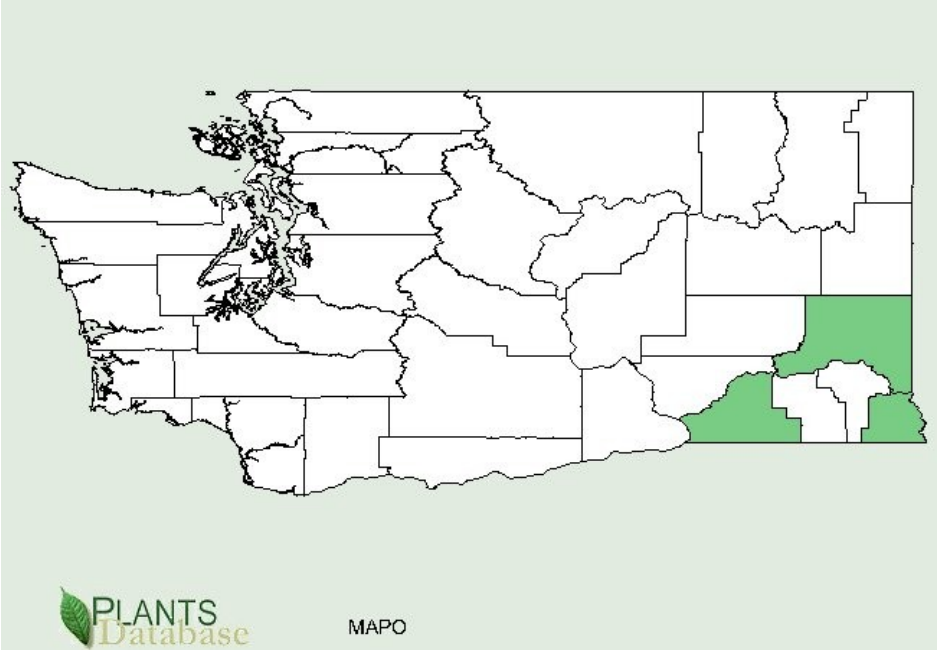

Fig. 2 – Washington state distribution map from USDA PLANTS Database [1]

Fig. 3 Full tree photo – University of Western New Mexico [15]

Fig. 4 M. pomifera fruit – USDA NRCS plant guide [13]

TAXONOMY	
Family Names	
Family Scientific Name:	Moracaea
Family Common Name:	Mulberry
Scientific Names	
Genus:	Maclura
Species:	pomifera
Species Authority:	(Rafinesque.) C.K. Schneid.
Variety:	
Sub-species:	
Cultivar:	
Authority for Variety/Sub-species:	
Common Synonym(s) (include full scientific names (e.g., *Elymus glaucus* Buckley), including variety or subspecies information)	Ioxylon pomiferum Raf., Toxylon pomiferum Raf. ex Sarg (PLANTS 2003)
Common Name(s):	Osage Orange, hedge-apple, bodark, bois-d'arc, bowwood, and naranjo chino [2]
Species Code (as per USDA Plants database):	MAPO
GENERAL INFORMATION	
Geographical range (distribution maps for North America and Washington state)	N.America – Found in all U.S. states except MN, ND, MT, ID, WY, NV, AZ. Also found in Canada in the Ontario province. WA – Located in the southeastern counties of Walla Walla, Asotin, and Whitman. [1]
Ecological	

distribution (ecosystems it occurs in, etc):	"Osage-orange grows on a variety of soils but does best on rich, moist, well-drained bottomlands. It occurs on alkaline soils, shallow soils overlaying limestone, clayey soils, and sandy soils [6,8,9]. It can occur on bottomlands which are seasonally flooded [6]." [2]
Climate and elevation range	"Osage-orange grows best in areas that receive 25 to 40 inches (640-1,020 mm) precipitation a year but tolerates a minimum of 15 inches (380 mm). It is sensitive to cold and succumbs to winter-kill in the northern Great Plains [6,7]." [2] It is present at elevations ranging from sea level to 1500m. [14]
Local habitat and abundance; may include commonly associated species	According to the USDA PLANTS database, Maclura pomifera is found in three southeastern counties of Washington state with habitats most closely resembling the hotter, drier conditions where larger populations of the plant are found in Texas, Arkansas, and Oklahoma. It is unclear why the USDA PLANTS database lists Maclura pomifera as native to Washington state as most sources describe it as a native of Texas and Oklahoma. It was spread primarily through early white settlers planting it for windbreaks and use as fence posts. [13] <u>Forest Service description of associated species (Outside WA):</u> "On the Trinity River floodplain in Texas, mostly small (less than 8-inch [20 cm] diameter) osage-orange occurs in bottomland forests dominated by cedar elm (Ulmus crassifolia), sugarberry (Celtis laevigata), green ash (Fraxinus pennsylvanica), and western soapberry (Sapindus soponaria var. drummondii) [3] In Iowa, osage-orange occurs in a honey-locust (Gleditsia triacanthos)-black locust (Robinia psuedoacacia)-boxelder (Acer negundo)-elm (Ulmus spp.) forest [4]. On lower terraces of Salt Creek in Illinois, osage-orange occurs in a bur oak (Quercus macrocarpa)-hackberrry (Celtis occidentalis) forest [5]. Osage-orange is also associated with white oak (Quercus alba), white ash (Fraxinus americana), and red mulberry (Morus rubra) [6]. In Tennessee, Kentucky, and Alabama, osage-orange occurs with eastern redcedar (Juniperus virginiana), black walnut (Juglans nigra), hickory (Carya spp.), and elm [6]. Osage-orange that has escaped cultivation often occurs as thickets along fencerows and ditches, in ravines, and in overgrazed pastures. It commonly occurs with honey-locust in disturbed areas [6]." [2]
Plant strategy type /	"Osage orange is a pioneering species forever invading exposed mineral soils, particularly overgrazed pastures and abandoned crop fields." [13]

successional stage (stress-tolerator, competitor, weedy/colonizer, seral, late successional)	It is an effective pioneer because it can tolerate many different soil types. It also has natural protection from grazing and prefers full sunlight. [13] "Osage-orange has few pests and, once established, can handle a variety of site / soil constraints. On resource-rich sites in full sun, osage-orange can grow fast. A major concern in growing young trees is elimination of both herbaceous and woody competition. Osage-orange is considered hardy to non-fluctuating winter temperatures found up to winter hardiness zone 5. Within its native range, osage-orange is attacked by Phymatotrichum omnivoum -- cotton root rot. In addition, osage-orange has been attacked by leafy mistletoe, Verticillium wilt, assorted leaf spots, Pythium root rot, stem borers, scale, and rodents. Osage-orange is not attacked by subterranean termites." [12]
Plant characteristics (life form (shrub, grass, forb), longevity, key characteristics, etc)	"Osage-orange is a small tree or large shrub averaging 9 m (30 ft) in height at maturity. Isolated trees on good sites may reach heights of as much as 21 m (70 ft); crowded trees usually do not grow so tall. In windbreak plantings on the Great Plains, Osage-orange grew 6 m (20 ft) tall on average sites during a 20-year period; on some sites it grew 12 m (40 ft) tall [10]. Branchlets growing in full sunlight bear sharp, stout thorns. Slow-growing twigs in the shaded portions of the crown of mature trees are thornless. The thorns, 1.3 to 2.5 cm (0.5 to 1 in) long, are modified twigs. They form in leaf axils on 1-year-old twigs. Shade-killed lower branches remain on the tree many years. … Mature trees have short, curved boles and low, wide, deliquescent crowns. Even in closed stands on good sites, less than half the stems contain a straight log, 3 m (10 ft) long, sound and free of shake." [11]
PROPAGATION DETAILS	
Ecotype (this is meant primarily for experimentally derived protocols, and is a description of where the seed that was tested came from):	
Propagation Goal (Options: Plants, Cuttings, Seeds, Bulbs, Somatic Embryos, and/or Other Propagules):	Plants [12]

Propagation Method (Options: Seed or Vegetative):	Seed [12] and Vegetative [13] are both possible
Product Type (options: Container (plug), Bareroot (field grown), Plug + (container-field grown hybrids, and/or Propagules (seeds, cuttings, poles, etc.))	
Stock Type:	
Time to Grow (from seeding until plants are ready to be outplanted):	
Target Specifications (size or characteristics of target plants to be produced):	
Propagule Collection (how, when, etc):	SEED: "To successfully collect seeds and grow seedlings, it is critical that you locate fruiting females with several neighboring males. Fruits can be collected from the ground anytime after they fall until just before Spring." [12] CUTTING: "Osage orange can be propagated by softwood cuttings in June or by hardwood cuttings harvested in January." [13] "Root cuttings taken in fall or early winter are also a possible source of vegetatively produced materials." [13]
Propagule	SEED:

Processing/Propagule Characteristics (including seed density (# per pound), seed longevity, etc):	"The milky juice in the fruit serves as a dormant season pesticide in protecting the seeds from damage."[12] "Cleaning and extracting seed from the fruits are easiest if the fruit is stored in a moist place and allowed to decay for several months. Seeds can then be extracted in water by macerating the fruit and then floating off the pulp or screening it off. The average Osage orange fruit contains from 200 to 300 seeds per fruit." [13] "Do not ferment the fruits to assist in seed removal. Avoid prolonged skin contact with the milky juice." [12]
Pre-Planting Propagule Treatments (cleaning, dormancy treatments, etc):	SEED: "Osage-orange seeds have a short-duration dormancy factor which is removed by a moist, cool period (30 days), or soaking in cool water for 48 hours. Expected germination is 50% of seeds within 30 days." [12] CUTTING: "Softwood cuttings should be treated with indole butyric acid (IBA) at 5,000 to 10,000 parts per million (PPM) and placed in sand beds under mist conditions (Dirr and Heuser, 1987). Hardwood cuttings from previous seasons growth should be placed in a cool greenhouse and provided bottom heat (68 °F) and 5,000 to 10,000 ppm IBA quick dip to encourage rooting of the cuttings. Covering of hardwoods with an opaque poly sheet will delay shoot development. Rooting is possible in six weeks with this method." [13]
Growing Area Preparation / Annual Practices for Perennial Crops (growing media, type and size of containers, etc):	SEED: "Sow the seeds 3/8 inch deep and firm soil." [12] "Seeds may be drilled in rows 20 to 30 cm apart, or in bands 7.5 to 10 cm wide. They should be covered with 0.6 to 1.25 cm of soil… Recommended bed densities are 100 to 160 seedlings per meter squared." [13]
Establishment Phase (from seeding to germination):	
Length of Establishment Phase:	
Active Growth Phase (from germination	

until plants are no longer actively growing):	
Length of Active Growth Phase:	
Hardening Phase (from end of active growth phase to end of growing season; primarily related to the development of cold-hardiness and preparation for winter):	
Length of Hardening Phase:	
Harvesting, Storage and Shipping (of seedlings):	
Length of Storage (of seedlings, between nursery and outplanting):	
Guidelines for Outplanting / Performance on Typical Sites (eg, percent survival, height or diameter growth, elapsed time before flowering):	SEED: “For fall sowing, sow cleaned but otherwise untreated seeds in mineral soil and then use a light organic mulch over the top. For Spring sowing, sow cool-treated seeds in mineral soil without mulch. Seeds require mineral soil contact, full sunlight, and moist conditions.” [12]
Other Comments (including collection restrictions or guidelines, if available):	SEED: “Seeds can be stored for several years if cleaned and kept under dry, cool conditions.” [12]
INFORMATION SOURCES	

References (full citations):	
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