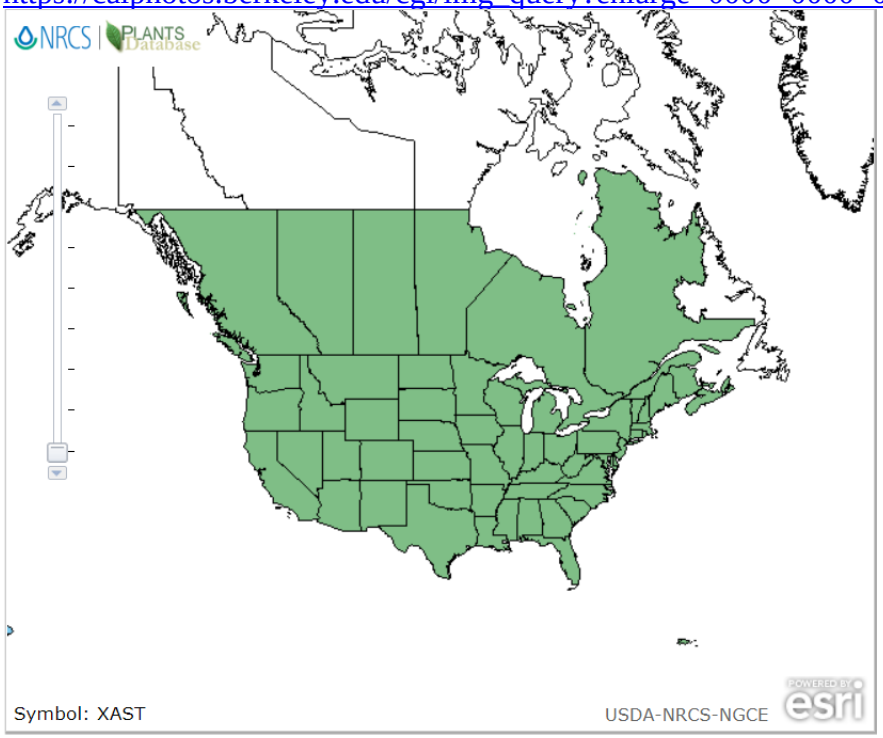
**Plant Propagation Protocol for *Xanthium strumarium* L.**

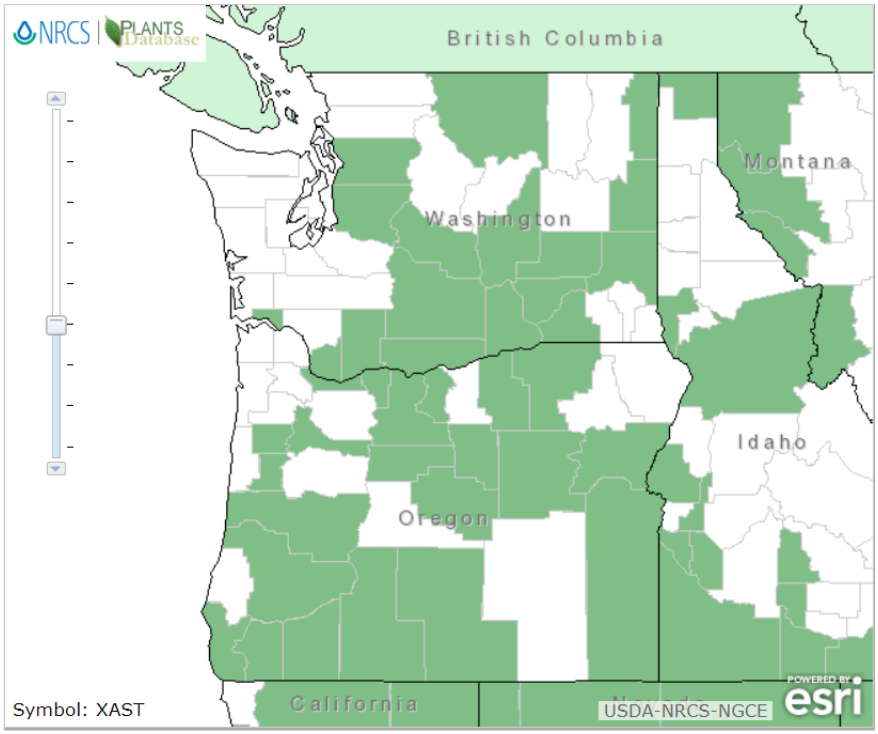
ESRM 412 – Native Plant Production

Protocol URL: https://courses.washington.edu/esrm412/protocols/XAST.pdf

Image by George W. Hartwell, 2003, https://calphotos.berkeley.edu/cgi/img_query?enlarge=0000+0000+0703+0780




Distribution in North America



Distribution in Washington and Oregon
Maps by USDA NRCS PLANTS Database[1]

| TAXONOMY | |
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| Plant Family | |
| Scientific Name | *Xanthium strumarium* |
| Common Name | Rough cocklebur |
| Species Scientific Name | |
| Scientific Name | *Xanthium strumarium* Linnaeus |
| Varieties | *Xanthium strumarium* var. *canadense* (Mill.) Torr. & A. Gray<br>*Xanthium strumarium* var. *glabratum* (DC.) Cronquist<br>*Xanthium strumarium* var. *strumarium* |
| Sub-species | N/A |
| Cultivar | N/A |
| Common Synonym(s) | *Xanthium calvum* |
| Common Name(s) | Canada cockeblur (var. *canadense*), Noogoora bur (Australia), clotbur, ditchbur |
| Species Code (as per USDA Plants database) | XAST |
| **GENERAL INFORMATION** | |
| Geographical range | This species grows worldwide in temperate and subtropical zones, widespread in North America, Europe, and Asia, and present in some regions of South America, Australia, and the Pacific Islands[5]. Found |

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| | between latitudes 53°N and 33°S[6]. See maps above for distribution in North America and the Pacific Northwest. |
| Ecological distribution | Often found on disturbed sites and grows in grasslands, marshes, and alongside streams and ponds[2,3,6]. |
| Climate and elevation range | Typically grows in areas less than 1400 m asl[2]. |
| Local habitat and abundance | Often found in alkaline soil and disturbed areas including roadsides and over-grazed pastures. Found in open areas, preferring full sun, including both seasonally wet areas as well as wetlands. It can be found growing very large on fertile, moist land and less vigorous in dry, poorly developed soil[2,4,6]. |
| Plant strategy type / successional stage | *X. strumarium* is an aggressive competitor and can grow in a variety of soil types and climates. Its seed dispersion method is highly effective, allowing for widespread invasion. Both roots and shoots grow quickly, aided by large, fleshy cotyledons[5], outcompeting neighboring vegetation for nutrients and water. It rapidly forms large stands and is a problematic weed in agricultural settings worldwide, affecting crops such as rice, sugarcane, and cotton. It is also an issue in pastures and can poison livestock[4,6]. |
| Plant characteristics | Dicot annual forb typically 20 to 150 cm tall[2,5].<br>**Leaves:** alternately arranged, rough-hairy in texture on both sides, toothed or lobed margins, three primary veins, triangular-ovate to broadly ovate in shape, 4 to 12 cm long and 3 to 10 cm wide, with 2 to 10 cm petioles[2,5]<br>**Stems:** erect, ridged, hairy, branching, with purple spots[5]<br>**Flowers:** inconspicuous clusters 5 to 8 mm wide, monoecious with only stamen or pistils on individual clusters, green, flowering time highly variable between July and October[2,5,6]. A short-day plant, flowering is initiated through increased night length during the fall. Demonstrate clinal variability in North America, in that plants growing at northern latitudes demonstrate a critical night length of around 9.5 hours (45°N) in contrast to 11.5 to 12.5 hours at southern latitudes (30°N)[9].<br>**Fruits:** hard, woody, spiny burs 10 to 30 mm long, brown at maturity and oval in shape, with two beaks extending from terminal end curving inward. Each bur contains two oblong achenes, one larger than the other, gray to dark brown to black in color. Large variety in fruit size and degree of curvature in spines, with fruits |

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| | ripening throughout fall. Fruits are dispersed by adhering to animals and humans or are carried water and wind. Self-fertile. Burs are predated upon by insects, with smaller seeds more likely to experience predation than larger seeds[2,4,5,6,11,12]. |
| **PROPAGATION DETAILS – DIRECT SEEDING IN OUTDOOR PLOT Adapted from Lechowicz[7]** | |
| Ecotype | Ruderal population from disturbed area in Quebec, Canada |
| Propagation Goal | Plants or Seeds |
| Propagation Method | Seed |
| Product Type | Bareroot (field grown) |
| Stock Type | Bareroot |
| Time to Grow | 4 months (late May to late September) |
| Target Specifications | At the time of harvest in late September, individual seedlings averaged 122 cm in height with 7,000 mature seeds (3,500 mature fruits with 2 seeds each). |
| Propagule Collection Instructions | Collect mature, brown[5] fruits from wild populations in fall |
| Propagule Processing/Propagule Characteristics | Fruits have sharp burs and removing them was shown to increase germination rate[8]. |
| Pre-Planting Propagule Treatments | Burs can be sown directly without extracting achenes or performing any treatment, as demonstrated this study. See protocol below adapted from Albers-Nelson *et al.*[8] for possible pre-planting treatment. |
| Growing Area Preparation / Annual Practices for Perennial Crops | Sow fruits in late May in an outdoor plot. The soil in this study is noted as 75.5% clay, 24.5% silt, and 13.8% organic matter with a pH of 5.8. Although *X. strumarium* has been noted to perform best in moist, course-textured soil and a pH of 5.2 to 8, this species will grow in a wide variety of soil types[5]. Sow 5 fruits 5 cm deep per 4 $m^2$ and create two rows of buffer plants around the perimeter or the plot. |
| Establishment Phase Details | Once seeds have germinated, thin plants to one seedling per 4 $m^2$. |
| Length of Establishment Phase | Emergence can be expected nine to ten days after sowing. |
| Active Growth Phase | The first true leaves should arise 14 days from sowing. |
| Length of Active Growth Phase | 3 months[4] |
| Hardening Phase | Plants will senesce after fruit production. |
| Length of Hardening Phase | N/A |
| Harvesting, Storage and Shipping | If seed production is the goal, mature fruits can be collected in fall as stock plants begin to senesce. |
| Length of Storage | N/A |

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| Guidelines for Outplanting / Performance on Typical Sites | Albers-Nelson *et al.*[8] found that propagation in containers or direct sowing on the site of interest yielded greater vigor than transplanting bareroot stock. However, if this is the desired method, seedlings should be transferred before true leaf development in soil balls in 10 to 15 cm in diameter. |
| Other Comments | Seeds should be sourced from a donor population at the same latitude as the planting site, as *X. stumarium* demonstrates clinal variability in short-day flowering initiation. The critical night length will initiate flowering even if the plant is recently germinated, resulting in low seed production[9]. Larger fruits have demonstrated a higher germination percentage[13] and seedlings grown from larger fruits have been demonstrated increased survival in the field[10]. Smaller fruits also may be more likely to be predated upon by insects[11]. |
| **PROPAGATION DETAILS – PROPAGATION IN CONTAINER Adapted from Albers-Nelson *et al.*[8]** | |
| Ecotype | Population along stream in Oklahoma |
| Propagation Goal | Plants or Seeds |
| Propagation Method | Seed |
| Product Type | Biodegradable container or plug |
| Stock Type | Container |
| Time to Grow | Seedlings perform best in the field if outplanted immediately after cotyledons are fully developed and before any true leaves have formed, 1 to 2 days after germination. Alternatively, if the propagation objective is seed production, seedlings can be transferred to outdoor plots at the cotyledon stage and fruits can be harvested in fall, for a total length between sowing and harvest of around 3 months[4]. |
| Target Specifications | At 8 weeks from emergence, seedlings should be 60 to 65 cm tall if bur spines were removed and 45 to 53 cm tall without spine removal. |
| Propagule Collection Instructions | Collect all available fruits in March from 30 donor plants. |
| Propagule Processing/Propagule Characteristics | Fruits have sharp burs and removing them was shown to increase germination rate. |
| Pre-Planting Propagule Treatments | In this study, burs were planted both without treatment as well as with removal of spines. A higher germination percentage resulted from the removal of spines, however some of these seedlings died due to failure to separate from the bur after establishment. Whether or not the spine removal strategy is utilized, |

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| | store fruits at 4°C and 50% relative humidity until planting. In late May, place seeds in a glass container with a screen cover under cold running water for 24 hours. |
| Growing Area Preparation / Annual Practices for Perennial Crops | In this study, seeds were sown in peat tablets, peat pots filled with field soil (silt loam with 1% organic matter and 6.8 pH), and plastic 1206 inserts (individual compartments 1.5x1.5x2.25 in) filled with standard garden soil. Seedlings in peat tablets outperformed seedlings from the other container types once transplanted to field and demonstrated greater total bur weight at the time of senescence. |
| Establishment Phase Details | Following running water treatment, cover seeds in a wetted 2:1 mixture of soil and sand and house in 30°C germination chamber. When radicle emerges and before it reaches 1 cm in length, plant seeds in desired container and cover ¾ of seed in media. |
| Length of Establishment Phase | Not noted by Albers-Nelson *et al.* |
| Active Growth Phase | Place chosen containers in well-drained trays in a greenhouse and supply water. If seedlings are not being outplanted immediately, transfer to outdoor nursery before true leaf development or 1 to 2 days after germination. Plant seedings 3 m apart in rows spaced 3 m apart. Apply ammonium nitrate fertilizer at 45 kg N/ha. Perform hand watering or employ sprinkler irrigation. Should unwanted weeds emerge after transplanting, apply pesticide and shield seedlings using plastic pots or remove competing vegetation mechanically. Blaise and Lechowicz[10] found that plants grown in less than optimum moisture and nutrient conditions have been shown to produce a smaller number of larger fruits, while a large number of smaller fruits was produced in optimum conditions. If seed production is the objective, provide ample moisture and fertilizer to increase chances of producing high seed numbers and limit water to increase chances of producing large seeds. |
| Length of Active Growth Phase | 3 months[4] |
| Hardening Phase | Plants will senesce after fruit production. |
| Length of Hardening Phase | N/A |
| Harvesting, Storage and Shipping | If seed production is the goal, mature fruits can be collected in fall as stock plants begin to senesce. |
| Length of Storage | N/A |
| Guidelines for Outplanting / Performance on Typical Sites | Seedlings propagated in biodegradable peat tablets or pots can be outplanted in their container while those in plastic pots must be extracted. Optimal growth |

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| | observed when transplanted before the development of true leaves or 1 to 2 days after germination. |
| Other Comments | See recommendations in same section of above protocol. |
| **INFORMATION SOURCES** | |
| References | See list below |
| Other Sources Consulted | See list below |
| Protocol Author | Abigail Lovell |
| Date Protocol Created or Updated | 05/27/20 |

References


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