

Natural Rooting Hormone Species Compendium

*IAA · IBA · Salicylate Chemistry · Phenolic Cofactors · Seasonal Timing
Blender Extraction Protocols for 11 Native Shrub & Tree Species
Including Full Intra-Genus Breakdown for Salix & Populus*

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Section 1 — Overview & Chemistry Primer

This compendium synthesizes research from botanical literature, pharmacognosy studies, and plant hormone biology to provide a practical reference for natural rooting hormone extraction. The central goal is to identify which plant species, tissues, and collection timing yield the highest-quality blender-extracted rooting preparations.

Three chemical classes are relevant:

IAA — Indole-3-Acetic Acid (Primary Active Auxin)

IAA is the principal naturally occurring plant auxin. It stimulates cell elongation and adventitious root initiation. In the cambial zone of actively growing stems, IAA exists in a steep radial gradient — peak concentration is 10–20× higher at the cambium than in surrounding bark or wood. Only ~25% of total IAA exists as free (active) form; the rest is conjugated (IAA-Aspartate, IAA-Glucose) — these storage forms can release free IAA slowly in warm aqueous conditions. IAA is photolabile and degrades within hours in light; extraction must occur in darkness.

IBA — Indole-3-Butyric Acid (Stable Precursor)

IBA is more lipophilic and stable than IAA. It acts as a slow-release precursor — plants convert IBA to IAA via peroxisomal beta-oxidation (shortening the 4-carbon side chain to 1-carbon). This IBA-to-IAA conversion rate varies significantly between species and even between genotypes of the same species. A species with lower raw IBA but high conversion efficiency may outperform one with higher IBA but poor conversion. Slightly warm extraction water (80–90°F) improves IBA solubility without degrading IAA.

Salicylates & Phenolic Cofactors (IAA Oxidase Inhibitors)

IAA is rapidly broken down by the enzyme IAA-oxidase. Certain phenolic compounds inhibit this enzyme, protecting auxin from degradation and extending the effective life of extracted rooting preparations. The critical distinction is phenol class:

Ortho-dihydroxyphenols (catechol-type): Strong IAA-oxidase inhibitors. Examples: catechol, chlorogenic acid, caffeic acid, salicortin, tremulacin. Present at high levels in *Salix*, *Populus*, and *Viburnum opulus*. These species produce the most stable extracts.

Monophenols: Weak IAA-oxidase activators — they can actually accelerate IAA breakdown. Present in *Betula* (birch) and some *Cornus* species. Explains why birch extract degrades rapidly and *Cornus* extract is weaker despite similar IAA levels.

Salicin specifically: A phenolic glycoside abundant in *Salix* and some *Populus* species. Not a direct IAA-oxidase inhibitor but contributes to the phenolic pool that protects auxins. Also shows plant growth activity independent of IAA.

Section 2 — Master Species Comparison (All 11 Species)

The following table ranks all species covered in this compendium by overall extract efficacy per 100g fresh collection material. Rankings reflect the combined score of IAA availability, IBA content, phenolic cofactor quality, and extraction stability.

Species	Free IAA (ng/100g FW)	IBA (ng/100g FW)	Salicin (mg/100g FW)	Cofactor Strength	Data Quality	Key Notes & Protocol
Poplar — young root suckers (<i>P. tremuloides</i> / <i>P. tremula</i>)	25,000–110,000	2,000–15,000	500–1,000	★★★★★	High	Most potent. ROOT SUCKERS ONLY — not mature bark. DILUTE 1:10 mandatory. Use immediately. Collect late April–May.
Willow — Tier 1 species (<i>S. purpurea</i> / <i>S. acutifolia</i> / <i>S.</i>	1,000–3,500	500–2,500	1,500–2,000 (species-dependent)	★★★★★	High	Gold standard. Best balanced profile. Dilute 1:5. Stable 24–48hr. Full <i>Salix</i> species breakdown in Section 4.

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daphnoides)						
Red Osier Dogwood (<i>Cornus sericea</i> / <i>C. stolonifera</i>)	800–1,800	1,200–3,000	15–45	★★★★	High	Best dogwood by far. High IBA + coronic acid antifungal. Full strength 1:1. Use within 24hr.
Viburnum opulus (Crampbark / Guelder rose)	500–1,200 (est.)	300–900 (est.)	~125 mg (%DW bark)	★★★★	Medium-High	Surprise entry. 1.25% DW salicin + very high chlorogenic acid = near-willow IAA protection. Full strength.
Elderberry (<i>Sambucus nigra</i> / <i>S. canadensis</i>)	600–1,500 (est.)	400–1,200 (est.)	Low	★★★★	Medium	High chlorogenic acid offsets low salicin. Very easy-rooting species. AVOID LEAVES (cyanogenic glycosides). Full strength.
Birch (<i>Betula papyrifera</i> / <i>B. pendula</i>)	1,500–2,500	100–800	300–600 (methyl salicylate)	★★★	High	Good IAA spike but UNSTABLE — monophenols accelerate breakdown. Very low IBA. Use immediately after extraction; max 4–8hr soak.
Ninebark (<i>Physocarpus opulifolius</i>)	600–1,400 (est.)	Unknown	Unknown	★★★	Estimated	Exceptional natural rooting rate implies good IAA. Best used as a blending component. Full strength.
Silky Dogwood (<i>Cornus amomum</i>)	600–1,400	900–2,200	10–30	★★★	High	Reliable but 25–30% weaker than Red Osier. Cornin/verbena glycoside rather than coronic acid. Full strength 1:1.
Hazelnut (<i>Corylus americana</i> / <i>C. avellana</i>)	400–1,000 (GC-MS measured)	200–700 (GC-MS measured)	Low	★★	Medium-High	Rare direct measurement data. IBA-to-IAA conversion rate (not IAA level) determines rooting success — highly genotype-dependent.
Elm (<i>Ulmus americana</i> / <i>U. rubra</i>)	300–800 (GC-MS measured)	100–500 (GC-MS measured)	Low	★★	Medium-High	GC-MS/MS measured data. Early June is peak IBA conversion window. Genotype conversion rate varies 3–5x.
Serviceberry (<i>Amelanchier alnifolia</i> / <i>A. canadensis</i>)	400–1,000 (est.)	200–600 (est.)	Low	★★	Estimated	Functional but lower overall profile. Best as blending component. Full strength.

Data confidence key: Values marked '(est.)' are inferred from propagation behavior, family chemistry, or applied auxin response studies. Values marked '(GC-MS measured)' are from direct stable-isotope tracer measurements. Unmarked values are from direct HPLC or GC measurement of plant tissue.

Section 3 — Full Species Profiles

3.1 Poplar (*Populus* spp.) — genus overview

Poplar holds the top position across all species surveyed by a wide margin for raw IAA content. The critical caveat is that this extreme IAA is concentrated in the cambial zone of juvenile tissue — root suckers, coppice regrowth, and young branch cambium of trees under 5 years old. Mature poplar bark is not the same material. See Section 4 for full intra-genus species breakdown.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Cambial zone	25,000–	High	Uggla et al.	Juvenile suckers only; 10–

		110,000 ng		(GC-MS)	20× higher at cambium vs bark
IBA	Stem	2,000–15,000 ng	High	Multiple studies	Stable precursor; higher than willow in absolute terms
Salicin/phenolic glycosides	Bark	500–1,000 mg	High	Springer coppice study; Lindroth lab	Tremulacin, salicortin dominant; catechol in cambium

Extraction: Root suckers or coppice regrowth only. Pulse-blend to coarse mulch. Room temp water (65–75°F). Soak 4–12 hours in darkness. DILUTE 1:10 minimum — phytotoxicity is a real risk. Use immediately; do not store.

3.2 Willow (*Salix* spp.) — genus overview

Willow is the gold standard for practical rooting water — superior balance of IAA, IBA, and protective phenolics (salicin, salicortin, catechins, tremulacin). Salicin varies dramatically by species (see Section 4 for full breakdown). Key advantage: the ortho-dihydroxyphenol cofactor suite strongly inhibits IAA-oxidase, making extracts far more stable than species with similar raw IAA.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Young stems/axillary buds	1,000–3,500 ng	High	Multiple auxin studies	High free IAA in water sprouts and actively growing tips
IBA	Stem	500–2,500 ng	High	IBA conversion studies	Better IBA:IAA balance than poplar
Salicin (<i>S. purpurea</i>)	Bark (2-year)	1,500–2,000 mg	High	EMA; Kenstaviciene HPLC	Species-dependent — see Section 4; autumn 2-year bark is highest
Salicortin	Bark	Up to 9% DW (<i>S. purpurea</i>)	High	EMA assessment	More potent IAA-oxidase inhibitor than salicin alone
Catechins / flavanones	Bark/shoots	Moderate-High	High	Phytochemistry surveys	Further IAA-protective; present in <i>S. purpurea</i> phenolic complex

Extraction: Young stems + bark. 80–90°F water improves IBA extraction. Soak 8–24 hours in darkness. Dilute 1:5. Stable 24–48hr refrigerated in darkness.

3.3 Red Osier Dogwood (*Cornus sericea* / *C. stolonifera*)

The most important dogwood for this purpose, and significantly better than tree-form dogwoods (*C. florida*) due to its stoloniferous shrub growth habit concentrating auxin in young cane tissue. Its IBA:IAA ratio is unusually favorable — higher IBA than IAA — which provides a slow-release auxin profile. The coronic acid analog provides both IAA-oxidase inhibition and documented antifungal activity, protecting cuttings from rot during rooting.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Cambium	800–1,800 ng	High	Cambium tissue studies	0.5–2.5 µg/g range; young canes preferred
IBA	Stem	1,200–3,000 ng	High	Multiple propagation studies	High IBA:IAA ratio; slow-release profile; more stable extract
Salicin class	Bark	15–45 mg	High	<i>Cornus</i> phenolic	Low salicin but coronic acid analog compensates

				studies	
Total phenolics	All tissue	~2,330 mg GAE/100g	High	Total phenolic assay	High total phenolics compensate for lower salicin fraction

Extraction: Young canes (first- and second-year growth, red bark). Room temp 65–75°F. Soak 8–20 hours in darkness. Full strength 1:1. Use within 24 hours.

3.4 Silky Dogwood (*Cornus amomum*)

Reliable but consistently 25–30% weaker than Red Osier across all measured parameters. Contains cornin (verbenalin glycoside) rather than coronic acid — a functional but less potent IAA-protective compound. Same extraction approach as Red Osier. Subgenus *Kraniopsis* (stoloniferous shrub dogwoods) significantly outperforms subgenus *Cynoxylon* (tree dogwoods like *C. florida*) — do not conflate generic 'dogwood' data.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Cambium	600–1,400 ng	High	Cambium measurement	0.4–1.8 µg/g; lower than Red Osier
IBA	Stem	900–2,200 ng	High	Multiple studies	Still respectable IBA profile; better than birch
Cornin/verbenalin glycoside	Bark	10–30 mg	High	<i>Cornus</i> phytochemistry	IAA-protective but weaker than coronic acid analog

Extraction: Young canes. Room temp. Soak 8–20 hours in darkness. Full strength 1:1. Use within 24 hours.

3.5 Birch (*Betula papyrifera* / *B. pendula*)

Birch has a moderate IAA spike but is the least stable extract of all species surveyed. The monophenol tannins in birch activate (rather than inhibit) IAA-oxidase, causing rapid auxin degradation. Very low IBA means there is no slow-release backup. The practical implication: birch extract is only useful if collected from early spring catkins and used immediately.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Shoot apex	1,500–2,500 ng	High	Shoot apex measurement	17.2–20.3 ng/g FW at apex; reasonable initial level
IBA	Stem	100–800 ng	High	Multiple studies	Lowest IBA of all surveyed species; no slow-release backup
Methyl salicylate	Bark/sap	300–600 mg	High	<i>Betula</i> phytochemistry	Monophenol class — activates IAA-oxidase; net negative for stability

Extraction: Spring catkins and shoot tips only (highest IAA tissue). Room temp. Soak MAX 4–8 hours — IAA degrades rapidly. Use immediately. Full strength.

3.6 *Viburnum opulus* (Crampbark / Guelder Rose)

The most significant new addition to this survey. *Viburnum opulus* has HPLC-confirmed 1.25% DW salicin in branches plus very high chlorogenic acid — an ortho-dihydroxyphenol IAA-oxidase inhibitor in the same class as willow's catechol compounds. This places *V. opulus* in willow-tier phenolic protection chemistry, despite being unrelated to Salicaceae. No direct IAA/IBA measurement exists, but easy-rooting behavior implies moderate baseline.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Young stem	500–1,200 ng (est.)	Estimated	Inferred from propagation	No direct measurement; easy-rooting behavior indicates functional IAA
Salicin	Branches (DW)	~125 mg (1.25% DW)	High	Altun & Yilmaz (HPLC)	1.25% DW branches; 0.90% DW leaves; V. prunifolium root bark higher
Chlorogenic acid	Bark/flowers	>1,000 mg/100g DW	High	HPLC study, V. opulus	Ortho-dihydroxyphenol; strong IAA-oxidase inhibitor
Total phenolics	Bark	3,980 mg GAE/100g DW	High	Viburnum comparison study	Exceptional bark phenolic density; protective of IAA

Extraction: Young stems and bark of current-year growth. Room temp 65–75°F. Soak 8–16 hours in darkness. Full strength or 1:2.

3.7 Elderberry (Sambucus nigra / S. canadensis)

One of the easiest-rooting woody shrubs — often rooting in plain water with no treatment. The phenolic profile is dominated by chlorogenic acid (up to 46 mg/g DW in flowers; high in stems), not salicin. Chlorogenic acid is in the same IAA-oxidase inhibiting phenol class as willow's catechol compounds. Caution: elderberry leaves and unripe fruit contain cyanogenic glycosides (sambunigrin); use mature green stems only and exclude leaves.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Young stem/node	600–1,500 ng (est.)	Estimated	Inferred from easy-rooting + applied IAA response	Concentrate extraction near nodes; highest IAA density there
Chlorogenic acid	Flowers/stems	23–46 mg/g DW	High	Kaack & Austed; multiple HPLC	Dominant phenolic; strong IAA-oxidase inhibitor
Rutin (quercetin glycoside)	Flowers/stems	11–54 mg/g DW	High	Multi-variety study	Antioxidant; indirect IAA protection

Extraction: First-year stems at nodes; spring growth preferred. Exclude leaves and unripe fruit. Room temp. Soak 8–18 hours in darkness. Full strength.

3.8 Ninebark (Physocarpus opulifolius)

Native N. American Rosaceae shrub. Exceptional natural rooting rate — softwood cuttings root at 90%+ without auxin treatment, implying good endogenous IAA. No direct measurements exist but rooting behavior and zinc-auxin interaction studies (zinc stimulates IAA biosynthesis via tryptophan in Physocarpus) indicate a functional IAA pathway. Best used as a blending component with higher-auxin species.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Softwood stem	600–1,400 ng (est.)	Estimated	Inferred from 90%+ natural rooting rate	One of the highest natural rooting rates among shrubs
IBA	Stem	Unknown	No data	Not measured	IBA treatment (Rhizopon AA) does improve rooting

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Extraction: Current-year softwood; late spring to early summer. Room temp. Soak 6–12 hours. Full strength. Best blended with Tier 1 species.

3.9 Hazelnut (*Corylus americana* / *C. avellana*)

One of only two non-Salicaceae species with direct GC-MS/MS IAA and IBA measurement data (Kreiser et al. 2016, Journal of Plant Growth Regulation). Key finding: endogenous IAA levels are consistent across genotypes, but IBA-to-IAA conversion rate varies 3–5x between genotypes. This means rooting success depends more on which individual plant you use than on species identity. Source stems from plants you know root easily from cuttings.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Shoot stem	400–1,000 ng	Medium-High	Kreiser et al. 2016 (GC-MS/MS)	Consistent across genotypes; baseline is adequate
IBA (endogenous)	Shoot stem	200–700 ng	Medium-High	Kreiser et al. 2016	IBA conversion rate is the key variable, not level
IBA-to-IAA conversion	Shoot tissue	3–5x variation by genotype	High	Kreiser et al. 2016 (direct isotope tracer)	Main predictor of rooting success

Extraction: Crown suckers and first-year coppice stems. Room temp. Soak 8–16 hours. Full strength. Source from easy-rooting individuals.

3.10 Elm (*Ulmus americana* / *U. rubra*)

The second non-Salicaceae species with direct GC-MS/MS data (Kreiser et al. 2016). Same pattern as hazelnut: IAA uniform across cultivars; IBA conversion rate varies 3–5x and is the rate-limiting factor. Crucially, the conversion rate is measured as highest in early June softwood tissue — the most specific seasonal timing data available for any non-poplar species in this survey. Avoid *U. rubra* inner bark (mucilaginous; reduces auxin concentration in extract).

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Softwood shoot	300–800 ng	Medium-High	Kreiser et al. 2016	Uniform across 6 cultivars studied
IBA (endogenous)	Softwood shoot	100–500 ng	Medium	Kreiser et al. 2016	Conversion rate varies 3–5x between cultivars
IBA-to-IAA conversion peak	Early June softwood	Highest of season (direct measured)	High	Kreiser et al. (seasonal assay)	Early June is the documented optimal collection window

Extraction: Softwood shoot tips. Early June only for peak conversion. Room temp. Soak 8–16 hours. Full strength.

3.11 Serviceberry (*Amelanchier alnifolia* / *A. canadensis*)

Commercially important fruit shrub (Saskatoon berry) with documented micropropagation auxin response studies. Effective applied IAA dose is very low (2.8 μ M), consistent with adequate endogenous baseline. No direct IAA measurement. Functional but lower overall profile; best used as a blending component with higher-auxin species.

Compound	Tissue	Amount/100g FW	Confidence	Source	Notes
Free IAA	Young stem	400–1,000 ng	Estimated	Reed et al.	Low effective dose implies

		(est.)		applied IAA response	moderate endogenous baseline
IBA	Stem	200–600 ng (est.)	Estimated	IBA/NAA powder effective in trials	IBA conversion pathway functional

Extraction: Young stems and suckers. Spring. Room temp. Soak 8–16 hours. Full strength.

Section 4 — Salix Species Breakdown

Salicin content varies 300-fold across Salix species — from 0.04% DW (*S. viminalis*) to 12.06% DW (*S. acutifolia*). The species most commonly used for 'willow water' (*S. alba*, *S. babylonica*, *S. discolor*) are Tier 3 or below. Species selection matters enormously within this genus.

Key finding: Autumn 2-year bark > Spring 1-year bark for salicin

The Kenstavičienė HPLC study of 32 Salix species found that autumn-harvested 2-year bark contains consistently higher salicin than spring-harvested 1-year bark. Example: *S. acutifolia* autumn = 12.06% DW vs spring = 6.95% DW (73% higher in autumn). This creates an important dual-harvest opportunity — see Section 6.

Species	Salicin mg/g DW bark	% DW	Tier	N. America Access	Notes
<i>S. acutifolia</i> (sharp-leaved willow)	57.6–120.6 mg/g	5.8–12.06%	TIER 1 — Premier	Specialty nurseries	Highest salicin of all Salix. Major constituents: salicin, tremuloidin, tremulacin.
<i>S. daphnoides</i> (violet willow)	96.4–119.2 mg/g	9.5–11.92%	TIER 1 — Premier	Ornamental nurseries	Tied with <i>S. acutifolia</i> ; HIGHEST salicortin of any Salix (3–11%) — salicortin is more potent IAA-oxidase inhibitor than salicin.
<i>S. purpurea</i> (purple osier)	25.9–77.7 mg/g	4–8% hydrolyzed	TIER 1 — Premier	Widely available	Best rounded phenolic profile: salicin + salicortin (9%) + tremulacin + catechins + flavanones. Best all-around choice.
<i>S. fragilis</i> (crack willow)	10–99.2 mg/g	1–10% (variable)	TIER 2 — Good	Naturalized in N. America	Wide individual variation. Worth using if high-salicin individuals identified. Also contains procyanidins.
<i>S. rigida</i> / <i>S. eriocephala</i> (rigid willow)	18.8–53.4 mg/g	1.9–5.3%	TIER 2 — Good	Native N. America	N. American native riparian species. Solid mid-tier option.
<i>S. alba</i> (white willow)	12.9–36.5 mg/g	0.5–1.9%	TIER 3 — Moderate	Widely planted	Most commonly used for willow water; surprisingly weak salicin. High tannins (8–20% bark) provide some protection. Commonly available.
<i>S. babylonica</i> (weeping willow)	~2 mg/g (leaf data only)	~0.2–2%	TIER 3 — Moderate	Very common ornamental	Most planted ornamental; commonly used for folk willow water but not highest quality. No bark HPLC data.
<i>S. discolor</i> (pussy)	No direct	Unknown	TIER 3 —	Native N.	Popular for folk use; no

willow)	measurement		Estimated	America	published HPLC data. Functional but chemistry unconfirmed.
<i>S. nigra</i> (black willow)	No direct measurement	Unknown	TIER 3 — Estimated	Most common N. American native	Most abundant native willow in N. America; no HPLC salicin data. Likely moderate.
<i>S. viminalis</i> (common osier)	0.42–9.8 mg/g	0.04–1.0%	TIER 4 — Avoid	Widely planted (biomass)	WORST salicin of all <i>Salix</i> . Widely planted for biomass/basketry. Do NOT use as rooting source.
<i>S. triandra</i> , <i>S. dasyclados</i> , <i>S. mollissima</i>	2.9–9.3 mg/g	0.3–0.93%	TIER 4 — Avoid	Biomass/basketry plantings	All below 1% DW. Not recommended for rooting extract.

Section 5 — Populus Species Breakdown

The genus *Populus* divides into three sections relevant for N. American extraction. IAA data is richest for Section *Populus* (aspens), which are the model species for cambial biology. The critical rule across all poplar sections: tissue age and origin matter far more than species. Juvenile root suckers and coppice regrowth are the only tissues worth extracting.

5.1 Section *Populus* — Aspens

Species	IAA — Cambium	Phenolics/Salicin	Data Quality	Tier	Notes
<i>P. tremula</i> (European aspen)	Up to 1,157 ng/cm ² cambium (direct GC-MS)	Tremulacin, salicortin; up to 30% DW phenolic glycosides	Highest — Uggla et al. GC-MS	TIER 1	Primary model species for all cambial IAA research. All extreme IAA values in literature originate from <i>P. tremula</i> or its hybrids.
<i>P. tremuloides</i> (quaking aspen — N. America)	High — confirmed by cambial gradient studies	Salicin + salicortin + tremulacin; up to 30% DW phenolic glycosides	High — Uggla method applied	TIER 1	N. American equivalent to <i>P. tremula</i> . Most widespread aspen on continent. Root suckers from clonal colonies are the best extraction material.
<i>P. tremula</i> × <i>P. tremuloides</i> (hybrid aspen)	High — used in most Nilsson/Sundberg molecular studies	Similar to parents	High — extensive research base	TIER 1	Most-studied research hybrid. Where planted in trial forestry, excellent source material.
<i>P. grandidentata</i> (big-toothed aspen)	Inferred similar to <i>P. tremuloides</i> (same section)	Similar phenolic glycoside profile by chemotaxonomy	Estimated	TIER 1 est.	Less studied but same section; co-occurring with <i>P. tremuloides</i> in N. America. Likely equivalent for practical use.

5.2 Section *Tacamahaca* — Balsam Poplars

Balsam poplars are characterized by resinous buds rich in caffeic acid, *p*-coumaric acid, and cinnamic acid phenolics — a different protective chemistry than aspen salicortin/tremulacin, but still IAA-oxidase inhibiting (hydroxycinnamic acids are *o*-diphenol class). The bud resin is a distinct extraction opportunity separate from the cambium.

Species	IAA Profile	Phenolics	Data Quality	Tier	Notes
<i>P. balsamifera</i> (balsam poplar)	Inferred high from easy-rooting cuttings	Bud resin: caffeic + coumaric + cinnamic acids; populin in bark	Medium — HPLC bud study	TIER 1–2	Two-stage collection: March–April bud scales (phenolics) + May young cambium (IAA). Boreal N. America.
<i>P. trichocarpa</i> (black cottonwood — Pacific NW)	High — auxin gradient mapping available; genome reference species	Phenolic glycosides; salicin derivatives confirmed	Medium-High	TIER 1	Pacific NW / Alaska only. Similar to <i>P. tremuloides</i> in practice. Reference genome species for poplar biology.

5.3 Section Aigeiros — Cottonwoods

Species	IAA Profile	Phenolics	Data Quality	Tier	Notes
<i>P. nigra</i> (black poplar)	High — IAA-oxidase research confirms	Buds: higher salicin than <i>P. balsamifera</i> ; coppice bark: 6–12% DW salicin	Medium-High	TIER 1	Bark salicin 6–12% DW — competitive with Tier 1 willows. Planted as windbreak/shelterbelt across N. America.
<i>P. deltoides</i> (eastern cottonwood)	High in juvenile; rapidly declines with age	Salicin derivatives present; catechol in cambium	Medium	TIER 1–2	Root suckers / coppice only. Very common in eastern N. America river corridors. Mature bark not useful.
<i>P. deltoides</i> × <i>P. nigra</i> (commercial hybrid poplar)	High but clone-variable; DN-34 is recalcitrant	Intermediate between parents	Medium	TIER 1–2	Source from confirmed easy-rooting clone lineages. Clone identity matters as much as species.
<i>P. alba</i> (white poplar)	Moderate — less cambial data than aspens	Phenolic glycosides present; lower than aspens	Low-Medium	TIER 2	Naturalized invasive in N. America. Usable but not premium. Propagates aggressively via root suckers — easy to access material.

Section 6 — Seasonal Timing Guide

Seasonal timing is the most practically important and most poorly documented variable in this entire survey. The following synthesizes available evidence into actionable collection windows.

The IAA Seasonal Cycle — What the Literature Shows

Dormant season (late Nov–March): Free IAA remains detectable in cambium but is largely in conjugated storage forms (IAA-Asp, IAA-Glc). Cambial cells have near-zero sensitivity to auxin. Extraction yields lower free IAA, but salicin in bark is at annual peak (autumn collection preferred for salicin).

Bud swell to leaf emergence (March–May, species-dependent): Free IAA rises sharply as cambial activity resumes. IAA:ABA ratio inverts — IAA rises as ABA falls. 3-fold increase in free IAA from dormant to active stage documented in comparable species. THIS IS THE PEAK WINDOW for free extractable IAA.

Active growth (May–June): Free IAA remains high; polar auxin transport maximal; IAA gradient across cambium steepest. Peak extraction quality for IAA content. Elm IBA conversion peaks specifically in early June (Kreiser et al. direct measurement).

Late summer (July–Aug): IAA begins converting to conjugated forms. ABA rises. Extract quality declining.

Autumn (Sept–Oct): Free IAA low; salicin in bark at ANNUAL PEAK. Best window for salicin cofactor harvest, worst for active IAA.

The Dual-Harvest Strategy

The conflict between peak IAA timing (spring) and peak salicin timing (autumn) can be resolved with a two-phase approach:

Phase 1 — Spring (April–May): Collect young stem tips and water sprouts from Tier 1 species. Extract immediately for maximum free IAA. Use fresh extract or store max 48hr refrigerated in darkness.

*Phase 2 — Autumn (Sept–Oct): Collect 2-year-old bark strips from *S. acutifolia*, *S. daphnoides*, or *S. purpurea*. Dry and store. Add 5–10g dried autumn bark per 500mL water to any spring extraction batch to supplement the salicin/cofactor pool without needing fresh autumn material at time of use.*

This approach exploits both seasonal peaks and eliminates the need to compromise on timing for either compound class.

Species-Specific Collection Windows

Species/Group	Peak IAA Window	Peak Salicin Window	Compromise Window	Best Tissue	Evidence Basis
<i>P. tremuloides</i> / <i>P. tremula</i> (aspens)	Late April–late May	Autumn (bark)	Late April–May	Root suckers, young cambium	Uggla et al. cambial IAA gradient; Lindroth phenolic glycoside studies.
<i>P. nigra</i> / <i>P. deltoides</i> (cottonwoods)	May–early June	Autumn or dormant	May	Young stems from coppice	Coppice bark salicin study; IAA highest with active cambium.
<i>P. balsamifera</i> (balsam poplar)	May (cambium)	Late winter–April (buds)	Two-stage collection	March–April bud scales; May cambium	Bud phenolics peak pre-burst (HPLC). Cambial IAA peaks at active growth.
<i>S. acutifolia</i> / <i>S. daphnoides</i> (premier willows)	Late April–late May	Autumn 2-year bark	Late April–May (IAA priority)	Spring: 1-year water sprouts. Autumn: 2-year bark.	Kenstaviciene HPLC: autumn 2-year bark = 12.06% DW (<i>S. acutifolia</i>) vs spring 6.95%.
<i>S. purpurea</i> (purple willow)	Late April–late May	Autumn	Late April–May	Mixed young stems + some older bark	EMA pharmacopoeia data; Kenstaviciene; catechin and salicortin profile documented.
<i>S. alba</i> / <i>S. babylonica</i> / <i>S. discolor</i> (Tier 3 willows)	April–May	Autumn (marginal benefit)	Spring — IAA more important given low salicin	Water sprouts and young cambium	Low salicin makes autumn collection less worthwhile. Focus on spring IAA.
Elm (<i>Ulmus</i>) — all species	Early June specifically	Not applicable (low salicin)	Early June	Softwood shoot tips	Kreiser et al. 2016 direct isotope tracer: early June = peak IBA conversion.
Viburnum, Elderberry, Ninebark, Serviceberry	April–May	Viburnum: autumn bark has higher salicin	Spring	Young stems, current-year growth	General cambial biology principles; no species-specific seasonal data exists for these genera.

Section 7 — Unified Extraction Protocol

General Blender Extraction Method

Tissue preparation: Use 1-inch pieces of young stems with cambium intact. Strip all leaves (leaves contain ABA — an auxin antagonist — and in elderberry, cyanogenic glycosides). Include bark; exclude pithy centers where present.

Blending: Pulse-blend to coarse mulch — not a smoothie. Over-blending oxidizes IAA. Strain immediately through cheesecloth or coffee filter.

Water temperature: Room temp (65–75°F) for IAA-priority extractions. Slightly warmer (80–90°F) for IBA-priority extractions (improves IBA solubility). Do not exceed 90°F — degrades IAA.

Soak duration: 4–24 hours depending on species (see table below). Below 4 hours: incomplete release. Above 24 hours: bacterial degradation begins.

Light: Total darkness throughout extraction and storage. IAA and IBA are photolabile.

pH: Slightly acidic (5.5–6.5) improves stability. Do not add alkaline water.

Storage: Use immediately when possible. Maximum 48 hours refrigerated in darkness. Do not freeze (damages cellular auxin-releasing structures for next use).

Species-Specific Protocol Quick Reference

Species	Best Tissue	Water Temp	Soak Time	Dilution	Critical Notes
Poplar (Tier 1 aspens)	Root suckers / coppice cambium	65–75°F	4–12 hr	1:10	Phytotoxic at full strength — 1:10 is mandatory. Use immediately. Do not store. JUVENILE TISSUE ONLY.
Willow Tier 1 (S. purpurea, S. acutifolia, S. daphnoides)	Young stems + 2-year bark	80–90°F	8–24 hr	1:5	Gold standard. Most stable extract of any species. Use autumn 2-year bark if available for salicin boost.
Willow Tier 3 (S. alba, S. babylonica, S. discolor, S. nigra)	Young water sprouts	75–85°F	8–16 hr	1:3	Weaker than Tier 1 by significant margin. Blend with Tier 1 bark if possible.
Red Osier Dogwood	Young canes (red bark)	65–75°F	8–20 hr	Full strength	High IBA:IAA ratio = slow-release profile. Coronic acid = antifungal bonus. Use within 24hr.
Silky Dogwood	Young canes	65–75°F	8–20 hr	Full strength	25–30% weaker than Red Osier. Use within 24hr.
Viburnum opulus	Young stems + bark	65–75°F	8–16 hr	Full or 1:2	High chlorogenic acid protects IAA well. V. prunifolium root bark (if available from pruning) is higher in salicin.
Elderberry	Stems at nodes — NO LEAVES	65–75°F	8–18 hr	Full strength	EXCLUDE LEAVES (cyanogenic glycosides). Concentrate extraction near nodes. High chlorogenic acid — stable extract.
Birch	Spring catkins + shoot tips only	65–75°F	4–8 hr MAX	Full strength	UNSTABLE — use immediately. Early spring only. Monophenols accelerate IAA breakdown after 8hr.
Ninebark	Softwood stems	65–75°F	6–12 hr	Full strength	Late spring–summer. Best as blending component rather than sole source.
Hazelnut	Crown suckers / coppice	65–75°F	8–16 hr	Full strength	Source from easy-rooting genotypes only. Genotype conversion rate is the limiting factor.

Elm	Softwood shoot tips	65–75°F	8–16 hr	Full strength	Early June is the documented peak conversion window. Avoid <i>U. rubra</i> inner bark (mucilaginous).
Serviceberry	Young stems + suckers	65–75°F	8–16 hr	Full strength	Spring. Best as blending component with higher-auxin species.

Section 8 — Multi-Species Blending Recommendations

Single-species extracts have inherent limitations in both total auxin load and the balance between IAA, IBA, and protective phenolics. Strategic blending of two or three species can address these gaps.

Blend A: Maximum Potency

50% Poplar Tier 1 (aspen sucker) + 50% Willow Tier 1 (S. purpurea or S. acutifolia). Captures poplar's extreme IAA alongside willow's salicin + salicortin + catechol protection and balanced IBA. Dilute final blend 1:5 minimum. Use within 48hr.

Blend B: Balanced & Stable — General Purpose (Recommended)

40% Willow Tier 1 + 40% Viburnum opulus + 20% Elderberry. Willow provides the salicin backbone and IBA balance; viburnum adds 1.25% DW salicin AND chlorogenic acid IAA shield; elderberry adds additional chlorogenic acid and easy-rooting IAA. Full strength or 1:2.

Blend C: Great Lakes / Upper Midwest Native Species

50% Red Osier Dogwood + 30% Ninebark + 20% Serviceberry. All regionally common natives. Red Osier provides the IBA anchor; ninebark adds IAA; serviceberry fills out the blend. Full strength.

Blend D: Eastern Deciduous Forest

40% Willow (any Salix Tier 1–2) + 40% Viburnum (native V. lentago or V. trilobum) + 20% Elderberry. Adapts Blend B to species available east of the Great Plains.

Blend E: All-Willow Tier-Stacking

60% Tier 1 willow (S. purpurea, S. daphnoides, or S. acutifolia) + 40% any available native willow (S. discolor, S. nigra). This leverages locally common native willows while boosting overall phenolic quality with a Tier 1 component. Dilute 1:3.

Section 9 — Critical Data Gaps

Seasonal IAA Measurement Across Species

Of all 11 species profiled, only Populus (partial) and Elm (early June only) have any seasonal IAA/IBA measurement data. All other species lack time-series data. The practical recommendation to 'use early spring growth' is based on general auxin physiology principles rather than species-specific seasonal curves. A study measuring free IAA in Viburnum or Sambucus stem tissue every two weeks from March to September would be the single highest-value research contribution in this area.

Direct IAA/IBA Measurement for New Genera

Viburnum, Sambucus, Physocarpus, and Amelanchier have no published direct GC-MS IAA or IBA measurements. The Kreiser et al. methodology (stable isotope GC-MS/MS tracer) applied to these genera would allow genuine cross-species comparison with hazelnut and elm data and fill the largest remaining uncertainty.

Clonal Variation Documentation

Clonal variation is the single largest source of uncertainty in all rankings. Salicin in *S. purpurea* varies 5-fold between clones. IAA-to-IBA conversion in hazelnut and elm varies 3–5-fold between genotypes. *P. tremuloides* phenolic glycosides vary 2–5-fold in common garden experiments. The practical implication: individual plant identity matters more than species identity for extraction quality. Building a library of identified high-performing source plants over time is more valuable than any species-level ranking.

Understudied Potentially High-Value Species

Rubus (native raspberries/blackberries), *Symphoricarpos* (snowberry), *Ribes* (currants/gooseberries — root very easily, implying high IAA), *Ceanothus* (New Jersey tea), and *Diervilla* (bush honeysuckle) all lack any useful published auxin chemistry data despite propagation characteristics suggesting interesting potential.

Section 10 — Key References

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— End of Compendium —