

**Screening of pioneer metallophyte plant species with phytoremediation potential at a severely contaminated Hg and As mining site.
(Matanzas et al., 2021)**

Supplementary Material 1

Table S1: Plants identified in the geobotanical study.

Taxon	Botanic family	Biotype				Habitat	Distribution	
		Arboreal	Shrubby	Herbaceous				Lichenic muscinal
				Perennial	Annual			
<i>Betula celtiberica</i> Rothm. y Vasc.	Betulaceae	X					Forests and acidophilous forests	NW Iberian Peninsula
<i>Populus nigra</i> L.	Salicaceae	X					Riverside forests and cultivated as ornamental	E Eastern Europe and W Asia (feral in the Iberian Peninsula)
<i>Salix atrocinerea</i> Brot.	Salicaceae	X					Acidophilous wet willows	Atlantic Europe (preferably Iberian Peninsula, Morocco, Tunisia y Corsica)
<i>Anthriscus caucalis</i> M. Bieb.	Apiaceae			X			Nitrified areas, abandoned fields, edges of roads.	Europe
<i>Calluna vulgaris</i> (L.) Hull	Ericaceae		X				Heath y heath-thickets, on siliceous soils	Europe y NW de Africa
<i>Cistus salvifolius</i> L.	Cistaceae		X				Degradation scrub on acidophilic soils	Mediterranean Region
<i>Cornus sanguinea</i> L.	Cornaceae		X				Hedge of brambles, shrubs and bushes, border scrub, forest clearings	Europe y SW Asia
<i>Dianthus armeria</i> L.	Caryophyllaceae			X			Forest borders, lawns on sandy or calcareous soils	Europe
<i>Erica arborea</i> L.	Ericaceae		X				Border thickets on siliceous soils	Mediterranean Region, N and E Asia, N y E Africa

Taxon	Botanic family	Biotype					Habitat	Distribution
<i>Juncus buffonius</i> L.	Juncaceae			X			Annual grasslands on floodplains	Palaearctic
<i>Pteridium aquilinum</i> (L.) Kuhn	Dennstaedtiaceae		X				Border thickets on Deep soils, abandoned meadows	Subcosmopolitan
<i>Rubus</i> gr. <i>fruticosus</i>	Rosaceae		X				Stockade, thorn scrub thickets border	NW Iberian Peninsula
<i>Rubus ulmifolius</i> Schott	Rosaceae		X				Stockade, thorn scrub thickets border	W de Europe
<i>Agrostis capillaris</i> L.	Poaceae			X			Clearings of bushes, grassland, roads edges	Europe and Asia
<i>Agrostis tenuis</i>	Poaceae			X			Clearings of bushes, grassland, roads edges	
<i>Anarrhinum bellidifolium</i> (L.) Willd.	Scrophulariaceae			X			Grasslands, stony ground, tailings and slopes	W Europe
<i>Artemisia vulgaris</i> L.	Asteraceae			X			Nitrophilous grasslands, roads edges	Europe and Asia
<i>Blechnum spicant</i> (L.) Roth	Blechnaceae			X			Deciduous forests and shady slopes on acidophilic soils	Europe, SW Asia, N Africa, Macaronesia
<i>Cirsium vulgare</i> (Savi) Ten.	Asteraceae			X			Nitrophile grasslands, roadsides and tailings	Europe, W Asia y N de Africa
<i>Dactylis glomerata</i> L.	Poaceae			X			Mowing meadows, herbaceous bordeers, hedges	Europe
<i>Epilobium parviflorum</i> Schreb.	Onagraceae			X			Wet grasslands	Europe, Asia, N Africa and Macaronesia
<i>Hedera helix</i> L.	Araliaceae			X			Forests, walls	Europe and Caucasus
<i>Hirschfeldia incana</i> (L.) Lagr.-Foss.	Brassicaceae			X			Grasslands of roadsides and crops	Mediterranean Region and SW Asia

Taxon	Botanic family	Biotype					Habitat	Distribution
<i>Holcus lanatus</i> L.	Poaceae			X			Mowing meadows	Europe
<i>Hypericum pulchrum</i> L.	Hypericaceae			X			Humid and gloomy forests, steep bank and scrubland	N, W and C Europe
<i>Leontodon saxatile</i> Lam. subsp. <i>rothii</i> Maire	Asteraceae			X			Sandy lawns	Mediterranean Region
<i>Lolium perenne</i> L.	Poaceae			X			Mowing meadows and lawns	Europe and N Africa
<i>Lotus corniculatus</i> L.	Fabaceae			X			Mowing meadows and lawns	Europe, Asia, N Africa and Canary Islands
<i>Medicago lupulina</i> L.	Fabaceae			X			Meadows, pastures and crops	Europe, SW and C Asia, N and E of Africa
<i>Persicaria maculosa</i> S.F. Gray	Polygonaceae			X			Nitrophilous grasslands and slag heaps	Europe and Asia
<i>Piptatherum miliaceum</i> (L.) Coss.	Poaceae			X			Nitrophilous grasslands and slag heaps	Europe and Asia
<i>Plantago lanceolata</i> L.	Plantaginaceae			X			Meadows and grasslands	Europe and Asia
<i>Prunella vulgaris</i> L.	Lamiaceae			X			Mowing meadows more or less humid	Europe, Asia, N Africa and North America
<i>Trifolium repens</i> L.	Fabaceae			X			Meadows of mowing	Europe and Macaronesia
<i>Trifolium dubium</i> Sibth.	Fabaceae			X			Siliceous annual lawns	Europe, SW Asia, NW Africa and Macaronesia
<i>Verbena officinalis</i> L.	Verbenaceae			X			Nitrophile grasslands of roadsides, crops and slag heaps	Europe, Asia, N of Africa
<i>Verbascum pulvulentum</i> Vill.	Scrophulariaceae			X			Nitrophile grasslands of roadsides, crops and slag heaps	W, C y S of Europe
<i>Verbascum virgatum</i> Stokes	Scrophulariaceae			X			Nitrophile grasslands of roadsides, crops and slag heaps	W de Europa
<i>Arabis glabra</i> (L.) Bernh.	Brassicaceae				X		Shady grassland shores	Europe, Asia, N and CE Africa, N of

Taxon	Botanic family	Biotype					Habitat	Distribution
								America, Australia
<i>Cerastium glomeratum</i> Thuill.	Caryophyllaceae				X		Annual lawns, crop, roadsides and meadows	Cosmopolitan
<i>Chenopodium botrys</i> L.	Amaranthaceae				X		Grasslands of roadsides and ruderalized places	Mediterranean Region, SW and C of Asia
<i>Conyza canadensis</i> (L.) Cronquist	Asteraceae				X		Nitrophile grasslands, tailings and roadsides	North America
<i>Desmazeria rigida</i> (L.) Tutin (= <i>Catapodium rigidum</i>)	Poaceae				X		Annual lawns on roadsides and trampled areas	S and W of Europe
<i>Festuca nigrescens</i> Lam.	Poaceae				X		Meadows and pastures	Europe
<i>Geranium robertianum</i> L.	Geraniaceae				X		Annual lawns, roadsides and ruderalized areas	Europe and Asia
<i>Helianthus annuus</i> L.	Asteraceae				X		Breakaway crop, tailings	North and Central America
<i>Lotus hispidus</i> Desf. ex DC.	Fabaceae				X		Annual lawns on sandy soils	S of Europe, SW Asia, N Africa and Macaronesia
<i>Melilotus albus</i> Medik.	Fabaceae				X		Ruderalized grassland, crops and roadsides	Europe, Asia, N of Africa
<i>Pastinaca sativa</i> L. subsp. <i>sylvestris</i> (Mill.) Rouy y Camus	Apiaceae				X		Ruderalized grassland of humid soils, crops	Europe and Asia
<i>Picris echioides</i> L.	Asteraceae				X		Nitrophile grasslands of roadsides, tailings, crops	Mediterranean Region
<i>Poa annua</i> L.	Poaceae				X		Meadows, crops, artificial lawns	Cosmopolitan
<i>Sagina apetala</i> Ard.	Caryophyllaceae				X		Trampled areas, crops, walls	Europe, SW of Asia, N Africa, N of América and Macaronesia
<i>Solanum nigrum</i> L.	Solanaceae				X		Nitrophilous	Cosmopolitan

Taxon	Botanic family	Biotype					Habitat	Distribution
							grasslands, crops, slag heaps	
<i>Sonchus asper</i> (L.) Hill	Asteraceae				X		Crops, roadsides, tailings	Europe, Siberia
<i>Sonchus oleraceus</i> L.	Asteraceae				X		Crops, roadsides, tailings	Europe
<i>Stellaria media</i> L.	Caryophyllaceae				X		Crops, roadsides, tailings	Circunmediterranean
<i>Veronica arvensis</i> L.	Plantaginaceae				X		Crops, roadsides, tailings	North Hemisphere
<i>Verbascum pulvulentum</i> Vill.	Scrophulariaceae				X		Nitrophile grasslands of roadsides, slopes, tailings	W, C and S of Europe
<i>Vulpia bromoides</i> (L.) Gray	Poaceae				X		Annual siliceous lawns on Sandy substrates	Europe, Asia Minor, N of Africa
<i>Bryum argenteum</i> Hedw.	Bryaceae					X	Very busy trampled areas, between the cobbles or cracks of the asphalt	North Hemisphere

Supplementary Material 2

Agrostis tenuis L. (fine grass, hay)

It is a dwarf species of medium density and whose radical system is formed by superficial and brief roots, rhizomes that give bushes, forming a dense green-blue lawn. It is found in almost all fine grass mixtures, being used in high quality gardening and golf courses. Its establishment is slow and tolerates the shade moderately. It adapts to the maritime climate with cool, wet nights during summer and mild-cold winters. It requires a mild temperature and high humidity, being specially adapted to oceanic climates. It has very small seeds (from 15,000 to 20,000 per gram approximately), it requires a very superficial surface and a very low density of sowing (500 grams per 1 kg per 100 m², being able to use pure or forming part of a mixture. It is a calcifuge specie, adapted to acidic soils. It thrives well in poor and poorly drained soils and its root system deepens the soil little. In dry periods, it requires a lot of water (up to twice a day), and does not resist heat stress or drought. They tolerate a very low cut, between 0.5 and 2 cm, also requires high fertilization and control of pests and diseases.

Betula celtiberica Rothm. & Vasc. (Iberian Birch)

Deciduous and monoecious tree up to 15 meters high with a loose, rounded crown. It has the trunk straight and straight, with white upper branches and always ascending. It presents a white or grayish-white bark, with fine horizontal stripes and isolated vertical fissures of dark gray color in the lower parts. Its wood is clear and is appreciated in cabinetmaking. The young branches are covered by small warts that alternate with hairs. Its leaves are alternate, ovate-rhombic and sharp up to 7 cm, with double edge and irregularly sawed, dark green on the beam and more clear and tomentose on the back. Inflorescences in male hanging catkins, the separated and less showy female ones, are formed from March to May. Presents elongated ovoid infrutescences that open in autumn releasing small nuts with two wing expansions (samaras) that are disseminated by the wind. Endemism of the northwest of the Iberian Peninsula, is located in sunny places and extends from sea level to the subalpine levels of the mountains. It spreads easily in uncultivated and uncultivated lands due to its anemophilic dissemination and the numerous fruits it produces. Its leaves have been used for medicinal purposes and in homeopathy. From the point of view of its geographic distribution we have to emphasize that *Betula celtiberica* is endemic (exclusive) of the Northwest of the Iberian Peninsula (Ashburner & Mc Allister, 2013).

Calluna vulgaris (L.) Hull (Heather)

Shrub plant up to 1, meters high, very ramified from its base. The young stems have patent hairs, while the old ones, reddish in color, are rounded. Opposite leaves, sessile, slightly fleshy, with the base lobed and adhered to the stem, very densely imbricated. The flowers appear solitary in the axils of the leaves, with a short curved pedicel finished in 4 bracts, with a reddish and hairy edge. The calice is formed by 4 pink

petals of oval shape, more or less lanceolate, the pistil has a reddish ovary with 8 ribs provided with hairs and a style with thickened stigma, under the ovary there is a nectariferous disc. It lives in heathland on acidophilous soils, in borders and clearings of forests, pastures on decarbonised limestones, in sunny places, and hardly or at all nitrified. From sea level to 2100 m, although it is more abundant in mountainous areas.

***Dactylis glomerata* L. (Dactyl)**

Perennial gramineae, large, reaching up to 1.20 meters. Panicles rigidly erect, with approximate branches or, at most, the lower distant. Spikelets compressed laterally. With 2-5 flowers, almost sitting and arranged in glomeruli, dense and unilateral, ovate. Glumes and slogans lanceolate, sharp, usually with stiff hairs on the keel. Almost equal beads with slogans provided with rigid short edge. Normally glaucous leaves, quite wide, folded longitudinally at their origin, because the shoots are compressed laterally, the tip of the leaf forms a kind of characteristic cap. It has a ligule with a special tip. Stems erect or open. It forms thick isolated shrubs, by the production of a large number of basal leaves.

It is good quality grass, suitable for all kinds of cattle and for mowing meadows. The appetite for the cattle decreases a lot in the adult form, because its outbreak hardens soon, if it does not paste with the due frequency. It is a very useful plant, because it presents an almost continuous growth, attenuated in summer and winter; It springs soon in spring and grows actively until well into winter. Prefers limestone, but lives well in siliceous not too acidic (pH optimum, 6-7). Tolerates plaster and salinity. Live well under the shade of trees, if this is not very intense, but loses quality. It responds very well to the subscriber especially to nitrogen. It is a very broad species with a great number of forms and ecotypes adapted to live in very diverse conditions, from sea level up to 2000 meters of altitude, and supporting up to 250 millimeters of annual precipitation.

***Plantago lanceolata* L. (Lanceleaf plantain)**

Perennial herb hemicryptophyte, with roots of 0.75 mm thick, typical of meadows, pastures, ribazos and sidewalks, up to 1950 m altitude. It can be included in plant communities belonging to the *Molinio Arrhenatheretea* Class, of Eurosiberian or Mediterranean distribution with high coverage in which hemicryptophytes and geophytes of deep soils dominate, with variable humidity and nutrients derived from management by mowing or grazing. Its ecological requirements are the penumbra and prefers the moderate heat, mainly montane floor; of sub-oceanic continentality does not support late frosts or extreme temperatures. It has a preference for dry soils being an indicator of moderate dryness, and is typical of weakly acid soils (pH 4.5 - 7.5), moderately poor or slightly rich in nitrogen without being present in highly fertilized soils. Characteristics are leaves that form one or several basal rosettes (more than five times longer than wide), which are linear-lanceolate to

lanceolate, and entire or sparsely toothed, pubescent and sessile or with a petiole as long as the lamina. Flowers from March to November, the flowers are tetrameric, actinomorphic, hermaphroditic and bracteate (ovate and glabrous), are arranged in spikes at the end of a scape that measures approximately twice as long as the leaves and has 5 longitudinal grooves and one pubescence more or less adpressed, the ears are very dense and measure between 0.5 and 8 cm, and at the end of the ovary are white or yellowish anthers, visible when the flower matures. The fruit is a capsule of 3-4 mm, dehiscent.

***Salix atrocinerea* Brot.** (Ash willow)

Shrub or small tree that can reach 12 meters in height, with grayish-brown trunk that develops a little dense glass. Its branches are straight and elongated, pubescent those of the young and hairless branches or glabrescent those of a year. Its wood has abundant longitudinal ribs once peeled. And the buds are keeled and brownish. Possesses alternate petiolate leaves of trasovado-oblong or lanceolate form and 2-10 x 1-2 cm, has a rounded or cuneiform base, somewhat attenuated and its apex is obtuse or acute; the revolutionary margin, whole or something jagged. Of young they are pubescent with the dark green beam and lower glauco tomentoso, later they lose the pilosidad except reddish hair that conserves in the nerves. It flowers from January to March, and the flowers gather in bracteate, precocious and lateral catkins, sessile or on short peduncles, and present a nectariferous disk. Its fruit is a tomentose capsule with an ovate to conical shape. It grows on the banks of water courses, more or less nitrified, humid meadows, valleys, and even in hedges and / or less humid forests, from sea level to 2000 m in height. For its upper part, *Salix atrocinerea* is an endemism of the Iberian Peninsula that reaches some area of North Africa, Corsica and the west of France (Castroviejo, 1986-2012).

***Trifolium repens* L.** (White clover)

Hemicryptophyte perennial plant of 10-50 cm, with creeping and rooting stems and trifoliate leaves, often with a white spot on the bundle, obovate denticulate leaflets. The flowers have a white or pink membranous corolla in the fruiting and are grouped in pedunculated globose heads. It is a species native to Europe, present throughout the Iberian Peninsula, being currently the perennial perennial legume legume, is grown in dry areas in temperate areas and irrigated in drier areas, settling on long-lasting bifer grasslands with English ryegrass and polyphytic prairies. The food that it provides is of high quality, rich in protein and with a high and sustained digestibility throughout its cycle, with grazing being the best way of harvesting and occasionally mowing and haying. It is implanted without difficulty although the sowings must be very superficial (due to the small size of the seed). It resists trampling very well and has a high capacity for regrowth. It also has efficient vegetative propagation mechanisms (stolons), which contribute greatly to its expansion in the pasture. It adapts to diversity of climates, soil and altitudes. Its optimal

growth is in temperate-humid climates with little summer drought. It does not tolerate shading, and to be productive it requires moisture and good levels of phosphorus and potassium in the soil.