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NOVEL APPROACHES TO WILD *SOLANACEAE* DOMESTICATION: MORPHOLOGICAL DIVERSITY, BIOCHEMICAL COMPOSITION, GENETIC TRANSFORMATION AND GENE EDITING

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This monograph presents a comprehensive overview of recent advances in biotechnology, genetic transformation, and gene editing across 51 wild and semidomesticated species within the *Solanaceae* family. While these species are currently utilized in food, ethnomedicine, and various local applications, they have yet to achieve broad global cultivation. A detailed examination was conducted on each species' potential for callus induction, shoot regeneration, genetic transformation and gene editing.

In addition to the technical data, the review provides information on each species' geographical distribution, morphological characteristics (with representative photographs of flowers, whole plants, and fruits), ways of traditional uses, and reported medicinal properties.

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CONTENTS

LIST OF ABBREVIATIONS

The following abbreviations are used in this manuscript:

2,4-D	2,4-Dichlorophenoxyacetic acid, growth stimulant
AcMYB110	gene coding *Solanum americanum* Myb domain protein 110
ALS	ACETOLACTATE SYNTASE
APETALA2	ANTHOCYANIN1
AtGA20ox1	gene encodes gibberellin 20-oxidase1
ATHK1	*Arabidopsis* Histidine Kinase 1
AtPAP1	*Arabidopsis thaliana* anthocyanin pigment 1
BAP	6-Benzylaminopurine
BC-ATPase	gene encodes Bcs1 type of AAA-ATPase transmembrane protein
CAS	gene encodes CRISPR associated protein 9
Cat	gene encodes catalase
Chl H	Mg-chelatase H subunit
CLE9H	CLAVATA3/ESR-RELATED 9
CmGA20ox1v	gibberellin 20 oxidase gene
CRISPR	Clustered Regularly Interspaced Short Palindromic Repeats
cry1A	gene encodes *Bacillus thuringiensis* Cry1A protein
CycB	LYCOPENE BETA-CYCLASE
DHNA	dihydroneopterin aldolase
DsRed2	gene encodes *Discosoma* sp. red fluorescent protein
FAS,CLV3	FASCIATED, CLAVATA3
FW2.2-1	FRUIT WEIGHT 2.2 locus
FW2.2-1/2	FRUIT WEIGHT 2.2 locus
FW2.2-2	FRUIT WEIGHT 2.2 locus
GA_3	Gibberellic acid growth stimulant
GFP	gene encodes Green fluorescent protein
GGH	gene encodes Gamma-glutamyl hydrolase
GGP1	GDP-L-GALACTOSE PHOSPHORYLASE
GUS	β-glucuronidase gene, *E. coli* β-glucuronidase gene
HBsAg	Hepatitis B virus (HBV) gene that encodes the hepatitis B surface antigen (HBsAg)
HYG	hygromycin B *Streptomyces hygroscopicus* gene
IAA	Indole-3-acetic acid growth stimulant
INFA2β	Human interferon *α2β* gene
JIP21	wound-inducible tomato chymotrypsin inhibitor I gene
KIN	kinetin growth stimulant
LbCCD4.1	*L. barbarum* carotenoid cleavage dioxygenase LbCCD

LbERF5.1	*L. barbarum* gene encodes ethylene-responsive transcription factor 5
LbNCED1	*L. barbarum* gene encodes 9-cis-epoxycarotenoid dioxygenase
LbNR	*L. barbarum* nitric reductase gene
LOB	LATERAL ORGAN BOUNDARIES gene
LrCHS	gene encodes Leucine Rich Repeats and Calponin Homology Domain Containing 1 protein
LrCYP75B1	*L. ruthenium* gene encodes a flavonoid 3′-hydroxylase enzyme
LrERF5.1	*L. ruthenium* gene encodes ethylene-responsive transcription factor 5
LrF3HPro	*L. ruthenium* flavanone 3-hydroxylase promoter
LrFLS	*L. ruthenium* gene encodes Flavonol synthase enzyme
LrKUP8	*L. ruthenium* gene encodes Potassium Transporter
LrMYB1	*L. ruthenium* gene encodes MYB1 transcriptional factor
LrMYB94	*L. ruthenium* MYB DOMAIN PROTEIN 94 gene encode a putative transcription factor (MYB94)
LrTCP4	*L. ruthenium* encodes TCP family transcription factor 4
LrWRKY32	*L. ruthenium* gene encodes WRKY32 transcriptional factor
LUC	luciferase gene
MmGAox1	*Marah macrocarpus* gene encode GA3-oxidase1
MPF1	MADS-box transcription factor gene MPF1-Like
MPF2	MADS-box transcription factor gene MPF2-Like
MPF3	MADS-box transcription factor gene-3-Like
MULT (S)	MULTIFLORA, COMPOUND INFLORESCENCE
n.d.	not described
NAA	1-Naphthaleneacetic acid growth stimulant
NEP-TC	rRNA Methyltransferase gene encodes enzymes that modify ribosomal RNA (rRNA) by adding methyl groups
NobPDS	*Nicotiana obtusifolia* PHYTOENE DESATURASE gene
nptII	neomycin phosphotransferase II gene encode neomycin phosphotransferase II enzyme
O	OVATE
P13	*Physalis* bHLH transcription factor gene
P5	gene encodes a LOB transcription factor
PcGA2ox1	*Phaseolus coccineus* gibberellin 2-oxidase gene encode gibberellin (GA) 2-oxidase enzyme
PDS	PHYTOENE DESATURASE gene
PF10	*Physalis* WRKY TF gene
PF3	gene encodes zink finger protein which is a member of Zic family of transcription factors
PF7	gene encodes GAMYB-like protein from family of MYB transcription factors

PfCNR1L1	*Physalis philadelphica cell number regulator 1* locus
PfCNR1L2	*Physalis philadelphica cell number regulator 1* locus
PFCRC	CRABS CLAW, YABBY transcription factor
PfFCNR1	*Physalis philadelphica* cell number regulator 1, syn. POS2
PFGLO1	GLOBOSA-like1
PFGLO2	GLOBOSA-like2
PgAN1	*Physalis grisea* ANTHOCYANIN1
PgDEF	*Physalis grisea* DEFICIENT
PgEJ2	*Physalis grisea* ENHANCER-OF-JOINTLESS2
PgER	*Physalis grisea* ERECTA
PgGLO1	*Physalis grisea* MADS-box gene GLOBOSA1
PgGLO2	*Physalis grisea* MADS-box gene GLOBOSA2
PgLIN	*Physalis grisea* LONG INFLORESCENCE
PgMPF2	*Physalis grisea* MADS-box gene 2
PgMPF3	*Physalis grisea* MADS-box gene 3
PgRIN	*Physalis grisea* RIPENING INHIBITOR
PgSP	*Physalis grisea* SELF PRUNING
PgTAG1	*Physalis grisea* AGAMOUS 1
PgTAGL1	*Physalis grisea* AGAMOUS-LIKE 1
PgTM6	*Physalis grisea* MADS-BOX 6
POS1	*Physalis* Organ Size 1
PpPDS	*Physalis peruviana* PHYTOENE DESATURASE gene
Ppr-CLV1	*Physalis pruinosa* CLAVATA1
Ppr-SP	*Physalis pruinosa* SELF-PRUNING
Ppr-SP5G	*Physalis pruinosa* SELF-PRUNING 5G
rolA	this gene is part of the TL-DNA (transferred DNA) of the Ri plasmid (root-inducing plasmid) of *Agrobacterium rhizogenes*
rolB	this gene is part of the TL-DNA (transferred DNA) of the Ri plasmid (root-inducing plasmid) of *Agrobacterium rhizogenes*
rolC	this gene is part of the TL-DNA (transferred DNA) of the Ri plasmid (root-inducing plasmid) of *Agrobacterium rhizogenes*
rolD	this gene is part of the TL-DNA (transferred DNA) of the Ri plasmid (root-inducing plasmid) of *Agrobacterium rhizogenes*
RUBY	syntetic gene encodes three enzymes (CYP76AD1, DODA and glucosyltransferase) *Rx4* - gene coding RX4 protein
Rx4CDS	gene (Solyc11g069020) encodes a RX4 protein that mediates the hypersensitive response (HR) to bacterial spot disease caused by *Xanthomonas euvesicatoria* pv. perforans race T3
sGFP	gene encodes superfolder Green Fluorescent Protein
SgHKT1;1	*Solanum galapagense* HIGH-AFFINITY K+TRANSPORTER 1;1 gene, encodes HKT1-like transporters

SgHKT1;2	*Solanum galapagense Solanum galapagense* HIGH-AFFINITY K+TRANSPORTER 1;2 gene encodes HKT1-like transporters
SmMYB113	*Solanum melongena* MYB113 transcription factor
SnAN2	*Solanum nigrum* ANTHOCYANIN 2
SnLazy1 locus	*Solanum nigrum* gene codes *SnLazy1 protein*
SnMYB1	*Solanum nigrum* gene coding MYB DOMAIN PROTEIN 1
SnS	*Solanum nigrum* MULTIFLORA, COMPOUNF INFLORESCENCE
SnSP	*Solanum nigrum* SELF-PRUNING
SP	SELF-PRUNING
SP5G	SELF-PRUNING 5G
SPL8	squamosa promoter binding protein-like 8
SpRDR6	RNA-DEPENDENT RNA POLYMERASE 6
SpSGS3	SUPPRESSOR OF GENE SILENCING 3
SpPR-1	PATHOGENESIS-RELATED PROTEIN-1
SpProSys	PROSYSTEMIN
SpMlo1	MILDEW RESISTANT LOCUS O
STMAD16	MADS-box transcription factor
SYSFR	fragment of gene encodes prosystemin protein
HMGR	gene encodes 3-Hydroxy-3-methylglutaryl coenzyme A reductase
WF2	FRUIT WEIGHT 2
WUS	WUSCHEL
Y	YABY
ZEA	zeatin, growth stimulant

PREFACE

This monograph presents a comprehensive overview of recent advances in biotechnology, genetic transformation, and gene editing across 51 wild and semi-domesticated species within the *Solanaceae* family. While these species are currently utilized in food, ethnomedicine, and various local applications, they have yet to achieve broad global cultivation. A detailed examination was conducted on each species' potential for callus induction, shoot regeneration, genetic transformation, gene editing.

For comparative and statistical analyses, several parameters were assessed, including: the type and age of explants used for callus initiation, shoot regeneration, and microclonal propagation; optimal concentrations and combinations of growth regulators; and the overall efficiency of plant regeneration. The study identifies the most effective explant types and developmental stages and compiles a list of genes that have been successfully delivered, edited, and stably integrated into plant genomes.

In addition to the technical data, the review provides information on each species' geographical distribution, morphological characteristics (with representative photographs of flowers, whole plants, and fruits), ways of traditional uses, and reported medicinal properties. Data were statistically analyzed and visualized using the Flourish online platform, with comparative findings presented in the form of a Sankey diagram.

Keywords: gene editing; genetic transformation; *Solanaceae*; wild tomatoes; biotechnology.

INFORMATION ABOUT THE AUTHORS

Olha Yaroshko – biotechnologist, microbiologist with 12 years of practical experience in plant biotechnology, plant genetic engineering. The main areas of my research are genetic transformation of plants, gene editing, plant tissue culture, plant regeneration, microclonal plant propagation, plant cultivation *in vitro* and *ex vitro*, biotic and abiotic stresses and their effects on plants, improvement of the biochemical composition of agricultural plants and creation of drought-resistant plants by genetic engineering methods; creation of biopharmaceuticals and proteins with therapeutic properties, etc. I have previously worked with many different plant species: *Solanum lycopersicum*, *S. lycopersicum cerasiforme* and *S. lycopersicum pimpenifolium* several genotypes, *Physalis peruviana*, *P. ixocarpa*, *P. pubescens*, *Amaranthus caudatus* varieties, *A. panuculatus* x *A. caudatus* hybrids, *Petunia* spp., *Nicotiana tabacum*, *Solanum tuberosum* varieties, *Helianthus annuus*, *Stipa* etc. I mainly work with agricultural crops from *Solanaceae* and *Amaranthaceae* families.

Taras Pasternak - physiologist and cell biologist with 30 years of experience with combinations of physiology, molecular and cellular biology expertise with diverse range of areas: single cells technology, tissue culture, phenotyping with 3D image generation and analysis, cell cycle regulations, stem cells biology, cell totipotence regulation. My current scientific focus combines the regulation of the biotic and abiotic stress response at cellular, organs and whole organism level by the nutritional status and endogenous and exogenous hormones.

- Expertise in field of plant phenotyping from whole plant to sub-cellular level, including detailed passport of each cell/cell types with gene expression in each.
- Highly knowledgeable in tissue culture *in vitro*, protoplasts culture, plant micropropagation and regeneration.
- Strong background in image generation and analysis, including segmentation, detection of gene expression and protein complex formation.

1. INTRODUCTION

In recent years climate changes, such as drought and high temperatures, have caused significant losses in crop production all over the world [1].

Crop production losses have had a significant negative impact on global population well-being and economic stability. This has posed a major challenge for both scientists and farmers, who are under pressure to develop new plant varieties with enhanced tolerance to abiotic stress and higher productivity. While traditional breeding and selection methods remain effective, they are often time-consuming and labor-intensive. Therefore, the application of advanced biotechnological tools and genetic engineering techniques offers a more rapid and efficient solution for developing improved cultivars - both for currently important crops and for those with the potential to become commercially valuable in the near future. By bridging the gap between laboratory breakthroughs and field applications, this review primarily aims to analyze strategies for rapid crop improvement, with a particular emphasis on the role of new genomic techniques (NGTs) in developing climate-resilient, semi-domesticated, and wild *Solanaceae* species with enhanced traits. What is more, the conservation of wild and semi-domesticated *Solanaceae in vitro* conditions represents a critical prerequisite for ensuring the long-term availability of genetic diversity essential to future breeding programs, advanced biotechnological applications, and the development of resilient crop species under changing environmental conditions.

Nevertheless, for commercially important crops (for ex. tomatoes) were already obtained many results connected with investigation of gene functions, the whole genomes sequencing, what allowed upgrade biochemical qualities of fruits, increase resistance towards biotic and abiotic stresses, change morphological characteristics of fruits and plant architecture (during the last 15 years the obtained results of tomato improvement were reflected in 356 experimental articles) [2] for wild and semi-domesticated *Solanaceae* species the biotechnological approaches are rare applied and there is limited quantity of publications where the results of genetic engineering and gene editing of orphan crops are presented (even though many of them are already consumed locally and have biochemical and nutrition value and potential for breeding and hybridization with cultural close plant relatives). The following gaps can be explained by lack of experimental data to full genomes sequencing and annotation of gene functions, recalcitrance of many wild species towards *Agrobacterium* transformation, low regeneration efficiency.

This review consolidates all available information on the biotechnological progress made in improving 51 wild *Solanaceae* species, providing a valuable resource for researchers planning future experiments in genetic engineering, gene editing, and the development of next-generation crops with multi-stress resistance.

In addition, for each species, detailed information was provided on

morphological characteristics, geographical distribution, traditional uses, known cultivars (where applicable), medicinal properties, and key biochemical components. Furthermore, the scientific names of all species were verified and standardized according to the most recent and accepted classifications. The following old names of species were changed to new approved names: *Physalis floridana* was changed on *Physalis pubescens*, *Physalis alkengri* changed on *Alkengri officinarum, Solanum gilo* changed on *Solanum aethiopicum* f. gilo, *Solanum indicum* changed on *Solanum lasiocarpum*, *Solanum toxicarum* changed on *Solanum stramoniifolium*, *Solanum rickii* changed on *Solanum sitiens*, *Solanum hirsutum* changed on *Solanum habrochaites*, *Solanum hirsutum* f. typicum and *Lycopersicon hirsutum* f. glabratum changed on *Solanum habrochaites*, *Solanum phychanthum* Dunal changed on *Solanum americanum, Lycopersicon glandulosum* C.H. Müll. changed on *Solanum corneliomulleri, Solanum khasianum* changed on *Solanum aculeatissimum Jack*.

2. BIOTECHNOLOGICAL AND MORPHOLOGICAL DESCRIPTION

Below we provide detailed descriptions of species one by one. The order of mentioning each plant species in this review was organized according to recent approved taxonomy for *Solanaceae* species [543, 544]. Thus, authors of this review unified the names of several plant species according to the last approved norms of *Solanaceae* taxonomy [543, 544].

2.1. *Solanum aviculare* G.Forst.

(Clade I. Major clade *VANAns*, Minor clade *Archaesolanum*)

Local/common names: kangaroo apple, meakich, mayakich, mookich, koonyang, gunyang, poroporo [4].

Morphological description. The plants are shrubs, can reach up to 2 m. The stem is erect, woody, glabrous. The leaves are pinnatisect or simple, the form of leaves is broadly elliptic or obovate, the lobes are 1–10 cm long and 1–2 cm wide. The inflorescence is cyme composed of up to 10 flowers. The blush-violet corolla is 3–4 cm in diameter, lobed. The fruits are berries, orange/red in maturity, 2 cm long and 1-1.5 cm wide [3], (**S3**, *sheet 1*).

Distribution: Australia, New Guinea, New Zealand [3].

Uses: ethnomedicine [4], the ripe fruits are edible, ethnic food (in the area Lake Condah), rootstock for grafting Eggplant / Aubergine (*Solanum melongena*) [5].

Medicinal properties: anti-inflammatory [5, 6], antifungal and anticancer [5, 6], antioxidant, contraceptive [5, 6].

Biochemical composition: rich in steroids [6].

Biotechnological achievements. The callus tissue [7–11], shoot regeneration [9-11], microclonal multiplication [9] and genetic transformation [7, 12–15] were obtained.

Callus induction was obtained from leaf explants mainly (8 mentioning)[1] cultivated on medium supplemented with 0.5–1 mg/L 2,4-D (9 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat*, **S2**, *link 1*). The rates of callus induction were not mentioned.

Shoot regeneration was obtained mainly from leaf explants cultivated on medium supplemented with different concentrations of BAP (5 mentioning, see **Table S1**, *sheet regeneration+callus+concentrat.*, ***S2***, *link 2*). The highest rates of shoot regeneration were obtained from stem derived protoplasts cultivated on medium supplemented with 0.5 mg/L BAP (90%) [10], or leaf explants, cultivated on medium supplemented with 2.2 mg/L BAP + 0.2 mg/L IBA (79% regeneration efficiency) (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).

Shoot elongation was not conducted in the majority of experiments (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3).*

[1] Numbers of mentioning are the results of the analysis in the Flourish program (look Supplementary S2: Links on graphics created in Flourish.com.). The program built graphs based on Excel spreadsheets created from articles raw data. These numbers show how many times some parameter was mentioned. For example, in this sentence, it was mentioned 9 times in different publications that concentrations of 0.5-1 mg/L 2,4-D were used for callus induction; 8 times in different publications the use of leaf explants for callus induction was mentioned. In the same way, other parameters that affect the effectiveness of callus formation, shoot regeneration, genetic transformation, etc., were analyzed using the Flourish program.

Rooting was not conducted in the majority of experiments (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4).*
Microclonal multiplication was not conducted in the majority of experiments (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 5, link 6*.
Genetic transformation was achieved from shoot-, leaf-, node-, seedling's explants cocultivated with *A. rhizogenes* (mainly) or *A. tumefaciens* strains (**Table S1**, *sheet transformation total*, **S2**, *link 8***)**. The delivery of genetic vectors was conducted *via Agrobacterium*-mediated transformation [7, 13, 14], agroinjection [12, 14] and direct delivery of plasmid [15] (**S2**, *link 11*). The outcome of experiments was obtaining of hairy root lines with incorporated *vir C*, *hgmg*, *npt II*, *rolA*, *B*, *C* genes [13, 14] transient expression *gus, npt II* [15], transformed plants with incorporated *gus*, *npt II* genes [15] (**S2**, *link 7, 12*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.2. *Solanum dulcamara* L.
(Clade I. Major clade *VANAns*, Minor clade *Dulcamaroid*)

Local/common names: bittersweet nightshade, bittersweet, woody nightshade, morelle douce-amère, morella rampicante [16].
Morphological description. The plants are perennial vines, herbaceous, can reach up to 120 cm height, glabrous or pilose-pubescent. The leaves are 3–9 cm long and 1.2–3 cm wide, ovate. The flowers are purple, 5–10 flowers formed cymes inflorescence. The calyx is 2.5 mm long, campanulate, pubescent. The corolla lobes are 2–3 mm long. The anthers are 2.5–4 mm long, yellow; the filaments are glabrous. The fruits are bright red berries, ovoid, 6–8 mm in diameter [16], (**S3**, *sheet 1*).
Distribution: Northern Africa, North America, Europe, Asia [16].
Uses: medicine [17].
Medicinal properties: treating skin diseases, cancers, anti-tumors, alterative, anodyne, depurative, mildly diuretic, emetic, expectorant, hepatic, mildly narcotic and purgative [18, 19], skin abrasions, inflammation [20]. More information can be found in review [17].
Biochemical composition: steroidal saponins [17], steroidal alkaloids [17], flavonoids [17], sterols [17]. More information can be found in review [17].
Biotechnological achievements. Callus tissue [21-28], shoot regeneration [21–29], microclonal multiplication [26] and genetic transformation [30–34] were obtained (**S2**, *link 6*).
Callus induction was obtained mainly from 3–4-week-old or 15-day old leaf explants (4 mentioning) or from hypocotyls (3 mentioning) cultivated on medium supplemented with 1 mg/L 2,4-D + 0.05 mg/L KIN + 1 mg/L GA_3 + 12% coconut milk. The rates of callus induction were not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*).
Shoot regeneration. The best results of shoot regeneration were obtained from 15-day-old leaf discs cultivated on medium supplemented with 0.02 mg/L BAP +

0.02 mg/L IAA, the rates of regeneration reached 100% [23]. In the majority of publications, the effectiveness of callus induction were not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).

Rooting was initiated on medium supplemented with 3 mg/L BAP + 0.5 mg/L IAA [29]. In majority of experiments rooting was not conducted or details were not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4*).

Genetic transformation. For genetic transformation, stem explants were used mainly (18 mentioning) (**Table S1**, *sheet transformation total*, **S2**, *link 7*). In many experiments *A. rhizogenes* strains were used which delivered following genes: *gus*, *nptII*, *rolABC*, *rolA*, *rolB*, *rolC*, *rolD*, as a result, hairy roots were obtained (**Table S1**, *sheet transformation total*). *A. tumefaciens* GV3101 strain caring out pLARS121 genetic vector with *CmGA20ox1v (gibberellin 20 oxidase gene)* and *nptII* resulted in generation of transgenic plants [28] (**S2**, *link 7*).

Other results. Infiltration of 2-week-old leaves or stem bases with suspension of *Dickeya solani* (bacteria) carrying *gfp* gene resulted in systemic colonization of plants with bacteria. The GFP proteins allowed monitoring in real time the spreading of bacteria in plant tissues (**Table S1**, *sheet transformation total*, **S2**, *link 7*).

Gene editing was not conducted (**Table S1**, *sheet transformation total*).

2.3. *Solanum villosum* Mill.
(Clade I. Major clade *DulMo*, Minor clade *Morelloid*)

Local/common names: woolly nightshade, red nightshade, red-berried nightshade, morella rossa, erva de Santa Maria, yerba mora, red Nightshade [35].

Morphological description. The plants are erect herbs, reach 40-60 cm high. The stems are pubescent. The leaf blade is ovate or elliptic, 3–7 cm long and 2–4 cm wide, pubescent. The inflorescences are extra-axillary, umbellate. The calyx is puberulent. The corolla is white or purplish, 5–7 mm long and 8–10 mm wide. The berries are red / orange / or yellow, bright, globose, 6-8 mm in diam. [35] (**S3**, *sheet 1*).

Distribution: Macaronesia, Northern Africa to Eritrea and Mozambique, Central and Southers Europe to China, India [36].

Uses: This species is traditionally utilized as ethnic food; the ripe berries are consumed fresh, and the leaves are commonly boiled. Additionally, it has demonstrated notable bioactivity, including mosquitocidal effects against *Anopheles stephensi, Culex quinquefasciatus.* It also exhibits molluscicidal activity, specifically against *Galba truncatula* (the intermediate host of *Fasciola hepatica*) and *Biomphalaria alexandrina* (the intermediate host of *Schistosoma mansoni*) [37].

Medicinal properties: antibacterial, antiprotozoal (*Plasmodium falciparum*, *Trypanosoma brucei brucei*, *T. cruziand*, *Leishmania infantum*), anticancer, antioxidant [37].

Biochemical composition: alkaloids, flavonoids, phenols, saponins, tannins, terpenoids, steroids [37].

Biotechnological achievements. The callus tissue [38-40], shoot regeneration [38–40] and microclonal multiplication [39] have been successfully achieved (**S2**, *link 6*).

Callus induction was obtained from leaf explants cultivated on medium with 2 mg/L 2,4-D + 1.2 mg/L KIN [41] (**S2**, *link 1*).

Shoot regeneration was obtained mainly from leaf explants cultivated on medium supplemented with 1.9 mg/L BAP + 0.1 mg/L NAA (regeneration efficiency reached 91%) [38] or with 2 mg/L BAP + 0.1 mg/L NAA (regeneration efficiency was 90%) [39], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).

Shoot elongation was conducted on the medium without addition of growth stimulants in the majority of experiments (**Table S1**, *sheet regeneration+callus+concentrat,* **S2**, *link 3***)**.

Rooting was conducted on the medium without addition of growth stimulants in the majority of experiments (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4*).

Microclonal multiplication results were mentioned in one publication [39] (**S2**, *link 5*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total).*

2.4. *Solanum nigrum* L.
(Clade I. Major clade *DulMo*, Minor clade *Morelloid*)

Local/common names: black nightshade, wonderberry, blackberry, black berry nightshade, morelle noire, morella commune, erba morella, pomidorella, herva moira morelle commune, pera de Santa Maria, yerba mora, hierba mora [42].

Morphological description. The plants are annual herbaceous herbs, up to 30-100 cm heigh, pubescent. The leaves are oval and dentate; the apex is obtuse. The flowers are white, 8-10 mm long, the inflorescences are grouped by 3–5 flowers. The fruits are black berries, globose, the size is 8-10 mm in diameter [42] (**S3**, *sheet 1*).

Distribution: Europe, America, Australia, New Zealand, South Africa [42].

Uses: food, ethnomedicine [42].

Medicinal properties: antihyperlipidemic [43, 44], antimicrobial [45, 46], antitumor [47–53], molluscicidal [54–55], mosquitocidal effect [56], antinociceptive, antipyretic [53, 57, 58], antiulcerogenic [58], hepatoprotective [59, 60], antihistaminic [61], antiallergic [61], anti-inflammatory [61], antipyretic [61], CNS-depressant action [17, 61]. More information can be found in review [17, 61].

Biochemical composition: biochemical profile includes steroidal saponins, steroidal alkaloids, pregnane glycosides, sesquiterpenes, sterols and phenolic compounds [17]. More detailed information can be found in review [17].

Biotechnological achievements. The callus tissue (**Table S1**, *sheet regeneration+callus+concentrat,* **S2**, *link 1),* shoot regeneration (**Table S1**, *sheet regeneration+callus+concentrat,* **S2**, *link 2),* microclonal multiplication [62–72], micropropagation [73–77] genetic transformation (**Table S1**, *sheet transformation total,* **S2**, *link 7–12*) and gene editing (**Table S1**, *sheet gene editing total,* **S2**, *link 13–18*) were obtained.

Callus induction was initiated mainly from 2-week-old (15 mentioning) leaf explants (29 mentioning), node explants (22 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat*) which were cultivated on medium supplemented with 2,4-D (in majority of experiments, 9 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat*, **S2**, *link 1*). The highest rates of callus induction were obtained during cultivation of explants on media supplemented with 0.4 mg/L NAA + 3 mg/L ZEA, 100% [78], 0.4 mg/L NAA + 4 mg/L ZEA, 92,8% [78], 0.1 mg/L 2,4-D + 0.5 mg/L BAP + 1 mg/L NAA, 100% [79], 2 mg/L 2,4-D + 0.4 mg/L KIN [80], 1.5 mg/L TDZ or 0.5-1.5 mg/L IBA, 100% [69]. *S. nigrum* has good callus induction efficiency (**Table S1**, *sheet regeneration+callus+concentrat,* **S2**, *link 1*).

Shoot regeneration. The majority of experiments was conducted on media supplemented with BAP (20 mentioning), BAP+NAA (13 mentioning), TDZ (9 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat.,* **S2**, *link 2).* The highest results of shoot regeneration were obtained on media supplemented with following combinations and concentrations of growth stimulants: 0.4 mg/L NAA + 3 mg/L TDZ, 100% [78], 0.1 mg/L NAA + 0.75 mg/L TDZ, 100% [81], 2 mg/L ZEA + 0.1-0.2 mg/L IAA, 100% [82], 1 mg/L BAP + 0.2 mg/L IAA, 100% [82], 3 mg/L BAP + 0.5 mg/L NAA, 100% [83], 0.02 mg/L BAP + 0.02 mg/L IAA, 100% [23]. The following results indicate that *S. nigrum* has initially good regeneration efficiency (**S2**, *link 2*).

Rooting was initiated on media supplemented with 0.1–10 mg/L IBA (25) or 0,1–1 mg/L NAA (16 mentioning) mainly (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4).*

Microclonal multiplication was achieved on media supplemented with BAP or TDZ (5 mentioning, each), or KIN (4 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat.,* **S2**, *link 5).*

Genetic transformation. In the majority of experiments the leaf explants (18 mentioning) were transformed with *A. tumefaciens* (29 mentioning) LBA 4404 strain (8 mentioning) and *A. rhizogenes* (3 mentioning) (**Table S1**, *sheet transformation total,* **S2**, *link 8–10***)**. The delivery of genetic vectors was achieved *via Agrobacterium*-mediated transformation (31 mentioning) (**Table S1**, *sheet transformation total,* **S2**, *link 11***)**. The outcomes of experiments were stable transformed plants (28 mentioning), hairy roots culture (3 mentioning), transient expression (1 mentioning). The transgenes which were delivered into plant tissues were: *gfp*, *nptII, gus, DsRed2*, *MmGAox1*, *MmGAox2*, *AtGA20ox1*, *MmGAox1* + *MmGAox1*, *PcGA2ox1*, *nptII*, *wound-inducible tomato chymotrypsin*

inhibitor I gene, *AcMYB110*, *AtPAP1*, *nptII*, *INFA2β*, *hyg*, *cry1A* (**Table S1**, *sheet transformation total*, **S2**, *link 7***)**. The efficiency of transformation was high and, in many experiments, reached 70–90%) (**Table S1**, *sheet transformation total*).

Gene editing. The delivery of editing tools was performed *via Agrobacterium*-mediated transformation [81, 82, 84, 85] (**S2**, *link 13–18*). *A. tumefaciens* EHA105 strain caring out pAGM4723 genetic vector (7 mentioning) or GV3101 carrying out Phee401E-Snmyb1 genetic vector (1 mentioning) were used in experiments (**Table S1**, *sheet gene editing total***)**. The outcomes of experiments were generation of knock-out mutants (including double and quadruple mutants) [84] with edited genes: *SnMYB1*, *MULT (S)*, *SnSP*, *CLV3*, *CLE9H*, *CLV3* x *CLE9H*, *SnAN2*, *SnLazy1* (**Table S1**, *sheet gene editing total*, **S2**, *link 19***)**. The mutants had following changes: changes in biochemical composition, in inflorescence morphology, in plant architecture, in flower size, in flower morphology, in growth habit, change of color, in flower quantity, in quantity of fruits, in fruit size, in fruit weight (**S2**, *link 19*). The editing efficiency (75–91.7%) was mentioned only in one publication [81], in the experiment was used GV3101 strain carrying out Phee401E-Snmyb1 genetic vector [81].

2.5. *Solanum scabrum* Mill.
(Clade I. Major clade *DulMo*, Minor clade *Morelloid*)

Local/common names: garden huckleberry, black nightshade [87]

Morphological description: The plants are annual or perennial herbs. The leaves are ovate, 7–12 cm long and 5–8 cm wide. The inflorescence is simple composed of 9–12 flowers. The flowers are white, 15–20 mm in diameter, with yellow-green basal star. The purple-black berries are globular, 10–17 mm in diameter [86] (**S3**, *sheet 1*).

Distribution: Africa and Northern America. Introduced into Southern America (Brazil) [87].

Uses: ethnic food (mainly fresh fruits and preserves, jams and pies, but in Africa leaves are also consumed), ethnomedicine, natural dyes [87].

Medicinal properties: treatment of eye infections [87], treatment of ulcers and abdominal pain [87]. The species also have anti-inflammatory, diaphoretic, diuretic, emollient, febrifuge, narcotic, purgative, and antioxidant activities [87]. In addition, sedative properties have been reported [88].

Biochemical composition: steroidal alkaloid glucosides [89], polyphenols [90], flavonoids [90], carotenoids [90].

Biotechnological achievements. The callus induction and shoot regeneration were obtained [91] (**S2**, *link 6*).

Callus induction was obtained from hypocotyl- and cotyledon-derived protoplasts cultivated on medium which was supplemented with 1 mg/L KIN. The rates of callus induction were low - 0.6% (for hypocotyl-derived protoplasts) and 8.4% (for cotyledon-derived protoplasts) [91] (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*).

Shoot regeneration was obtained from callus cultivated on medium with 2 mg/L ZEA + 0.1 mg/L IAA [91]. The regeneration efficiency reached 34.6% (from callus which was obtained from cotyledon-derived protoplasts [91] (**S2**, *link 2*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).
Rooting was achieved without addition of growth stimulants into the medium [91] (**S2**, *link 4*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*) (**S2**, *link5*).
Genetic transformation was not conducted (**Table S1**, *transformation total*).
Gene editing was not conducted (**Table S1**, *gene editing total*).

2.6. *Solanum americanum* Mill.
(Clade I. Major clade *DulMo*, Minor clade *Morelloid*)

Local/common names: small-flowered nightshade, american black nightshade hierba mora negra, araxixu, caraxixá, erva-de-bicho, erva-mocó, erva-moura, guaraquinha, maria-preta, maria-pretinha, pimenta de cachorro, pimento de rato, pimenta de rato, caraxixá, erva moura, guaraquinha, maria-pretinha, pimento de galinha [92]
Morphological description. The plants are annual or perennial herbs, erect, and can reach up to 150 cm tall, glabrous or pubescent. The leaf blade is ovate or lanceolate, up to 14 cm long and 7 cm broad. The flowers (3–10) are in simple cymes inflorescences. The flowers are white or purple with basal yellow-green star, 5–9 mm in diameter, the anthers are yellow. The fruits are globose berries, 4–8 mm in diameter, purple - black when ripe [92] (**S3**, *sheet 1*).
Distribution. Native to Southern America. Introduced into Hawaii, India, China, Madagascar, Africa, Australia, New Zeland, Vietnam, Russia, Uzbekistan, Germany, Spain [92].
Uses: ethnic food (ripe fruit are eaten fresh or used for making jams; shoots can be eaten after boiling), ethnomedicine [93].
Medicinal properties: antiviral [17], antimicrobial [17], antidiabetic [94, 95], bladder spasm [17], protozoal infections [17], vermifuge [95], anticancer [96], against asthma [97].
Biochemical composition: steroidal saponins [17], steroidal alkaloids [17], monoterpenes [17], flavonoids [17], phenolic compounds [17], fatty acids and esters [17]**.** More information can be found in review [17].
Biotechnological achievements. The callus tissue [98], shoot regeneration [98] and genetic transformation [99, 100] were obtained.
Callus induction was achieved from cotyledons cultivated on medium supplemented with 2 mg/L 2,4-D + 1 mg/L BAP [98] (**S2**, *link 1*). Efficiency of callus induction was not mentioned [98] (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was achieved from cotyledons cultivated on medium

supplemented with 2 mg/L BAP + 0.2 mg/L IAA (**S2**, *link 2*). The efficiency of shoot regeneration was not mentioned [98].

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).

Rooting was not described (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 5)*.

Genetic transformation. The 10-day-old seedlings were used mainly for cocultivation with *A. tumefaciens* LBA4405 carrying out genetic vectors pR35BTR1 (with incorporated *nptII* and *DsRed2* genes) and 35S:AcMYB110 genetic vector (with incorporated *AcMYB110* gene) [99]. The transgenic plants were obtained with changed biochemical composition and fruit color (transformed with *AcMYB110* gene), the fruits, pulp, flowers had black color and increased anthocyanins accumulation [99]. In other experiments leaves were transformed with *A. rhizogenes* ATCC15834 strain and hairy roots were obtained with 96% efficiency of transformation [100] (**Table S1**, *transformation total*, **S2**, *link 17*).

Gene editing was achieved *via Agrobacterium*- mediated transformation. The *A. tumefaciens* EHA105 strain with pAGM4723 genetic vector was used [84]. As a result of experiments, the knockout mutants with edited *MULT (S)*, *SnSP* genes were obtained. The mutants had changed inflorescence morphology or changed plant architecture [84] (**Table S1**, *gene editing total*, **S2**, *link 19*).

2.7. *Solanum muricatum* Aiton
(Clade I. Major clade *Potata*, Minor clade *Basarthum*)

Local/common names: pepino, pepino dulce, apipa [101, 102].

The cultivars are very variable morphologically and genotypically [101].

Morphological description. The plants are perennial semi-shrubs. The young stems are herbaceous, later become lignified, usually green. The form of leaves is quite variable among cultivars, can be simple lanceolate leaves, or compound leaves with 3–7 leaflets, 10–40 cm long. The flowers are grouped in inflorescences of 5-20 flowers (up to 50 rare). The corolla is pentamerous, white, with purple veins. The fruit is a berry. The form and color can be greatly variable among cultivars. The fruit shape usually ovoid, more rare heart-shaped, elongate, cylindrical. The ripe fruits are yellow, light yellow or bright yellow with purple veins. More rare fruit color is bright orange [102] (**S3**, *sheet 8*).

Distribution: Native to South America. The plants are domesticated; the wild ancestors are not known. Distributed in Ecuador, Colombia, Peru, Chile, Sri Lanka, New Zealand, Western Australia, Spain, Israel, Morocco, Kenya, Japan, Hawaii, California [103, 104]. The plants are produced commercially. The main countries – producers are Peru, New Zealand, Australia [101].

Main commercial varieties are: Golden Spendour [105, 106], El Camino [106], Suma [106–109], Colossal [106, 110], Miski Prolific [106, 110], Toma [106, 110],

Sweet round [106, 11–113], Sweet Long [111–114], Golden Globe [106–115], Kawi [106, 107], Puzol [116], Valencia [117], Turia [106, 118], Pepo [119], Becky [119], Rosy [119], Hannah [119], Nitza [119], Tally [119], Lincoln Long [120], Golden Litestripe [120], Schmidt [120], Lima [116], Otavalo [116], Quito [116].
Uses: ethnic medicine [17], food, produced commercially [101].
Medicinal properties: anti-inflammatory [121], antidiabetic [122], antitumor [103, 104], antioxidant [104]. More information can be found in review [17].
Biochemical composition: flavonoids [17], phenolic compounds [17], carotenoids [123]. More information can be found in review [17].
Biotechnological achievements. The callus tissue [124-126] (**S2**, *link 1*), shoot regeneration [126–132] (**S2**, *link 2*), microclonal multiplication [129-131, 133] (**S2**, *link 5*) and genetic transformation [127, 128] (**S2**, *link 6–12*) were obtained.
Callus induction. The highest results of callus initiation were obtained from nodes/ leaves/ shoot apexes cultivated on media supplemented with 4.5 mg/L 2,4-D (66.86%) [125], from leaves cultivated on medium supplemented with 1 mg/L ZEA + 0.5 mg/L IAA (70%) [127], from shoot apexes cultivated on medium supplemented with 5 mg/L BAP (66.67%) [133] (**Table S1**, *sheet regeneration+callus+concentrat*, **S2**, *link 1*).
Shoot regeneration was achieved from shoot apexes cultivated on medium supplemented with 4–5 mg/L BAP (93.33%) [133] (**Table S1**, *sheet regeneration+callus+concentrat*, **S2**, *link 2*).
Shoot elongation was not conducted or not described (T**able S1**, *sheet regeneration+callus+concentrat*, **S2**, *link 3*).
Rooting was achieved on medium supplemented with 0.5–1 mg/L IBA [130, 131, 133] (**Table S1**, *sheet regeneration+callus+concentrat*, **S2**, *link 4*).
Microclonal multiplication was obtained from shoot apexes cultivated on medium supplemented with 4-5 mg/L BAP [133] (**Table S1**, *sheet regeneration+callus+concentrat*, **S2**, *link 5).*
Genetic transformation. The leaf or hypocotyl explants were transformed with *A. tumefaciens* LBA4404 or GV3101 strains [127, 128] (**S2**, *link 8*, *10*). The outcomes of experiments was obtaining of transient expression of transgenes and obtaining transformed plants with incorporated *nptII*, *als*, *gus*, and *SmMYB113* genes [127, 128] (**S2**, *link 7*, **S2**, *link 6–12*). The efficiency of transformation reached 20–70% [127] (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.8. *Solanum lycopersicoides* Dunal (Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [134].
Morphological description. The plants are herbs or small woody shrubs, which can reach up to 0.5–2.5 m height and up to 1 m in diameter. The stems are 8-10 mm in diameter, pubescent. The leaves are imparipinnate, 2.5–12 cm long and 1.2–6 cm wide, green, pubescent. The inflorescences are 7–15 cm long, composed

of 30–50 flowers. The flowers are 0.1–0.15 cm long. The corolla is 1.6–2 cm in diameter, bright yellow. The fruit are 1–1.2 cm in diameter, globose, the color is purple to black in maturity [134] (**S3**, *sheet 6*).

Distribution: in Peru, Chile [134].

Uses: can be used as a source of genes for improvement of cultivated tomatoes (resistant to race 1 strains of *Pseudomonas syringae* pv. *Tomato*, resistant to *Ralstonia pseudosolanacearum*) [135], resistance to *B. cinerea* and *A. solani* [136]; resistance to Cucumber mosaic virus (CMV), *Passalora fulva* and cold [137], salt tolerance [138], tolerance to arid conditions [139].

Medicinal properties: no information available.

Biochemical composition: rich in carotenoids and anthocyanins [140].

Biotechnological achievements. The callus tissue [141–145] and shoot regeneration [141–143] (**S2**, *link 6*), genetic transformation [146] was obtained.

Callus induction. Callus was initiated from protoplasts (3 mentioning). The used concentrations and combinations of growth stimulants were not mentioned in majority of articles (**Table S1**, *sheet regeneration+callus+concentrat.*). Callus tissue from protoplasts of interspecific hybrids *Solanum pennellii* x *Solanum lycopersicoides* and (*Solanum pennellii* x *Solanum lycopersicoides*) x *S. melongena* was obtained on the medium supplemented with 2 mg/L ZEA + 1 mg/L IAA [147] (**S2**, *link 1*). Also, callus was obtained from protoplasts of hybrid (*Solanum pennellii* x *Solanum lycopersicum*) x *Solanum lycopersicoides*, but the used concentrations and combinations of growth stimulants were not mentioned [148].

Shoot regeneration. The shoot regeneration was obtained from callus tissue initiated from protoplasts on medium supplemented with 3 mg/L ZEA + 0.1 mg/L GA_3 [143], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).

Shoot elongation was not described (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).

Rooting was not described (**Table S1,** *sheet regeneration+callus+concentrat.*, **S2**, *link 4*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 5*).

Genetic transformation was achieved from stem and leaf explants which were cultivated with *A. tumefaciens* pGS1166, pGV11, pGS1166 [146] (**S2**, *link 8–10*). The transformed plants with inserted *hyg*, *kan*, INFA2*β* genes were obtained [146] (**Table S1**, *sheet transformation total*) (**S2**, *link 7*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total***)**.

2.9. *Solanum sitiens* I.M.Johnst.
(Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [149].

Morphological description. The plants are small, erect shrubs, woody near the base, which reach up to 0.7 m height and 30–40 cm in diameter. The stems are green, glabrous, sometimes pubescent. The leaves are interrupted imparipinnate,

green, pubescent. The inflorescence is 3.5–9 cm long, composed of 10-50 flowers, bracteate. The flowers are 0.25 cm long, the corolla is 1.8-2.1 cm in diameter, yellow, pubescent abaxially. The fruits are berries, 1.1–1.3 cm in diameter, globose, pale yellow [149] (**S3**, *link 7*).

Distribution: in Chile [149].

Uses: can be used as a source of genes for improvement of cultivated tomatoes (has genes associated with drought and salinity tolerance) [150].

Medicinal properties: no information available.

Biochemical composition: no information available.

Biotechnological achievements. The callus induction and shoot regeneration were obtained for somatic hybrids *Solanum sitiens* x *Solanum tuberosum* and *Solanum peruvianum x S. sitiens* [151, 152] (**S2**, *link 1, 2*).

Callus induction was obtained from protoplasts [151, 152]. More details were not described [151, 152] (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*).

Shoot regeneration was obtained from protoplasts [151, 152] (**S2**, *link 2*). The regeneration efficiency was low - 1.32–14.89% [152] (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.10. *Solanum pennellii* Correll
(Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [153].

Morphological description. The plants are spreading perennial herb, woody near the base, can reach up to 1 m height and up to 0.4–0.5 m in diameter. The stems are pubescent. The yellowish-green leaves are interrupted imparipinnate, reach 3.5–13 cm long and 2.2–7.5 cm wide, pubescent. The inflorescences are 4–11 cm long, simple, composed of 6–15 flowers. The flowers are 0.5 cm long. The corolla is 2–2.1 cm in diameter, pentagonal, pubescent abaxially. The fruit are 1–1.3 cm in diameter, green, pubescent [153] (**S3**, *sheet 6*).

Distribution: in Peru, Chile [153].

Uses: can be used as a source of genes for improvement of cultivated tomatoes (resistant towards *Lepidoptera* – whitefly [154] and increased resistance to *Tuta absoluta* [155], drought tolerance [156], salt tolerance [157].

Medicinal properties: antioxidant activity [157].

Biochemical composition: no information available.

Biotechnological achievements. The callus tissue [144, 145, 158–162] (**S2**, *link 1*), shoot regeneration [144, 145, 158–162] (**S2**, *link 2*) and genetic transformation were

obtained [148].

Callus induction was obtained mainly from 12-day-old leaf explants mainly (**Table S1**, *sheet regeneration+callus+concentrat.*) on medium supplemented with 2.25 mg/L BAP + 0.186 mg/L NAA [159] or 0.5 mg/L KIN + 0.5 mg/L NAA [160] (**S2**, *link 1*). The callus tissue from leaf explants of interspecific hybrids *Solanum pennellii* x *Solanum lycopersicum* [161, 162], *Solanum pennellii* x *Solanum lycopersicum* x *Solanum pennellii* x *Solanum lycopersicoides* [147, 148] x *S. melongena* [147, 163] was obtained on medium supplemented with 2 mg/L ZEA + 1 mg/L IAA (**S2**, *link 1*). The efficiency of callus induction was not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration was obtained mainly from 12-day-old leaf explants mainly (**Table S1**, *sheet regeneration+callus+concentrat.*). In the majority of experiments was used BAP growth stimulant but efficiency of regeneration in the following experiments was not mentioned [161]. The highest efficiency of regeneration (more than 50%) was achieved on medium supplemented with 1mg/L ZEA + 0.4 mg/L IAA [144] (**S2**, *link 2*).

Shoot elongation in the majority of experiments was not conducted. In one publication it were mentioned that shoots were elongated on medium supplemented with 0.01 mg/L ZEA [144] (**Table S1**, *sheet regeneration+callus+concentrat.*), **S2**, *link 3*).

Rooting. In majority of experiments details of rooting initiation were not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*). In one publication it was mentioned that rooting was obtained on medium supplemented with 0.02 mg/L ZEA [144].

Microclonal multiplication in the majority of experiments was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 5*).

Genetic transformation. There is only one publication dedicated to genetic transformation [148]. *A. tumefaciens* C58C1 strain carrying out pGV3850 genetic vector was used in the experiment [148]. The outcome of experiments was obtaining transformed plants with *nptII* gene [148], (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.11.*Solanum chilense* (Dunal) Reiche
(Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [164].

Morphological description: The plants are perennial herbs, woody near the base, can reach up to 1 m height and up to 1 m in diameter. The stems are 8–12 mm in diameter at base, grayish, densely pubescent. The leaves are interrupted imparipinnate, 7–13 cm long, 2.5–6.5 cm wide, grayish green, densely pubescent. The primary leaflets in 5–7 pairs, narrowly elliptic. The Inflorescences are 6–20 cm long, usually once branched, composed of 20–50 flowers, ebracteate. The margins are white velvety pubescent. The flowers are 0.05-0.1 cm long. The corolla is 2–

2.6 cm in diameter, bright yellow, has medial darker midveins. The fruit are 1–1.5 cm in diameter, globose, greenish white with purple stripes at locule margins when ripe, pubescent [164] (**S3**, *sheet 8*).

Distribution: in Peru and Chile [164].

Uses: can be used as a source of genes for improvement of cultivated tomatoes (increased resistance to *Tuta absoluta* [155], resistance to Tomato yellow leaf curl virus (TYLCV) [165, 166], drought, high salinity, and low-temperature [150, 167], resistance to *Alternaria solani*, *Phytophthora infestans* and *Fusarium oxysporium* [168].

Medicinal properties: no information available.

Biochemical composition: no information available**.**

Biotechnological achievements. The callus tissue and shoot regeneration were obtained [144, 145, 169, 170]**.**

Callus induction was achieved from leaves [144, 145], protoplasts [170], cotyledons [169]. Also callus induction from protoplasts was obtained for hybrid *Solanum chilense x S. lycopersicum* [171]. The media supplemented with the following combinations and concentrations of growth stimulants were used: 2 mg/L BAP [145], 5 mg/L BAP + 2 mg/L NAA [170], 5 mg/L BAP + 5 mg/L NAA [169], 1 mg/L ZEA + 0.1 mg/L IAA [171].

Shoot regeneration was generated from callus which was initiated from upper mentioned types of explants. The highest percentage (more than 50%) of shoot regeneration was obtained from leaf explants cultivated on medium supplemented with 1 mg/L ZEA + 0.4 mg/L IAA [144], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation. The details of shoot elongation were mentioned only in one publication, for following purposes regenerated shoots were elongated on medium supplemented with 0.01 mg/L ZEA [144], (**Table S1**, *sheet regeneration+callus+concentrat.,* **S2**, *link 3*).

Rooting was achieved on medium supplemented with 0.02 mg/L ZEA [144], 0.2 mg/L IBA [169], 3 mg/L IAA [145], (**Table S1,** *sheet regeneration+callus+concentrat.*), **S2**, *link 4*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 5*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.12.*Solanum peruvianum* L.
(Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: peruvian tomato, wild tomato [621].

Morphological description. The plants are spreading or erect perennial herbs, sometimes small shrubs, can reach up to 0.5 m height and 1 m in diameter. The stems are grayish green, pubescent. The leaves are imparipinnate, 4–10 cm long and 1.6–7 cm wide, grayish green above, pubescent. The inflorescences are 8–16

cm long, composed of 8–20 flowers. The corolla is 1.7–2.3 cm in diameter, bright yellow. The fruits are 1–1.5 cm in diameter, globose, green or greenish white when ripe [172], (**S3**, *sheet 6*).

Distribution: in Peru, Chile [172].

Uses: can be used as a source of genes for improvement of cultivated tomatoes (plants resistant to Tomato yellow leaf curl virus (TYLCV) [165, 173], drought resistance [174], nematode resistance [175]; resistance to Parietaria mottle virus (PMoV) [176] and Tomato brown rugose fruit virus (ToBRFV), Tomato spotted wilt virus (TSWV) [177].

Medicinal properties: no information available.

Biochemical composition: anthocyanins [178].

Biotechnological achievements. The callus tissue [77, 144, 145, 151, 158, 160, 179-189] (**S2**, *link 1*), shoot regeneration [77, 144, 145, 151, 158, 180, 181, 183-192] (**S2**, *link 2*), microclonal multiplication [179] (**S2**, *link 3*), genetic transformation [146, 180, 193] (**S2**, *link 6–12*) and gene editing (**S2**, *link 13–18*) [180] were obtained. Also callus induction and regeneration was obtained for interspecific hybrids: *Solanum peruvianum* x *S. lycopersicum* [171, 181, 188–190], *Solanum peruvianum* x *S. tuberosum* [192], *Solanum peruvianum* x *Solanum sitiens* [151].

Callus induction was obtained from leaf explants mainly (13 mentioning). The age of explants in majority of publications was not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*). The callus induction was initiated on medium supplemented mainly with 2 mg/L 2,4-D + 1 mg/L BAP (4 mentioning), 0.5 mg/L TDZ + 0.5mg/L NAA(4 mentioning). The highest efficiency of callus induction (60–92%) was obtained on medium supplemented with 0.5 mg/L TDZ + 0.5 mg/L NAA or 2 mg/L KIN + 0.4 mg/L NAA (90%) (**S2**, *link 1*).

Shoot regeneration was initiated from leaf explants mainly (13 mentioning). In the majority of experiments the combination ZEA + IAA was used (9 mentioning). The following concentrations were used: 1 mg/L ZEA + 0.4 mg/L IAA, 3 mg/L ZEA + 0.02 mg/L IAA. The highest percentage of shoot initiation was obtained on medium supplemented with 0.175 mg/L IAA + 2.25 mg/L BAP – 97–100% [188], 1 mg/L KIN – 90–100% [184], 3 mg/L ZEA + 0.02 mg/L IAA – 46.2–85.7% [186], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).

Shoot elongation was not conducted in majority of experiments. In one article shoot elongation was obtained on medium supplemented with 0.01 mg/L ZEA [144], (**Table S1**, *sheet regeneration+callus+concentrat.*), (**S2**, *link 3*).

Rooting was not conducted in majority of experiments. In several articles rooting was obtained on medium supplemented with 0.02 mg/L ZEA [144], 3 mg/L IAA [145], 0.1 mg/L IAA [190] (**S2**, *link 4*). The highest rates of shoot regeneration were obtained on medium supplemented with 1 mg/L ZEA + 0.1 mg/L IAA – 22.2% [171], 1 mg/L ZEA + 0.4 mg/L IAA – more than 50% [144], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4*).

Microclonal multiplication was not conducted in majority of experiments or details were not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link*

5).

Genetic transformation was obtained mainly from leaf (12 mentioning) and stem explants (11 mentioning) (**Table S1**, *sheet transformation total,* **S2**, *link 8*). The way of transformation was mainly *Agrobacterium tumefaciens*-mediated transformation (27 mentioning), the electroporation was also used [193]. In the majority of experiments mainly *A. tumefaciens* carrying *pGV2260* genetic vectors were used (10 mentioning) (**S2**, *link 10*). The outcome of experiments were obtaining of transformed plants with incorporated transgenes: *ALS* [180], *cat* [193], *cry1A* [146], *hyg* [146], *INFA2β* [146], *nptII* [146, 180, 193]. *NptII* gene was used in the majority of experiments (24 mentioning) (**Table S1**, *sheet transformation total,* **S2**, *link 6*). The highest transformation efficiency reached 70–90% [146] and ≈80% [180].

Gene editing. There is only one publication where the results of gene editing were presented [180]. The 8–10-day-old cotyledons were transformed with *A. tumefaciens* LBA4404 and EHA105 strains [180]; plasmids or RNP complex were delivered into the protoplasts [692, 693]. AtCas9 [41] and Cas9 [692, 693] was used for editing [41] (**S2**, *link 3*). The results of editing and efficiency of editing were not mentioned in one publication [41] (**Table S1**, *sheet gene editing total*). In other publications were shown editing of following genes: *SpRDR6*, *SpSGS3*; *SpPR-1*, *SpProSys*, *SpMlo1* [692, 693], obtained knock-out mutants had following characteristics: wiry leaves, sterile phenotypes or changed seeds quantity, changed flower morphology, susceptibility towards Tomato yellow leaf curl virus [692, 693].

2.13. *Solanum habrochaites* S.Knapp & D.M.Spooner (Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [194].

Morphological description. The plants are sprawling shrubs or vines, can reach up to 6 m long. The stems are 0.2–0.5 cm in diameter, pubescent. The leaves are imparipinnate, 7–30 cm long and 3-16 cm wide, pubescent. The leaflets are elliptic 3–8.5 cm long and 1–5 cm wide. The inflorescences are 10–30 cm long, once-branched, composed with 20–30 flowers, bracteate. The bright yellow flowers midveins of the lobes are pubescent. The fruits are berries 1–1.5 cm in diameter, globose, pale green with the dark green stripes, pubescent [194] (**S3**, *sheet 6*).

Distribution: in Ecuador and Peru [194].

Uses: can be used as a source of genes for improvement of cultivated tomatoes resistant towards *Lepidoptera* – whitefly [195], Tomato brown rugose fruit virus (ToBRFV) [196].

Medicinal properties: no information available.

Biochemical composition: sesquiterpenes, terpenoids [197], methylketones [198].

Biotechnological achievements. The callus tissue [144, 145, 183], (**S2**, *link 1*), shoot regeneration were obtained [98, 145], (**S2**, *link 2*).

Callus induction was obtained mainly from leaf explants cultivated on medium supplemented with 2 mg/L BAP, 0.3 mg/L IAA, 3 mg/L KIN + 3 mg/L IAA (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*).
Shoot regeneration was obtained mainly on medium supplemented with 3 mg/L KIN + 0.3 mg/L IAA [183], 1 mg/L ZEA + 0.4 mg/L IAA [144], 2 mg/L BAP + 0.2 mg/L IAA [77] (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).
Shoot elongation was not conducted or details were not described (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).
Rooting was not conducted, or details were not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.14. *Solanum chmielewskii* C.M.Rick, Kesicki, Fobes & M.Holle (Clade I. Major clade *Potata*, Minor clade *Tomato)*

Local/common names: wild tomato [199].
Morphological description. The plants are spreading perennial herbs, woody near the base, can reach up to 1 m tall, and up to 1 m in diameter. The stems are 0.4–0.5 cm in diameter, light green, pubescent. The leaves are interrupted imparipinnate, which reach 5–12 cm long and 2–6 cm wide, have dark green color, pubescent. The inflorescences reach 3–9 cm, simple, composed of 2–7 flowers, pubescent. The flowers reach 0.05–0.1 cm long and 0.15–0.2 cm wide, lanceolate, pubescent. The yellow corolla is 1.6–2 cm in diameter. The fruits are berries, 1–1.3 cm in diameter, globose, the color is green, with a dark green stripe, pubescent [199] (**S3**, *sheet 7*).
Distribution: southern Peru to Sorata in northern Bolivia [199].
Uses: genetics studies (genes associated with fruit color) [200].
Medicinal properties: no information available.
Biochemical composition: no information available.
Biotechnological achievements. The callus tissue and shoot regeneration were obtained [145].
Callus induction. The callus tissue was obtained from 2–4-month-old leaf explants cultivated on medium supplemented with 2 mg/L BAP [145]. The efficiency of callus induction was not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*).
Shoot regeneration was obtained from 2–4-month-old leaf explants cultivated on medium supplemented with 2 mg/L BAP [145]. The efficiency of genetic transformation was not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).
Shoot elongation was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was achieved on medium supplemented with 3 mg/L IAA (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4*).
Microclonal multiplication was not described (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 5*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.15. *Solanum pimpinellifolium* L.
(Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato, currant tomato, cherry tomato [641].
Morphological description. The plants are annual/biennial, rare perennial herbs, erect when young, viny herbs when adult, can reach up to 3 m long. The stems are 8–11 mm in diameter, green, pubescent. The leaves are interrupted imparipinnate, the size is 4–12 cm long and 1.5–8 cm wide, green, pubescent. The inflorescences are 4–25 cm long, simple, composed of 7–30 flowers. The size of flowers is 0.05–0.1 mm long, pubescent. The corolla is 1.2–3 cm in diameter; the color is pale yellow or bright yellow. The fruits are bright red berries 1 cm in diameter, globose and glabrous [201] (**S3**, *sheet 7*).
Distribution: in Peru and Chile [201].
Uses: edible, can be used as a source of genes for improvement of cultivated tomatoes (resistant towards *Lepidoptera* – whitefly [154], *Pseudomonas syringae* pv. Tomato [202] and Tomato brown rugose fruit virus (ToBRFV) [203], Tomato yellow leaf curl virus (TYLCV) and Tomato yellow leaf curl Sardinia virus (TYLCSV) [204], *Ralstonia solanacearum* [125], resistance against two-spotted spider mite (*Tetranychus urticae* Koch) [205], salt tolerance [206], drought [207].
Medicinal properties: antioxidant activity [208].
Biochemical composition: no information available.
Biotechnological achievements. The callus tissue [145, 183, 185, 186, 209-213] (**S2**, *link 1*), shoot regeneration [145, 183–186, 209–211, 213–216] (**S2**, *link 2*), microclonal multiplication [179, 210, 211] (**S2**, *link 3*), genetic transformation [214, 217, 218] (**S2**, *link 7–12*), gene editing [214, 217, 219–221] were obtained.
Callus induction was achieved from leaf explants (7 mentioning, (**Table S1**, *sheet regeneration+callus+concentrat.*). The highest rates of callus induction were obtained on medium supplemented with 0.5 mg/L TDZ + 0.5 mg/L NAA, 66.6–100% [186], or supplemented with 2 mg/L BAP, 100% [186] or supplemented with 0.5 mg/L KIN [184] (**S2**, *link 1*).
Shoot regeneration was achieved mainly from leaf explants cultivated on media supplemented with different concentrations of ZEA + IAA (10 mentioning). The highest efficiency of shoot regeneration was obtained on medium supplemented with 0.5 mg/L IAA + 5 mg/L BAP, 95–100% [210], or 1 mg/L KIN, 100% [184], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).
Shoot elongation was not described in majority of articles, (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was not described in majority of articles (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted in majority of articles (**Table S1**, *sheet regeneration+callus+concentrat*). There are only 2 publications where microclonal multiplication was described [179, 210]. The following growth stimulants were used for shoot initiation 0.4 mg/L NAA + 2 mg/L KIN [179], 5 mg/L BAP [210] (**S2**, *link 4*).

Genetic transformation. The cotyledon explants were transformed with *A. tumefaciens* GV3101 strain (mainly). The following methods of transformation were used *Agrobacterium*-mediated [214]; agroinfiltration, VIGS [217]; agroinfiltration [218] (**S2**, *link 11*). The outcomes of experiments were obtaining of transformed plants [214, 217, 218], transient expression [217] (**S2**, *link 6*). The highest transformation efficiency reached 100% [217]. The genes which were incorporated into the plant genome: *Rx4CDS*, *nptII*, *Rx4*, *gus*, *hyg*, *gfp*, *cas*, *gus* (**Table S1**, *sheet transformation total*, **S2**, *link 7*).

Gene editing. The leaf and cotyledon explants were transformed with *A. tumefaciens* LBA4404 strain (mainly. In the experiments AtCas9 and Cas9 endonucleases were used (**S2**, *link 15*). The outcomes of experiments were obtaining knockout mutants with edited genes: *CLV3 – 6*, *SP5*, *CycB*, *DHNA*, *CLV3*, *GGH*, *GGP1*, *MULT (S)*, *O*, *Rx4*, *SP*, *SP5G*, *WF2*, *WUS*, *Y (***S2**, *link 19*). The editing of *CLV3* (6 mentioning) and *SP* (5 mentioning) was achieved in majority of experiments (**Table S1**, *gene editing total***)**. The following changes were observed in mutant plants: biochemical composition (5 mentioning), fruit size (6 mentioning), plant architecture (13 mentioning), plant physiology (1 mentioning), susceptibility to bacteria T3 strain Xv829 (1 mentioning), susceptibility to bacteria T3 strain Xv830 (1 mentioning), (**Table S1**, *gene editing total*, **S2**, *link 18*).

2.16. *Solanum cheesmaniae* (L.Riley) Fosber (Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [3].

Morphological description. The plants are perennial herbs, erect when young, vine-like when adult, can reach up to 4 m in long. The stems are 6–10 mm in diameter, green. Sympodial units 3-foliate; internodes 1.5–5(–8) cm long. The leaves are interrupted imparipinnate, the size is 3.5–14 cm long and 1.5–8.5 cm wide, light green or dark green, pubescent. The leaflets are ovate. The inflorescences reach up to 7.5 cm long, simple, composed of 11 flowers. The flowers are 0.05–0.1 cm long. The corolla is 1.8–2.8 cm in diameter, pentagonal, the color is yellow. The fruits are berries, 0.6–1.4 cm in diameter, globose, yellow or orange at when ripe, glabrescent [3] (**S3**, *sheet 7*).

Distribution. The plants are endemic and rare, in Galápagos Islands and Ecuador [3].

Uses: used as a source of genes for improvement of cultivated tomatoes (resistant to Tomato yellow leaf curl virus (TYLCV) [222], tolerance towards heavy metals

(Cu) contamination) [223]. ·
Medicinal properties: antioxidants [223].
Biochemical composition: phenolic compounds, flavonoids [223].
Biotechnological achievements. The callus induction and shoot regeneration were obtained [145, 183] (**S2**, *link 1, 2*).
Callus induction was initiated from leaf/stem or hypocotyl explants on medium supplemented with 2 mg/L BAP or 1 mg/L KIN + 1 mg/L IAA [145, 183] (**S2**, *link 1*). The efficiency of callus induction was not mentioned (**Table S1**, *sheet regeneration+callus+concentrat*).
Shoot regeneration was initiated from leaf/stem or hypocotyl explants on medium supplemented with 2 mg/L BAP or 3 mg/L KIN + 0.3 mg/L IAA [145, 183] (**S2**, *link 2*)**.** The efficiency of shoot regeneration was not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted or not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was obtained on medium supplemented with 3 mg/L IAA [145], 3 mg/L KIN + 1 mg/L IAA [183] (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).
Microclonal multiplication was not conducted or not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.17.*Solanum galapagense* S.C. Darwin & Peralta (Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [224, 225].
Morphological description. The plants are perennial herbs, erect when young, old plants are vine-like, can reach up to 3 m long. The stems are 10–12 mm in diameter, green, pubescent. The leaves are imparipinnate, 5–25 cm long and 2–17 cm wide, green, pubescent. The inflorescence is up to 10 cm long, usually simple, composed of 12 flowers. The flowers are 0.05–0.1 cm long. The corolla is 1.6–3.2 cm in diameter, 5-lobed, yellow. The fruits are 0.6–1.1 cm in diameter orange berries, globose, glabrescent or pubescent. Detailed description can be found on portal [224] (**S3**, *sheet 6*).
Distribution: Endemic to Ecuador (the Galapagos Islands), rare [224, 225].
Uses: the ripe fruits are edible (feed for local mockingbirds) [226], can be used as a source of genes for improvement of cultivated tomatoes, the plants are salt tolerant [195, 227] and resistant towards *Lepidoptera* – whitefly [195, 228], viruses [195].
Medicinal properties: no information available.
Biochemical composition: anthocyanins [229] and carotenoids [230].
Biotechnological achievements. Only the experiments dedicated to genetic transformation were conducted [124, 230].
Callus induction was not described (**Table S1**, *sheet*

regeneration+callus+concentrat.).
Shoot regeneration was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation. There are limited number of publications dedicated to genetic transformation [124, 230] (**S2**, *link 7–12*). The transformation was conducted *via A. tumefaciens*-mediated (RNAi) delivery [230]. The strain and genetic vector weren't mentioned [230]. The outcome of experiments was obtaining stable transformed plants with integrated *SgHKT1;1* and *SgHKT1;2* transgenes [230], (**Table S1**, *sheet transformation total).*
Gene editing was not conducted (**Table S1**, *gene editing total*).

2.18. *Solanum huaylasense* Peralta (Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [232].
Morphological description. The plants are sprawling perennial herbs; the stem is woody near the base. The plant can reach up to 1 m height and up to 1 m in diameter. The stem is 7–10 mm in diameter, green, puberulent. The leaves are interrupted imparipinnate, the size is 3.5–13 cm long, 1–6 cm wide, bright green, pubescent. The inflorescences are 12-30 cm long, composed of 8-30 flowers. The flowers are 0.05–0.1 cm long. The corolla is 1.8–2.5 cm in diameter, yellow. The fruits are 1–1.4 cm in diameter, globose berries, green with dark green or purple stripes when ripe. The fruits are sparsely pubescent [231] (**S3**, *sheet 8*).
Distribution: Peru, rare [232].
Uses: potentially edible, ethnomedicine, ornamental [233] can be used as a source of genes for improvement of cultivated tomatoes (resistance to *Bactericera cockerelli* [234], resistance to *Meloidogyne* spp. [235]).
Medicinal properties: treating fever, headaches, and stomachaches [233].
Biochemical composition: no information available.
Biotechnological achievements. The callus tissue and shoot regeneration were obtained [158] (**S2**, *link 1,2*).
Callus induction was initiated from leaf explants. The details were not described (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*).
Shoot regeneration was initiated from leaf explants on medium supplemented with 0.5 mg/L ZEA, the regeneration efficiency reached 52–96% [158] (**S2**, *link 2*).
Shoot elongation was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.19. *Solanum corneliomulleri* J.F.Macbr.
(Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [236].

Morphological description. The plants are spreading or erect perennial herbs, woody near the base, can reach up to 1 mm height and to 1 m in diameter. The stems are 7–12 mm in diameter, green, pubescent. The leaves are interrupted imparipinnate, 3.5–13 cm long and 1.5–6.5 cm wide, green, pubescent. The leaflets are elliptic. The inflorescences more often are bracteate, 4–12 cm long, composed with 8–16 flowers. The yellow corolla is 1.5–2.4 cm in diameter. The fruits are 0.9 –1.3 cm in diameter, globose, green or greenish white with green or purple stripes pubescent [232] (**S3**, *sheet 8*).

Distribution: in Peru [236]. ·

Uses: increased resistance to *Tuta absoluta* [155], resistance to Parietaria mottle virus (PMoV) [176].

Medicinal properties: sedative and anxiolytic in laboratory experiments [237].

Biochemical composition: no information available.

Biotechnological achievements. The callus initiation and shoot regeneration were obtained [158, 183] (**S2**, *link 1,2*).

Callus induction was achieved from hypocotyls cultivated on medium supplemented with 3 mg/L IAA [158], and from stems cultivated on medium supplemented with 3 mg/L KIN + 3 mg/L IAA [183], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*).

Shoot regeneration was achieved from leaf explants on medium supplemented with 0.5 mg/L ZEA, the regeneration efficiency in these variants of experiments reached 68.75–93.75% [158]. Also, regeneration was obtained from hypocotyls and stems cultivated on medium supplemented with 3 mg/L KIN + 0.3 mg/L IAA [183], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 2*).

Shoot elongation was not conducted, (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was achieved on medium supplemented with 3 mg/L KIN + 1 mg/L IAA [183], (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 4*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1,** *sheet gene editing total*).

2.20. *Solanum arcanum* Peralta
(Clade I. Major clade *Potata*, Minor clade *Tomato*)

Local/common names: wild tomato [238].

Morphological description. The plants are spreading or erect perennial herbs, woody near the base, can reach up to 1 m height and up to 1 m in diameter. The

stems are 7–12 mm in diameter at base, green, glabrous. The leaves are interrupted imparipinnate, the size is 5–15 cm long and 2.5–7 cm wide, green to pale green, glabrous or short pubescent. The primary leaflets are elliptic to broadly elliptic. The inflorescences are 6–20 cm long, simple, composed of 5–20 flowers, ebracteate, glabrous. The flowers are 0.5–0.7 cm long and 0.15–0.2 cm wide, lanceolate, glabrous or pubescent. The corolla is 1.8–2 cm in diameter, pentagonal, yellow. The fruits are 1–1.4 cm in diameter, globose, green with the dark green stripes, can change to purple at maturity, glabrous [238] (**S3**, *sheet* 8).
Distribution: endemic in Peru [238].
Uses: can be used as a source of genes for improvement of cultivated tomatoes **(**increased resistance to *Tuta absoluta* [155], resistance to Tomato yellow leaf curl virus (TYLCV) [165], more tolerant to suboptimal temperatures [239].
Medicinal properties: no information available.
Biochemical composition: no information available**.**
Biotechnological achievements. The callus tissue and shoot regeneration were obtained [158] (**S2**, *link 1, 2*).
Callus induction was obtained from leaf explants [158]. There are no more detailed information (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was obtained from leaf explants on medium supplemented with 0.5 mg/L ZEA [158] (**S2**, *link 2*). The regeneration efficiency reached 4–100% [158], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.21.*Solanum abutiloides* (Griseb.) Bitter & Lillo (Clade II. Major clade *Brevantherum*)

Local/common names: dwarf tamarillo [240].
Morphological description. The plants are shrubs or trees, reaching up to 1-3 m hight, unarmed. The older stems bark is yellowish brown, but the color of the young branches is yellowish green. The leaves are simple, the blades can reach 7–27 cm long and 6–12 cm wide, ovate, dark green, pubescent adaxially. The inflorescences are 5–14 cm long, formed by 25–60 flowers. The calyx is 7–9.5 mm long, lobed, pubescent abaxially. The corolla is 1.5–1.8 cm in diameter, sometimes pubescence, white to bluish white (more usually light yellow). The stamens are glabrous, the anthers are yellow. The fruits are fleshy berries, about 1 cm in diameter, yellow when ripe [240] (**S3**, *sheet 5*).
Distribution: in Argentina and Bolivia is endemic plant [241], Kenya, South Africa, Swaziland [17].

Uses: ornamental, ethomedicine, ethnic food [17].
Medicinal properties: anti-fungal [241, 242]. More information can be found in review [17].
Biochemical composition: steroidal saponins [17], steroidal alkaloids [17], sesquiterpenes, sterols [17]. More information can be found in review [17].
Biotechnological achievements. The callus tissue and shoot regeneration were obtained [243] (**S2**, *link 1, 2*).
Callus induction was initiated from hypocotyl-derived protoplasts (hypocotyls were 2–3-week-old) on medium supplemented with 1 mg/L KIN (**S2**, *link 1*). The effectiveness of callus induction was 34.8% [243], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was initiated from protoplasts from callus, obtained from hypocotyl-derived protoplasts on medium supplemented with 2 mg/L ZEA (**S2**, *link 2*). The regeneration efficiency was 59% [243], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was initiated on medium without addition of growth stimulants [243], (**Table S1**, *sheet regeneration+callus+concentrat.*) (**S2**, *link 3*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.22. *Solanum betaceum* (*Cyphomandra betacea*) Cav. (Clade II. Major clade *Cyphomandra*)

Local/common names: tomarillo, tomato tree, tomate de arbol, tomate de arvore [244].
Morphological description. The plants are small trees, can reach up to 2–7 m height. The stems are puberulent. The leaves are simple, the blades are 7–40 cm long and 6–35 cm wide, ovate, puberulent. The inflorescences are 2.5–15 cm long, formed with 10–50 flowers. The corolla is 2–2.5 cm in diameter, glabrous abaxially and adaxially. The fruits are 4–10cm long, ovoid, the color of fruits is yellow-orange/red/purple, glabrous [244] (**S3**, *sheet 5*).
Distribution: native in Bolivia, Colombia, Chile, Ecuador, Peru, or Puerto Rico. Introduced into Asia, Australia, India, Sri Lanka, Brazil, Philippines, Costa Rica, Puerto Rico, New Zealand, Malaysia, Haiti, Italy, Jamaica, Mexico, United States, Ghana, Ethiopia, Zaire, Uganda, Zimbabwe, Spain, Portugal, France, Italy, Netherlands, Canary Islands [244]. The countries – biggest commercial producers of fruit are Ecuador, Colombia and Australia, New Zealand Colombia, Peru, and Ecuador, Australia, New Zealand [245].
Uses: food (fresh salads, preserved form, sweets, jellies, cakes, drinks, meat dishes). Produced commercially [244].
Cultivars: Gigante amarillo (Giant yellow) [246], Morado Puntón, Large Red and Oratia Red [247]; Común, Híbrido, Injerto, Holandés [248]; Ecuadorian Orange,

Goldmine, Inca Gold, Rothamer, Ruby Red, Solid Gold, Yellow [249].

Medicinal properties: antioxidant [245, 250], antinociceptive [154], anti-inflammatory [154], antibacterial [154], antifungal activity [154], prebiotic [154], reduce symptoms in Alzheimer's disease [154], treating gastrointestinal diseases [154], anticancer, antiobesity [251]. More information can be found in review [17].

Biochemical composition: sesquiterpenes [17], monoterpenes [17], flavonoids [17], phenolic compounds [17], carotenoids [245]. More information can be found in review [17].

Biotechnological achievements. The callus tissue [252–262] (**S2**, *link 1*), shoot regeneration [124, 252, 258, 259, 263–270], microclonal multiplication [263, 269, 271, 272] (**S2**, *link 3*) were obtained.

Callus induction. The leaf explants mainly (25 mentioning, (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 1*) were cultivated on medium supplemented with 2,4-D (13 mentioning). The highest percentage of callus induction (100%) was obtained when leaf explants were cultivated on medium supplemented with 5 mg/L 2,4-D [258] or 1 mg/L BAP [266] (**S2**, *link 1)*.

Shoot regeneration The leaf explants mainly (25 mentioning, (**Table S1**, *sheet regeneration+callus+concentrat.*) were cultivated on medium supplemented with BAP (11 mentioning). The highest results of shoot regeneration were obtained when leaf explants were cultivated on medium supplemented with 5 mg/L NAA – 100% [258], 0.2 mg/L BAP – 90% [269], 0.2 mg/L GA_3 – 90% [269], 0.2 mg/L NAA – 90 % [269] (**S2**, *link 2*).

Shoot elongation in majority of experiments was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*, **S2**, *link 3*).

Rooting was conducted on medium without addition of growth stimulants (5 mentioning) (**S2**, *link 3*), in majority of experiments details of rooting were not described (**Table S1**, *sheet regeneration+callus+concentrat*).

Microclonal multiplication in majority of experiments was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*). In several publications the micro shoots were multiplicated on medium supplemented with 0.2–2 mg/L BAP [263], 0.2 mg/L NAA or 0.2 mg/L GA_3 [269] (**S2**, *link 4*).

Genetic transformation. There are only several publications dedicated to genetic transformation [124, 252, 253]. *A. tumefaciens* LBA4404 strain was used mainly in experiments. The following genes were introduced into plant tissues: *NEP-TC*, *nptII*, *als*, *gus* (**Table S1**, *sheet transformation total*), **S2**, *link 7*). In the majority of experiments, *nptII* gene was used (**Table S1**, *sheet transformation total*). The outcomes of experiments were obtaining transgenic plants [124, 252, 253]. The efficiency of transformation (100%) was mentioned only in one publication [253].

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.23. *Solanum mammosum* L.

(Clade II. Major clade *Leptostemonum*, Minor clade *Acanthophora*)

Local/common names: nipplefruit, cow's udder, beringela [273].

Morphological description. The plants are shrubs, which can reach up to 0.5–2 m height, has single stem up to 4 cm in diameter, usually armed. The young stems are green or purple, pilose. The leaves are simple, the blades are 8–17 cm long, 9–20 cm wide, abaxial surfaces is puberulent. The inflorescences are lateral, up to 2 cm long, formed with 2–10 flowers, pilose, unarmed. The flowers are 5-merous. The corolla is 1–2 cm in diameter, pale bluish purple. The fruits are spherical berries, 3.5–5.5 cm in diameter, bright yellow or orange-yellow when ripe [273] (**S3**, *link 5*).

Distribution: native in South America and possibly the Caribbean islands. Distributed in southern Mexico, Panama, Bolivia, Guyanas. Rare and sporadic in the east Brazil. Introduced in Africa, India [273].

Uses: ethnomedicine (locally Philippines), ethnic food (Philippines), detergent decorative, insecticidal [273].

Medicinal properties: prebiotic (in laboratory experiments with *Lactobacillus acidophilus*) [274], antifungal (against *T. mentoagrophytes* and *C. albicans in vitro* experiments) [275], antibacterial (against *P. aeruginosa*) [275], antioxidant [276, 277], antidiabetic [277], antiviral (against SARS-CoV-2 in laboratory experiments) [278].

Biochemical composition: steroidal glycosides [274], flavonoids [277], phenols [277], alkaloids [277], carotenoids [277].

Biotechnological achievements. The callus tissue [146, 279-281] (**S2**, *link 1*), shoot regeneration [146] (**S2**, *link 2*) and genetic transformation [146, 282] (**S2**, *link 6-12*) were obtained.

Callus induction was obtained from anthers and embryos [146] or from protoplasts on media supplemented with 2 mg/L KIN + 0.5 mg/L 2,4-D [281], 1 mg/L 2,4-D + 0.1 mg/L KIN [280], 2 mg/L KIN + 0.5 mg/L NAA [279], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration. The details were not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting. The details were not described (**Table S1,** *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation was conducted with stems and leaves cultivated with *A. tumefaciens* pGV11-21 strain with pGV2260 genetic vectors [146] (**S2**, *link 10*). As result transformed plants with incorporated genes *nptII* and *INFA2β* were obtained and the efficiency of transformation reached 1.25% [146]. Also, different strains of *A. rhizogenes* were used for transformation leaf explants [282]. As a result, hairy root lines were obtained [282]. The efficiency of transformation

reached 15,47–21.43% in experiments with *A. rhizogenes* [282], (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.24. *Solanum myriacanthum* Dunal
(Clade II. Major clade *Leptostemonum*, Minor clade *Acanthophora*)

Local/common names: himalayan nightshade, Kota-Bengena [283].
Morphological description. The plants are erect shrubs, can reach up to 0.5–1.5 m height. The stems are pilose; have spines. The leaves are simple, the blades are 4–15 cm long and 4–14 cm wide, ovate, the adaxial side of leaf blade is pubescent. The inflorescences are 0.5 cm long, unbranched, with 1–5) flowers. The corolla is 1.7–2.5 cm in diameter, yellowish green. The fruits are 2–3 cm in diameter, globose, yellow, glabrous [283] (**S3**, *link 5*).
Distribution: in Mexico, Guatemala, El Salvador, Honduras, Nicaragua. Also sporadic in Cuba [283].
Uses: ethnomedicine (in India) [284].
Medicinal properties: antihelminth effect for humans, analgetic, antimalaria, effect against bovine filariid, *Setaria cervi* in experiments, antihelminth effect in experiments with laboratory rats [284].
Biochemical composition: steroidal alkaloid glycosides [285].
Biotechnological achievements. There are no achievements that were obtained (**Table S1**, *sheet regeneration+callus+concentrat.*).
Callus induction was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.25. *Solanum aculeatissimum* Jacq.
(Clade II. Major clade *Leptostemonum*, Minor clade *Acanthophora*)

Local/common names: goat nightshade, Dutch eggplant, love-apple nightshade [286].
Morphological description. The plants are herbs or small shrubs. The stems are erect, can reach 1–2 m height, armed with spines. The leaves are ovate, 6–15 cm long and 4–15 cm wide. The racemes inflorescences are axillary, formed with 1–4 flowers. The calyx is campanulate, 5.5 cm long. The corolla is white, 4 mm long and 14 mm wide, pubescent as on calyx. The berries are pale yellow, globose, 2–3 cm in diameter [286] (**S3**, *sheet 5*).
Distribution: spread in Brazil; sporadically distributed in Africa and in Asia

[286].
Uses: ethic medicine (only in Africa), the fruits are toxic [286].
Medicinal properties: anti-inflammatory, anthelmintic, anticancer [287-289]. More information can be found in review [17].
Biochemical composition: steroidal saponins and steroidal alkaloids [17]. More information can be found in review [17].
Biotechnological achievements. The callus tissue [10, 11, 290–293] (**S2**, *link 1*), shoot regeneration [10, 11, 290, 292, 293] (**S2**, *link 2*) and genetic transformation [146, 294] (**S2**, *link 6–12*) were obtained.
Callus induction was obtained from leaves and stems cultivated on medium supplemented with 1 mg/L NAA [11]; from protoplasts cultivated on medium with 1 mg/L BAP + 0.2 mg/L NAA [290] or 0.2 mg/L 2,4-D + 0.5 mg/L ZEA + 1 mg /L NAA [10]. The highest efficiency of callus initiation (100%) was obtained from stems cultivated on medium supplemented with 1 mg/L NAA [11], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was achieved from 4–6-week-old leaves cultivated on medium supplemented with 2 mg/L BAP + 0.1 mg/L NAA, regeneration efficiency reached 79.33% [292], from protoplasts cultivated on medium supplemented with 2 mg/L ZEA + 0.1 mg/L IAA, regeneration efficiency was 80% [10] and on medium with addition of 0.5 mg/L BAP + 1 mg/L ZEA, the efficiency of shoot regeneration was 65% [290], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was achieved on medium without addition of growth stimulants [292], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was obtained on medium supplemented with 0.1–1 mg/L IAA [292, 293], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was conducted with stems and leaves cultivated with *A. tumefaciens* pGV11-21 strain with pGV2260 genetic vectors [146]. As result transformed plants with incorporated genes *nptII* and *INFA2β* were obtained and the efficiency of transformation reached 70–90% [146] (**S2**, *link 7*). Also, seedlings were cocultivated with *A. rhizogenes* ATCC 15834 strain. As result, hairy root lines with incorporated *rolB* gene were obtained [294], (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, sheet *gene editing total*).

2.26. *Solanum stramoniifolium* Jacq.
(Clade II. Major clade *Leptostemonum*, Minor clade *Lasiocarpa*)

Local/common names: coconilla [295].
Morphological description. The plants are erect or spreading perennial shrubs, can reach up to 1–2 m high. The young stems are green. The stems of adult plants are glabrescent or glabrous, can have prickles or be unarmed. The leaves are

simple, the blades are 20–30 cm long and 18–25 cm wide, ovate, pubescent adaxially. The inflorescences are 0.5–2.5 cm long. The flowers and the calyx are broadly campanulate, 3–6 mm wide, 2.5–5 mm long, abaxially pubescent. The purple corolla is 1.5–2.5 cm in diameter, 7–12 mm long, pubescent abaxially, glabrous adaxially. The anthers are yellow. The fruit is globose, orange or red berry, pubescent. There are 3–15 fruits per inflorescence, the size is 1.2–2.4 cm in diameter [295] (**S3**, *sheet 4*).

Distribution: northern part of South America. Occasionally cultivated in Colombia and Peru [295].

Uses: ethic food [295].

Medicinal properties: can have antioxidant properties according to biochemical composition, antibacterial (against *Enterococcus faecalis*, *Acinetobacter baumannii*, *Escherichia coli*, *Escherichia coli ESBL*, *Klebsiella pneumoniae*, *Klebsiella pneumoniae ESBL*, *Pseudomonas aeruginosa*) [296].

Biochemical composition: flavonoids [296].

Biotechnological achievements. There is only one publication dedicated to callus induction and regeneration [243].

Callus induction was achieved from leaf-derived (3-week-old) protoplasts cultivated on medium which was supplemented with 1 mg/L KIN. The efficiency of callus induction was 45.2% [243], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration was achieved from callus obtained from leaf-derived (3-week-old) protoplasts cultivated on medium supplemented with 2 mg/ ZEA + 0.1 mg/L IAA. The shoot regeneration efficiency reached 91.8–98.8% [243], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was achieved without growth stimulants [243], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.27. *Solanum sessiliflorum* Dunal
(Clade II. Major clade *Leptostemonum*, Minor clade *Lasiocarpa*)

Local/common names: cocona [297].

Morphological description. The plants are erect or spreading, perennials herbs, can reach up to 1–2 m height. The stems are pubescent; usually unarmed. The leaves are simple, the blades are about 25–45 cm long and 21–39 cm wide, ovate. The inflorescences are 3–10 cm long, with 6–16 flowers. The flowers with the calyx campanulate, can reach 5 mm wide, 2 mm long, pubescent abaxially. The corolla is 1.8-2.8 cm in diameter, pubescent abaxially, glabrous adaxially. The anthers are yellow. The fruits are globose orange-red berries, 2–9 cm in diameter [297] (**S3**, *sheet 4*).

Distribution: native to Southern America: Peru, Colombia, Bolivia, Mexico, occasionally cultivated in Venezuela [297].
Uses: ethic food, ethnomedicine [297].
Medicinal properties: antioxidant, antitumor [298], anti-inflammatory [299].
Biochemical composition: steroidal alkaloids [17], monoterpenes [17], flavonoids [17], sterols [17], phenolic compounds [17]. More information can be found in review [17].
Biotechnological achievements. The callus tissue [300–303] (**S2**, *link 1*), shoot regeneration [300, 302, 304] (**S2**, *link 2*) and microclonal multiplication [305, 306] (**S2**, *link 3*) were obtained.
Callus induction was obtained mainly from hypocotyl explants (16 mentioning) cultivated on medium supplemented with 0.2 mg/L BAP + 0.1 mg/L NAA [300]. The rates of callus induction were different among used cultivars (28-100%) [300], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was obtained mainly from hypocotyl explants (16 mentioning) cultivated on medium supplemented with 0.2 mg/L BAP + 0.1 mg/L NAA. The rates of shoot regeneration were 0–56% [300], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was achieved on media supplemented with 0.1 mg/L IAA or without growth stimulants [305], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was achieved on media supplemented 0.64 mg/L KIN + 0.01 mg/L IAA [305], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.28. *Solanum pseudolulo* Heiser
(Clade II. Major clade *Leptostemonum*, Minor clade *Lasiocarpa*)

Local/common names: no information.
Morphological description. The plants are erect or spreading perennials, reach up to 0.5–1.5 tall. The stems are pubescent, have prickles. The leaves are simple, small, blades reach 9–30 cm long and 7–25 cm wide. The leaves have prickles along the petiole, midrib, and lateral veins. The inflorescences are 0–0.5 cm long, composed of 6–9 flowers. The flowers are broadly campanulate. The corolla is 2–3.5 cm in diameter, 12–10 mm long, white. The fruits are 2–4 cm in diameter, globose, orange or yellow-orange when ripe. The fruits are hirsute when young and glabrous when ripe [307, 308] (**S3**, *sheet* 4).
Distribution: in Colombia, Ecuador [307].
Uses: ethnic food (the fruits are consumed raw) [307].
Medicinal properties: not investigated [307].
Biochemical composition: not investigated [307].
Biotechnological achievements. There is still no achievements in biotechnology of

this species.
Callus induction was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.29. *Solanum quitoense* Lam.

(Clade II. Major clade *Leptostemonum*, Minor clade *Lasiocarpa*)

Local/common names: true lulo, naranjilla [309].
Morphological description. The plants are erect perennial herbs or shrubs, can reach up to 1–3 m tall. Stems are pubescent, unarmed or with prinkles. The leaves are simple, the blades are 13–50 cm long and 11–40 cm wide, ovate, pubescent. The flowers with the calyx campanulate. The corolla is 3–5 cm in diameter, 20–25 mm long, white. There are 1–4 fruits per inflorescence, 3–6.5 cm in diameter, globose, yellow-orange with green flesh, hirsute when young, glabrescent when ripe [309] (**S3**, *sheet 4*).
Distribution: native in Colombia and Ecuador; recently introduced into Costa Rica and Panama [309].
Uses: ethic food (juice, salads, sauces) [309].
Medicinal properties: antioxidant [309].
Biochemical composition: carotenoids, polyphenols [309].
Biotechnological achievements. The callus tissue [310] (**S2**, *link 1*), shoot regeneration [306, 311–-313] (**S2**, *link 2*), microclonal multiplication [306, 311–313] (**S2**, *link 3*) were obtained.
Callus induction. The 4-week-old shoot apexes and hypocotyls were used mainly in experiments [311]. The details of callus initiation were mentioned only in two articles, callus was initiated from cotyledon explants cultivated on medium supplemented with 6 mg/L NAA + 7 mg/L KIN (80% of callus induction) and on medium supplemented with 2mg/L NAA (percentage of callus induction was not mentioned) (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration The 4-week-old shoot apexes and hypocotyls were used mainly [311]. Various combinations and concentrations of growth stimulants were used: 6 mg/L BAP, 6 mg/L NAA, 9.3 mg/L NAA, 0.1 mg/L IAA, 20 mg/L KIN + 0.1 mg/L IAA (see Table S1). But the regeneration efficiency was mentioned only in two publication [311, 313]. The best results of shoot regeneration (25%) were obtained when cotyledon explants were cultivated on medium

supplemented with 6 mg/L NAA [313] (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.30. *Solanum candidum* Lindl.
(Clade II. Major clade *Leptostemonum*, Minor clade *Lasiocarpa*)

Local/common names: fuzzyfruit nightshade, naranjilla silvestre [314].
Morphological description. The plants are erect or spreadingly branched, perennials, up to 0.7–2 m height. Young stems are densely pubescent; have prickles. The leaves are simple, the blades are 7–50 cm long and 7–30 cm wide, elliptic or ovate, pubescent adaxially. The inflorescences are 0.5–2.5 cm long, formed by 5–20 flowers. The flowers and the calyx are campanulate, unarmed. The corolla is 2.5–4 cm in diameter, white, the lobes are 8–15 mm long and 5–9 mm wide, pubescent abaxially. The fruits are 1–4 per inflorescence, 2–4.5 cm in diameter, globose, orange or orange-red berries, densely hirsute [314] (**S3**, *sheet 4*).
Distribution: Mexico, Guatemala, El Salvador, Colombia, Peru, Chile, rarer in Central America [314].
Uses: potentially edible [314].
Medicinal properties: not investigated.
Biochemical composition: not investigated.
Biotechnological achievements. The shoot regeneration and microclonal multiplication were obtained [306] (**S2**, *link 2, 3*)**.**
Callus induction was not described [306], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was achieved from leaf explants cultivated on medium supplemented with 20 mg/L KIN + 0.01 mg/L IAA [306], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted, (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not described, (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was achieved from shoot apexes cultivated on medium supplemented with 0.002 mg/L NAA [306], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total).*

2.31. *Solanum lasiocarpum* Dunal
(Clade II. Major clade *Leptostemonum*, Minor clade *Lasiocarpa*)

Local/common names: tomate hutan [315].

Morphological description. The plants are herbs or subshrubs, erect or spreading, reach up to 1–1.5 m height, armed, pubescent with pale yellow, hairs. The stems and the branches are erect, have prickles. The leaf blades are ovate, 10–20 cm long and 8–18 cm long, pubescent with prickles along veins on both surfaces. The corolla is white, the size is 1–1.2 cm long and 2 cm. wide. The berries are orange, globose, 2 cm in diam., hirsute [315] (**S3**, *sheet 4*).
Distribution: in India, China, Malaysia, Indonesia, Philippines, New Guinea [315].
Uses: ethnomedicine, ethnic food (in Indonesia the fruits are used for preparation sauces [316].
Medicinal properties: antitumor, anti-inflammatory, antipyretic, anti-allergy, anti-fertility, hypoglycemic, anti-histamine, antioxidant, antiviral, analgesic, anti-ulcerogenic, nephroprotective, antidiabetic, immuno-secretory, cardiovascular, anti-platelet aggregation, anticancer, and hepatoprotective activities [317]; antibacterial (against *Staphylococcus haemolyticus*) [317, 318].
Biochemical composition: phenols, flavonoids and anthocyanins [317].
Biotechnological achievements. Only micropropagation in sterile conditions was performed [319].
Callus induction was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was not conducted (**Table S1,** *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Micropropagation was obtained from embryos cultivated on medium without addition of growth stimulants *Solanum aethiopicum* x *S. lasiocarpu* [319], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.32. *Solanum sisymbrifolium* Lam.
(Clade II. Major clade *Leptostemonum*, Minor clade *Sisymbriifolium*)

Local/common names: sticky nightshade, fire-and-ice, cardo, comida de vibora, espina colorada, guidilla de campo, putui, revienta caballos, tomatillo de campo, Red Buffalo-Bur [320].
Morphological description. The plants are annual herbs, armed, pubescent. The stems are erect, with yellow or orange-yellow prickles. The leaves are simple, ovate, 4.5–10 cm long and 2.5 cm wide, pubescent, often armed along main veins abaxial and adaxial, lobed. The inflorescences are axillary racemes. The calyx is cup-shaped, 1 cm long. The corolla is purplish or white, 1.6–3.5 cm, hairy. The calyx enlarged, prickly. The fruit is bright red berry, subglobose, 1–2 cm in diameter [320] (**S3**, *sheet 3*).

Distribution: Brazil, Argentina, Uruguay, Paraguay, native to South America [320].
Uses: ethnic food [321], trap for potato cyst nematodes [322], ethnomedicine [320].
Medicinal properties: contraceptive [321], diuretic [321], analgesic [321], contraceptive [321], anti-syphilitic [321], hepatoprotective [321], emmenagogue [321], fertility and hysteria [321], cardiovascular [323], antidiarrheal [324], hypertensive [323], antibacterial *Bacillus subtilis*, *B. coagulans*, *Escherichia coli*) [325], antioxidative [326], anticonvulsant, CNS depressant [327], molluscicidal [321], analgesic [324]. More information can be found in review [17].
Other properties pesticidal and insecticidal [322].
Biochemical composition: glycoalkaloids [321], steroidal saponins [17], steroidal alkaloids [17], flavonoids [17], sterols [17]. More information can be found in review [17].
Biotechnological achievements. The callus induction [11, 146] (**S2**, *link 1*), shoot regeneration [11] (**S2**, *link 2*) and genetic transformation [146] (**S2**, *link 6–12*) were obtained.
Callus induction was obtained from stems and leaves cultivated on medium supplemented with 3 mg/L BAP [146]. The callus induction for *S. melongena* and *S. sisymbriifolium* somatic hybrid was obtained stem-derived protoplasts on medium supplemented with 0.1 mg/L 2,4-D + 1 mg/L BAP [11], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was mentioned only for *S. melongena* L. and *S. sisymbriifolium* somatic hybrid generated from callus initiated from stem- derived protoplasts on medium supplemented with 1 mg/L ZEA [11], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was performed without growth stimulants [11], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was described only in one publication [146]**.** The transformation was achieved when the leaf or stem explants were cocultivated with *A. tumefaciens* pGV11-21 strain (the genetic vector carried out incorporated kan and *INFA2β* genes [146]. As a result, the stable transformed plants were obtained, the transformation efficiency was low (1.25%) [146], (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.33.*Solanum grandiflorum* Ruiz & Pav.
Clade II. Major clade *Leptostemonum*, Minor clade *Crinitum*)

Local/common names: no information.
Morphological description. The plants are shrubs or trees, can reach up to 1–15 m height. The stem is angular. The color of bark is golden yellow. The leaves are 2–9 cm long; the blade is 10–35 cm long and 11–26 cm wide, ovate. The flowers are

9–20 mm long. The calyx is 14–18 mm long. The adaxial surface is glabrous. The corolla is light grey/light yellow/ochreous. The fruits are 3.5–5.5 cm in diameter, globose, light green/yellow at maturity, glabrous [328] (**S3**, *sheet 2*).
Distribution: South America (Bolivia, Peru, Ecuador, Colombia) [328].
Uses: ethic food, medicine [328]. The plants have genes associated with salt tolerance; *Lepidoptera* and virus resistance [206].
Medicinal properties: no information available.
Biochemical composition: no information available.
Biotechnological achievements. There are no achievements obtained (**Table S1**, *sheet regeneration+callus+concentrat.*).
Callus induction was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.34. *Solanum torvum* Sw.
(Clade II. Major clade *Leptostemonum*, Minor clade *Torva*)

Local/common names: turkey berry, pea eggplant, [329].
Morphological description. The plants are perennial erect shrubs or small trees, can reach 0.8–3 m height, rare up to 5 m height, the stem is tomentose. The leaves are 9–13 cm long and 5–10.5 cm broad, ovate, pubescent. The flowers are pale white, grouped in paniculate cymes inflorescences. The calyx is pubescent. The fruits are globose berries, 8–12 mm in diameter, yellow [329] (**S3**, *sheet 2*).
Distribution: Brazil, Colombia, Caribbean, Central America, Mexico, tropical Africa, Asia, Australia, Hawaii, Guam, American and Western Samoa, Fiji, Hawaii, New Caledonia, Palau, Tonga) [17].
Uses: ethnic food (soups and sauces), ethnomedicine, rootstock for *S. melongena* [329].
Medicinal properties: antibacterial, anti-platelet aggregation [330], pesticide [331], analgestic [331], anticancer [332–334], antifungal, antimicrobial [335–337], antiulcerogenic [338], antiviral [339], anticonvulsant [340], antihypertensive [338, 341], antinephrotoxicity [342, 343], antioxidants [344-346], anti-inflammatory [347], antidepressant [348, 349], antiplasmodial [350], antidiabetic [351-353], antihelminthic [354]. More information can be found in review [17].
Biochemical composition: steroidal saponins [17], steroidal alkaloids [17], pregnane glycosides [17], triterpenes [17], sesquiterpenes [17], flavonoids [17],

sterols [17], phenolic compounds [17], fatty acids and esters [17]**.** More information can be found in review [17].

Biotechnological achievements. The callus (**S1**, *link 2*) & shoot regeneration were obtained [11] (**S2**, *link 2*) and micropropagation [355] (**S2**, *link 3*).

Callus induction was achieved from 1–4-month-old leaves cultivated on the medium supplemented with 5 mg/L IAA, the rates of callus induction was quite low - 15% [11], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration was achieved from 1–4-month-old leaves on medium supplemented with 5 mg/L KIN, the rates of regeneration reached 15,5% [11], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not described (see Table S1), (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was not described (see Table S1), (**Table S1**, *sheet regeneration+callus+concentrat.*).

Micropropagation was performed for *S. melongena* x *S. torvum* interspecific hybrids from embryos on medium supplemented with 0.5 mg/L BAP + 0.5 mg/L IAA [355] (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.35. *Solanum incanum* L.

(Clade II. Major clade *Leptostemonum*, Minor clade *Eastern Hemisphere Spiny*)

Local/common names: thorn apple, bitter tomato [356, 574].

Morphological description. The plants are erect herbs, reach up 0.4–1.5 m, prickly. The young stems are pubescent and prickly. The leaves are simple, the blades are 6–22 cm long and 4–15 cm wide with 0–4 prickles. The inflorescences are terminal or lateral, 3–8 cm long, composed of 5–10 flowers, pubescent, unarmed. The mauve flowers are 5-merous. The corolla is 2.4–3 cm in diameter. The fruits are spherical berries, 2.5–3.5 cm in diameter, the pericarp is smooth, yellow when ripe, glabrous [356] (**S3**, *sheet 3*).

Distribution: Sub-Saharan Africa, the Middle East, Pakistan [356].

Uses: ethnomedicine, dyeing agent for dyeing leather products [356].

Medicinal properties: antimalarial, against *Escherichia coli* and *Salmonella typhi* and two Gram-positive bacteria (*Bacillus subtilis* and *Staphylococcus aureus*) [357].

Biochemical composition: alkaloids, saponins, flavonoids, glycosides, terpenoids, and steroids [357].

Biotechnological achievements. There is only one article where callus induction was presented [358].

Callus induction was achieved from anthers of *S. incanum* L. and interspecific hybrid *Solanum incanum* x *S. melongena*, the effectiveness of callus induction reached 24% [358]. More details were not specified [358].

Shoot regeneration was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.35. *Solanum macrocarpon* L.

(Clade II. Major clade *Leptostemonum*, Minor clade *Eastern Hemisphere Spiny*)
Local/common names: African eggplant, or Gboma eggplant [360].
The species include four varietal groups: Mukono, Nabingo, semi-wild and Uganda group [359].
Morphological description. The plants are annual or perennial herbs, reach up to 1.5 m high, leaves armed with spines. Leaves ovate, hairy, later became mostly hairless except for the midrib. Leaves usually have long prickles on midrib and secondary veins above and below. Flowers in 2–6-flowered inflorescences. White or purple corolla is 5–6-lobed, 1.6–2.5 cm in diameter. Fruits are globose berries, 3-4.5 cm in diameter, yellow / orange-yellow / pale green / white with green stripes when ripe [360] (**S3**, *sheet 3*).
Distribution: in central Africa, Madagascar and Mascarene Islands, introduced in the Antilles, South America, Caribbean, Europe and southern Asia [360].
Uses: ethnic food (leaves and fruits boiled, used for soups or fried, or rare can be consumed fresh in salads (Vietnamese non bitter varieties)), ethnomedicine (leaves), decorative [86].
Medicinal properties: antibacterial for treating throat [86], for treating heart diseases [86], as a laxative [86], antihelminth [86], antidiabetic [361, 362].
Biochemical composition: glycoalkaloids [360], flavonoids [363].
Biotechnological achievements. The callus tissue [358, 364] (**S2**, *link 1*), shoot regeneration [365] (**S2**, *link 2*) and microclonal multiplication [319] (**S2**, *link 3*) were obtained.
Callus induction. Only in one publication was mentioned growth stimulants resulted on callus initiation. Callus tissue was obtained from 40-days old leaf explants on medium supplemented with 0.1 mg/L TDZ, the percentage of callus induction was 90% [364]. In other publications details of callus induction were not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot regeneration. In the majority of experiments the leaf explants was used for initiation of shoot regeneration (4 mentioning, **Table S1**, *sheet regeneration+callus+concentrat.*). The highest rates of shoot regeneration were obtained from 3-week-old leaves and 10-day-ols cotyledons on medium supplemented with 0.1 mg/L TDZ (100% and 63.3%, respectively) [365].
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.37. *Solanum dasyphyllum* Schumach. & Thonn.

(Clade II. Major clade *Leptostemonum*, Minor clade *Eastern Hemisphere Spiny*)

Local/common names: no information.

Morphological description. The plants are erect herbs or shrubs, can reach up to 0.5–1 m, covered with prickles. The leaves are simple, the blades are 10–35 cm long, 6–20 cm wide. The leaves are densely pubescent. The inflorescences are lateral, 4–7 cm long. The flowers are 5-lobbed. The corolla is 3.5–6 cm in diameter, pale mauve to purple, sometimes can be white. The fruits are spherical, glabrous, yellow berry [366] (**S3**, *sheet 3*).

Phylogeny: *S. dasyphyllum* is the wild progenitor of the *S. macrocarpon*, which is cultivated [366]. *Solanum macrocarpon* and *S. dasyphyllum* are included in Anguivi grade, where *S. anguivi* also included [366].

Distribution: distributed in Western, Central, Eastern Africa, sometimes in South Africa [366].

Uses: ethnic food (sometimes), ethnomedicine [366].

Medicinal properties: anti-inflammatory [367], antibacterial (against *K. pneumoniae, P. aeruginosa*) [368], neuromuscular [369], hypotensive [369], anticholinesterase activity [369], can be potentially used for treating neurodegenerative disease such as Alzheimer's and Parkinson's [369], protection effect against cyanide neurotoxicity [370].

Biochemical composition: alkaloids [367, 369], flavonoids [367, 369], steroids [369], glycoalkaloids [371], saponins [367], cyanogenic glycosides [367], tannins [367].

Biotechnological achievements. There is only one publication, where the conditions of callus initiation were mentioned [364].

Callus induction was initiated from 40-day-old leaves cultivated on the medium supplemented with 0.1 mg/L TDZ [364]. The percentage of callus induction reached 90% [364].

Shoot regeneration was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.38. *Solanum anguivi Lam.*

(Clade II. Major clade *Leptostemonum*, Minor clade *Eastern Hemisphere Spiny*)

Local/common names: anguivi, forest bitterberry [372, 576].

Morphological description. The plants are erect woody herb or shrub, up to 4 m height. The stems and leaves are armed with spines, yellowish to brownish, sometimes purple near the base, up to 13 mm long. Leaves are rhombic-ovate or elliptic, hairy, triangularly lobed. Prickles usually present along the midrib and main veins. Flowers (up to 20) formed racemose inflorescences. Corolla is pale mauve or bluish-purple to almost whitish, star-shaped. Fruits are 6-12 mm in diameter berries, globose, orange-red when ripe, glabrescent [372] (**S3**, *sheet 3*).

Distribution: originated in Uruguay, Argentina, Brazil, Non-arid Africa: Nigeria, Ghana. Introduced into: Assam, East Himalaya, India, Mauritius, Nepal, Queensland, Réunion [372].

Uses: ethnic food (leaves, fruits), ethnomedicine [372].

Medicinal properties: used for treating coughs, dysuria, nasal ulcers, asthma, toothache, cardiac disorder, worm complaints, spinal chord and nervous disorder, fever, diabetes, atherosclerosis, nasal ulcers, asthma, parturition, worm expeller, itching [373, 374], hypolipidemic [375, 376], anemia [373–375], Huntington's, Alzheimer, Parkinson, amyotrophic lateral sclerosis [377], antioxidant [375, 378, 379], hypotensive [378], antibacterial *Staphylococcus aureus, Streptococcus pyogenes, Klebsiella pneumonia* and *Escherichia coli*) [380]. More information can be found in review [17].

Biochemical composition: steroidal alkaloids [17, 380], flavonoids [17, 380], phenols [17, 380], glycosides, sterols [17, 380], terpenoids, steroidal saponins [17, 380], tannins [380], phenolic compounds [17]**.** More information can be found in review [17].

Biotechnological achievements. There is only one article where the results of microclonal multiplication were presented [355].

Micropropagation of *S. melongena* x *S. anguivi* was conducted from embryos on the medium supplemented with 4 mg/L BAP + 0.2 mg/L IAA growth stimulants [355].

Callus induction was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.39. *Solanum aethiopicum* L.

(Clade II. Major clade *Leptostemonum*, Minor clade *Eastern Hemisphere Spiny*)

Local/common names: African eggplant, mock tomato, scarlet eggplant, african eggplant, bitter tomato, aubergine écarlate, aubergine africaine, tomate amère, Jió. [383].

There are a phenotypically diverse plant group. *S. aethiopicum* (scarlet eggplant) includes the 4 different groups or subspecies which were obtained through a domestication from *Solanum anguivi* [359]. The domestication process took place in the following order [381]: first the domestication of *S. anguivi* resulted in appearing *S. aethiopicum* group Gilo (sometimes incorrectly named as *S. gilo* or *S. anomalum*). This group gave rise to the Kumba group, from which the Shum group was generated. However, a different theory reported by Sekara [382], supports a possible Shum origin of the Gilo group; according to Lester [381], the Aculeatum group wrongly called *S. integrifolium* (inedible) resulted from natural crosses between *S. anguivi* Lam and the Kumba group of *S. aethiopicum* L [359].

Morphological description. The plants are erect annual or perennial herbs or shrub, can reach up to 0.3-1 m height, unarmed [383]. Young stems are glabrous or pubescent, unarmed [383]. The leaves are weakly lobed, the blades are 5–18 cm long and 2.5–10 cm wide, ovate, sometimes elliptic, membranous to chartaceous, drying concolorous to discolorous [383]. The inflorescences is lateral, 1–1.8 cm long, with 1–2 (up to 10) flowers. Corolla is 0.8–1.8 cm in diameter, white. The fruit is a berry, usually spherical but the cultivars have various shapes [383] (**S3**, *sheet 3*).

Description of the 4 groups of *S. aethiopicum* L.

The **Gilo Group**. The plants of this group are common in Brazil and Africa. The plants have hairy, inedible leaves, the fruit shape is variable (round, elongated, egg-shaped, ribbed or smooth, color (from dark to light green, can be white or striped) [359].

The **Kumba Group**. The plants have glabrous, large, edible leaves, from medium to big ribbed fruits (up to 5–10 cm in diameter). This group is more distributed in the arid areas of tropical Africa [359].

The **Shum Group**. The plants have glabrous edible leaves; small round or elongated fruits (edible, but rare consumed) [359].

The **Aculeatum Group** (incorrect synonym is *S. integrifolium*). The plants have inedible leaves and fruits, more usually used as ornamental. The fruits are of different size and shape (round, flattened, ribbed, smooth), and different color (dark or greenish, purple) [359]. The plants of this group are used for pest and disease resistance breeding [359].

Distribution in China, India, Japan, Angola, Benin, Botswana,Burkina Faso, Burundi, Cameroon, Cape Verde, Central Africa, Chad, Comoros, Congo DR, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal,

Sierra Leone, Sudan, Togo, Zambia, Zimbabwe, Australia, Brazil, Italy, France [383].

Uses: ethnic food (fruits/leaves eaten), ornamental, rootstock for *S. melongena* in Japan (for diseases and pest resistance breeding), ethnomedicine [359].

Medicinal properties: antiulcer [384, 385], anticancer [386–388], anti-inflammatory [384, 385], sedative [383], anti-obesity effect [385], antioxidant [385, 389], purgative [385], anti-diabetic [385], anti-obesity [390], hypolipidaemic [385], anti-atherosclerotic [385].

Biochemical composition: polyphenols [385], alkaloids [385], phenolic acids [385], flavonoids [385], sesquiterpenes [17], sterols [17]. More information can be found in review [17].

Biotechnological achievements. The callus induction [146, 343, 365, 391, 392] (**S2**, *link 1*), shoot regeneration [11, 146, 243, 365, 391–393] (**S2**, *link 2*), micropropagation [319] (**S2**, *link 3*) and genetic transformation [146] (**S2**, *link 6-12*) were obtained.

Callus induction. The 3-week-old (4 mentioning) leaf explants were used mainly (8 mentioning). The KIN growth stimulant was used in the majority of experiments (**Table S1**, *sheet regeneration+callus+concentrat.*). The highest callus induction rates (21.86–55.9%) was achieved on medium supplemented with 5 mg/L 2,4-D + 5 mg/L KIN [392]. The callus tissue was obtained from the following interspecific hybrids: *S. melongena* x *S. aethiopicum* [391], *S. melongena* x *S. aethiopicum* gr. *Aculeatum* [394], *S. melongena* x *S. aethiopicum gr. gilo* [394], *Solanum aethiopicum gr. Gilo x Solanum aethiopicum* [319].

Callus induction of interspecific hybrids was obtained mainly from leaf derived protoplasts (3 mentioning, **Table S1**, *sheet regeneration+callus+concentrat.*). The highest rates of callus induction (60%) of interspecific hybrid *Solanum melongena* x *Solanum aethiopiocum* were obtained from leaf explants which were cultivated on medium supplemented with 0.05 mg/L TDZ [391]. But in experiments with other interspecific hybrids details of callus initiation were not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration. The 3-week-old (4 mentioning) leaf explants were used mainly (8 mentioning, **Table S1**, *sheet regeneration+callus+concentrat.*). The highest rates of shoot regeneration (100%) of *S. aethiopicum* were obtained from leaf explants cultivated on medium supplemented with 0.1 mg/L TDZ [365]. The rates of regeneration (from callus initiated from cotyledon-derived explants) reached 34.2% and 40% (from leaf explants) on medium supplemented with 2 mg/ ZEA + 0.1 mg/L IAA 0.05 mg/L TDZ [365]. The highest percentage of shoot regeneration from callus *S. melongena* x *S. aethiopicum* interspecific hybrids was 60% when the leaf explants were cultivated on the medium supplemented with 0.05 mg/L TDZ [391]. The rates of shoot regeneration of other interspecific hybrids were low (9%, *S. melongena* x *S. aethiopicum* gr. Aculeatum and *S. melongena* x *S. aethiopicum* gr. Gilo) [394] or not specified (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Rooting was not conducted in the majority of experiments (**Table S1**, *sheet regeneration+callus+concentrat.*).
Micropropagation of *Solanum aethiopicum x S. lasiocarpum* was achieved from embryos cultivated on medium without addition of growth stimulants [319], (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation There is one publication dedicated to genetic transformation [146]. *S. aethiopicum* cv. Gilo leaf explants were used for *Agrobacterium*-mediated transformation. The *A. tumefaciens* strains pGS1166, pGV3850/pAPap2034.355.11+pGS1166, pGV11 with different genetic vectors (with genes *npt II*, *INFA2β*, *hyg, cry1A + hyg* were used in the experiments. The positive results were not obtained [146], (**Table S1**, *sheet transformation total)***.**
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.40. *Physalis angulata* L.
(Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: ground cherry, cutleaf groundcherry [395].
Morphological description. The plant is sprawling or erect herb, can reach up to 1 m height, stems are glabrous. Leaves up to 10 cm long, ovate, the margins are dentate. Pedicels are 5–12 mm long. Flowers with the calyx 3–5 mm long, 2–4 mm, lobbed. Corolla is 4–10 mm. The anthers are bluish, sometimes yellowish, 2–2.5 mm long. Fruits are 10–25 mm long, yellowish green. The calyx is 20–30 mm long, glabrous. The fruit is globose berry, 10–12 mm across [395] (**S3**, *sheet 9*).
Distribution: Native to America and India. Introduced into Brazil [395].
Uses: ethnic food (In tropical Africa, the fruits are eaten, and the leaves are prepared in salads); ethnomedicine [395, 396].
Medicinal properties: analgetic and used to treat skin problems and muscle pain (itching, smallpox, whitlow, rheumatism), alleviate symptoms (fever, stomach aches, vomiting and diarrhea), antiparasitic activity (malaria, African trypanosomiasis, dracunculiasis - Guinea worm disease) [395], antiinflammation and cytotoxic [396], antioxidant [397], immunoregulatory effects [397], antitumor [397].
Biochemical composition: flavonoids, withanolides, physalins [396]. More detailed description can be found in review [397, 398].
Biotechnological achievements. For this species the results of callus initiation (**S2**, *link 1*), shoot regeneration (S2, link 2), root initiation (**S2**, *link 4*), genetic transformation are available (**S2**, *link 6–12*, **Table S1**, *sheet regeneration+callus+concentrat.*).
Callus induction. The node explants (10 mentioning) and apical shoots (9 mentioning) were mainly used for callus initiation. In many experiments were used 2,4-D separately (5 mentioning) or 2,4-D + KIN (3 mentioning), 2,4-D + BAP (4 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat.*). The highest rates

of callus induction were achieved when the media were supplemented with following combinations and concentrations of growth stimulants: 0.5 mg/L KIN + 2,4-D - 90% [399], 2 mg/L 2,4-D – 90% [400], 2 mg/L 2,4-D + 0.5 mg/L KIN - 90% [400], 0.25 mg/L 2,4-D + 1-1.5 mg/L BAP – 100% [401], 0.5 mg/L 2,4-D + 0.5 mg/L KIN – 100% [402]. To summarize, the formation of callus tissues was observed on media supplemented with different concentrations and combinations of growth stimulants (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration. The node and leaf explants were used mainly in the experiments (**Table S1**, *sheet regeneration+callus+concentrat.*). BAP growth stimulant was used in the majority of experiments (10 mentioning). The highest regeneration efficiency was observed on the media supplemented with 1 mg/L BAP [403, 404], 0.5–1 mg/L BAP – 100% [405], 1–2 mg/L KIN – 100% [405], 0.1 mg/L NAA or 0.1 mg/L IAA – 100% [405], 0.25 mg/L 2,4-D + 1-1.5 mg/L BAP – 100% [400] , 1.8 mg/L BAP or 2.2 mg/L KIN – 100% of callus formation for each growth stimulant [406]. The following results support hypothesis that *Physalis angulata* have initially high potential for *de novo* shoots formation.

Shoot elongation. For elongation of regenerated shoots were used media supplemented with different concentrations of BAP: 0.1–1.5 mg/L BAP [401, 407], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was achieved using different concentrations of IBA growth stimulant (14 mentioning) or NAA (8 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication. The media were supplied mainly with 0.1-1.8 mg/L BAP (11 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. The 3-week-old stems (3 mentioning) or protoplasts from leaf discs and stems (3 mentioning) were used in many experiments (see Table S1). *A. rhizogenes* (5 mentioning) and *A. tumefaciens* (3 mentioning) were used in the experiments (**Table S1**, *sheet transformation total*). The most used strain was LBA9402 carring out pBI121 genetic vector with incorporated *nptII*, *gus* genes [408]. The highest transformation efficiency (~90%) was recorded when *A. tumefaciens* C58C1 (pGV 2215 or pGV 2298) was used [409]. The delivery of genetic vectors was conducted *via Agrobacterium*-mediated transformation in all experiments (**Table S1**, *sheet transformation total*). The outcomes of experiments were following: obtaining of transformed callus [409] or transformed plants [409] or hairy root culture [408, 410].

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.41. *Physalis chenopodiifolia* Willd.
(Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: tomatillo sylvestre, wild tomatillo [411].

Morphological description. The plants are erect perennial herbs, can reach up to 70 cm height, have dense pubescence through the stem. The petioles are 0.6–2.3 cm; the blade is ovate to lanceolate, 1.7–6.7 cm long, 0.7–4.1 cm wide, apex acute

[411]. The flowers are solitary on peduncles 9–15 mm long [411]. The calyx is triangular to ovate, has lobes 1.5–4.2 mm long [411]. The corolla is bell-like shaped, yellow, 1.6–3 cm in diameter, with five reddish-brown spots in the canter, corolla is densely pubescent in the canter [411]. The anthers are blue, 2–3.5 mm long [411]. The fruits are green or purple-tinged berries, 1.3 cm in diameter [411] (**S3**, *sheet 9*).

Distribution. The plants are native in Mexico [412, 413].

Uses: ethnic food (fresh fruits consumed by locals in Mexico), ethnomedicine [412].

Medicinal properties: antibacterial, anti-inflammatory, antioxidant and anticancer effect [412].

Biochemical composition: terpenes/steroids, phenols and flavonoids [412, 413].

Biotechnological achievements. There is only one article dedicated towards biotechnological manipulations with *P. chenopodiifolia* [401]. In the experiments was obtained callus, shoot regeneration and microclonal multiplication [401], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Callus induction. The leaf explants were mainly used for callus induction and following combination and concentrations of growth stimulants: 0.25 mg/L 2,4-D + 0.1-2 mg/L BAP. The callus induction reached 100% when the upper mentioned concentrations of 2,4-D + BAP were applied [401], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration. For shoot regeneration were also used leaf explants and the same combinations and concentrations of growth stimulants which were used for callus induction in *P. chenopodiifolia* [401]. According to information presented in the article, regeneration efficiency was also achieved 100% [401], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation. The conditions of shoot elongation not described, (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting. For rooting was used 0.2-1 mg/L NAA growth stimulant [401], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication. The multiplication of shoots was achieved using the same concentrations and combinations of growth stimulants which were mentioned for callus induction [401], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation was not conducted (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.42. *Physalis grisea* (Waterf.) M.Martínez (Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: strawberry tomato, strawberry groundcherry [659, 660].

Morphological description. The plants are annual, erect herbs, up to 30–60 cm high. Stems are angular, branched, spreading, pubescent. Leaves are simple; blade is broadly ovate, 4–10 x 3–9.2 cm, glandular-pubescent on both surfaces,

acute at apex. Petioles are 3–7 cm long. Flowers are yellow, solitary. Pedicels are 5–6 mm long. Calyx is pubescent, has lobes 1.5–3 mm long. Corolla is yellow, with 5 large, dark brown spots in the centre. Anthers are blue, 1–2 mm long. The calyx is green, 5-angled, 2–3.5 cm long, 1.5–2.5 cm in diameter [414] (**S3**, *sheet 9*).

Distribution. The plants are native in USA (Alabama, Illinois, Tennessee, Vermont). Introduced in India, United Kingdom [414].

Uses: ethnic food (fresh berries are consumed locally in America), recently used as model object in genetic engineering [415]. The plants are cultivated commercially.

Cultivars: Mango, Pineapple (PI), PHY50 [416].

Medicinal properties: antihyperglycemic activity [417].

Biochemical composition: withanolides (physalins), lactones [417].

Biotechnological achievements. *P. grisea* was transformed and edited [418] (**S2**, *link 6–18*).

Callus induction was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration not described [418], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.).*

Rooting not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. The results are presented only in one article [418]. Researchers used *A. tumefaciens* (the strain is not mentioned) with genetic vector pAGM4723, the transgenes were not mentioned. The delivery of the vector was *Agrobacterium*-mediated. The researchers obtained transformed plants [418]. The efficiency of transformation was not mentioned [418], (**Table S1**, *sheet transformation total*).

Gene editing. The results are presented only in one article [418]. The editing tools were delivered with *A. tumefaciens* carrying out pAGM4723 genetic vector (*Agrobacterium*-mediated transformation) [418]. In experiments Cas9 endonuclease was used [418]**.** The outcomes of the experiments were obtaining of mutants (also double mutants) with knock-out multiple genes [418]. The following genes were edited: *PgAN1*, *PgMPF2*, *PgMPF3*, *PgGLO2*, *PgDEF*, *PgTM6*, *PgGLO1*, *PgTAGL1*, *PgTAG1*, *PgEJ2*, *PgLIN*, *PgRIN*, *APETALA2* [418], *PgER* and *PgSP* [419]. The following types of changes were observed in mutants: changes of flower color, biochemical composition fruit size, fertility [418], change of plant architecture and color [419]. Detailed description of mutant phenotypes is presented in **Table S1**, *sheet gene editing total***.**

2.43. *Physalis ixocarpa* Brot. ex Hornem.
(Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: purple tomatillo, tomatillo, Mexican husk tomato, tomate verde, miltomate [667, 668].

Morphological description. The plants are annual herbs, which can reach up to 1–1.5 m height. The leaves are glabrous, 6.53 cm long, 3.63 cm wide, ovate, and have leaf dentation. Flowers are yellow with purple spots in the centre. Petals are 8–10 mm long, bell-like form. Anthers are blue or yellowish, 2–4 mm long. The fruits are fleshy orange / yellow / greenish /violet berries, 3–6 cm in diameter. The fruit is surrounded by husk (calyx). In maturity the size of calyx is 4–5 cm long [420] (**S3**, *sheet 9*).

Distribution: native to Mesoamerica [420]. Introduced into Eritrea, Ethiopia, Egypt, Zambia, Zimbabwe, Botswana, Zair, Uzbekistan, Russia, India, Australia, Greece, Portugal, Spain, South-Central U.S.A. (New Mexico) [421].

Uses: food and ethnic food (green sauces, in salads) , ethnomedicine [420]. The plants are cultivated commercially.

Cultivars: Purple de Milpa, Purple Coban, Purple Keepers, Purple Blush, Morado [422]; Tecozautla, Diamante, Manzano, Amarylla [423].

Medicinal properties: antibacterial activity and antinarcotic effects, used for treating symptoms such as fever, cough, and amygdalitis [424].

Biochemical composition: phenolic compounds, steroidal lactones [424].

Biotechnological achievements. In experiments callus [425, 426] (**S2**, *link 1*), shoot regeneration [426–429] (**S2**, *link 2*) and microclonal multiplication [426, 430] (**S2**, *link 3*) were obtained.

Callus induction. For callus initiation, the 12–13-day-old cotyledons were mainly used (**Table S1**, *sheet regeneration+callus+concentrat.*). The highest efficiency of callus initiation reached 90% when 2.3 mg/L BAP was added to growth media [426].

Shoot regeneration. The cotyledon explants (12–13-day-old) were mainly used for the following purpose. The following growth stimulants were used mainly: BAP and 2,4-D + BAP (4 mentioning each variant of growth stimulants) (**Table S1**, *sheet regeneration+callus+concentrat.*). The highest percentage of regeneration reached 85–100% when 3 mg/L BAP + 0.2 mg/L NAA was added into the medium.

Shoot elongation. In the majority of publications details of shoot elongation were not described. In two articles were mentioned that 1 mg/L BAP + 0.1 mg/L NAA or 1.5 mg/L BAP were effective for significant elongation of regenerated shoots [428, 430], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting. In the majority of publications used growth stimulants for rooting initiation were not mentioned. In several publications were used following concentrations and combinations of growth stimulants: 0.23 mg/L BAP + 0.2 mg/L NAA [429], 1 mg/L BAP + 0.1 mg/L NAA [428], 0.2 mg/L IAA [431], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication. The microclonal multiplication was not conducted

in the majority of experiments. The details are mentioned in two articles, according provided information, effective rooting was obtained by addition 1.1-1,5 mg/L BAP to the media [426, 430], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. *A. tumefaciens* [431] and *A. rhizogenes* [432] were used for *Agrobacterium*-mediated transformation. The strains of *Agrobacterium* which were used for transformation: C58C1, C58C2, EHA105, ATCC15834, **Table S1**, *sheet transformation total)*. The following transgenes were delivered into *P. ixocarpa* tissues and cells: *nptII*, *gus, HBsAg*, *bar,* **Table S1**, *sheet transformation total*). The *nptII* gene was used in the majority of experiments (4 mentioning, **Table S1**, *sheet transformation total*). The outcomes of experiments were transformed plants or hairy root culture. The transformation efficiency was not mentioned in the majority of publications (**Table S1**, *sheet transformation total*). In only one publication was mentioned that 23% of plants were transformed [433].

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.44. *Physalis peruviana* L.
(Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: cape gooseberry, goldenberry [435, 244].

Morphological description. The plant is annual herbaceous. The stem is erect, ribbed, green, covered with trichomes. The leaves are velvety, dark green,7–11 cm length, 5.5–7 cm wide, ovate. The flowers are bell-shaped. The calyx is composed of five hairy sepals. The fruit is fleshy glabrous ovoid berry. The calyx is green at prematurity stages then became yellow at maturity stage, the color of the fruit is orange when ripe. The corolla has five yellow petals with dark purple-brown spots at the base. Androecium formed by five stamens joined with corolla [434] (**S3**, *sheet 9*).

Distribution: *P. peruviana* is native to Chile, Colombia, Venezuela, possible have originated from Brazil. Distributed across Africa, Asia, Pacific, less distributed in Europe [434]**.**

Uses: food, decorative, ethnomedicinal [434]. The plants are produced commercialy [435].

Cultivars: Agrosavia Dorada, Agrosavia, Andina [435].

Medicinal properties: antioxidant [397], anti-inflammatory [397], hypoglycemic effect (antidiabetic) [397], antitumor [397], neuroprotective effect [397], ameliorate the oxidative neurotoxicity of cadmium [397].

Biochemical composition: withanolides, flavonoids, polysaccharides [397]. More detailed description can be found in review [397].

Biotechnological achievements. The callus initiation [427, 436–438] (**S2**, *link 1*), shoot regeneration [436, 438–442] (**S2**, *link 2*), microclonal multiplication [436, 438, 439, 443–445] (**S2**, *link 3*) and genetic transformation were achieved [446] (**S2**, *link 6–18*).

Callus induction. The leaf explants were used mainly (13 mentioning), (**Table**

S1, *sheet regeneration+callus+concentrat.*). BAP growth stimulant was used in majority of experiments (8 mentioning, **Table S1**, *sheet regeneration+callus+concentrat.*). The callus induction rates reached 100% when following concentrations and combinations of growth stimulants were used: 0.5–1 mg/L IBA; 1–2 mg/L KIN + 0.5–1 mg/L IBA; 1–2 mg/L BAP + 1 mg/L KIN + 1 mg/L IBA; 0.25–1 mg/L 2,4-D + 1 mg/L BAP (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration. According to experimental data, BAP (9 mentioning) was effective for shoot regeneration (**Table S1**, *sheet regeneration+callus+concentrat*). The shoot regeneration reached 100% when 0.25–1 mg/L BAP was used [438].

Shoot elongation. In the majority of publications the details of shoot elongation are not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting could be obtained on media without addition of growth stimulants (6 mentioning, **Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication. Mainly not mentioned (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. There is only one publication dedicated to *P. peruviana* genetic transformation [446]. In the experiments *A. tumefacience* GV3101 strain with incorporated vectors (pTRV1 – pYL192, pTRV2 – pYL156, pTRV2 – pYL156) were used. The vectors were delivered *via* agroinfiltration (VIGS) of intact plants [446]. The following transgenes were delivered in plant tissues: *PpPDS, NobPDS* [446]. The transient expression of transgenes and gene silencing of host genes were achieved and the transformation efficiency varied among 20-47% [446]. The photobleaching of tissues was observed in transformed plants [446], (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.45. *Physalis pubescens* L.
(Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: hairy groundcherry [447, 672].

Morphological description: This is an annual plant, has hairy stem up to about 60 cm height. The oval or heart-shaped leaves are 3–9 cm long, have toothed edges. The hairy flowers are yellow with five dark spots in the center, five stamens on the top with blue anthers. The five-lobed calyx inflated, 3–6 cm long, sometimes pubescent. Berries are 10–15 mm diameter [447] (**S3**, *sheet 9*).

Distribution: in Brazil, Mexico, Central and South America [447].

Uses: ethnic food and food (the fresh fruits consumed directly in salads, preserved re used for pies, jellies, ice cream, sweets, dairy drinks, yoghurts, liqueurs) [448]; ethnomedicine (fruits, roots, stems, leaves) [447, 448]. The plants are produced commercially.

Medicinal properties: anti-diabetic [448], anti-inflammatory [448], antibacterial (*S. aureus*, *E. faecalis*, *P. aeruginosa*, *K. pneumoniae*) [397, 448], analgesic [448], antitumor [448], antipyretic agents [448], diuretics [448], anti-inflammatories

[448], antimalarial [448], antioxidant [448], antileishmanial [448], antiviral [448], immunomodulatory activities [448].

Biochemical composition: flavonoids, alkaloids, phytosteroids, carotenoids, withanolides, physalins [448]. More detailed description can be found in review [397].

Biotechnological achievements. There is a limited quantity of publications dedicated to biotechnological manipulations with *P. pubescens.* The callus [425, 449] (**S2**, *link 1*) and shoot regeneration [428, 450] (**S2**, *link 2*), genetic transformation [451–456] (**S2**, *link 6–12*) and gene editing [453] (**S2**, *link 13–18*) were obtained.

Callus induction. The following combination BAP + NAA in all experiments. The highest rates of callus induction (100%) were obtained when the 2-month old nodes or petioles were cultivated on medium supplemented with 0.5 mg/L BAP +0.25 mg/L NAA [425], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration. The highest rates of shoot regeneration (70–90%) were obtained when the petiole explants were cultivated on the medium supplemented with 0.5 mg/L BAP [449], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation. In the majority of experiments shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was conducted on the media supplemented with 0.5 mg/L NAA + 0.5 mg/L BAP or 0.5 mg/L NAA + 0.25 mg/L BAP [449], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication in the majority experiments was not conducted. In one article was mentioned that 0.5 mg/L BAP + 0.25 mg/L NAA was used for regenerated shoot multiplication [449], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. The 2-week-old seedlings were mainly used (15 mentioning) (**Table S1**, *sheet transformation total)*. For transformation *A. tumefaciens* LBA4404 (13 mentioning) and GV3101 (15 mentioning) strains was used in majority of experiments. The most used vector was virus-based TRV2 (in GV3101 strain, mentioning), (**Table S1**, *sheet transformation total*). The delivery of genetic vectors was conducted mainly by agroinfiltration (VIGS) method (9 mentioning) or vacuum infiltration (VIGS, 8 mentioning), (**Table S1**, *sheet transformation total*). Other ways of delivery which were also effective: particle bombardment, *Agrobacterium*-mediated, agroinjection and agroinfiltration (without usage of viral vectors), (**Table S1**, *sheet transformation total*). The transgenes which were inserted into plant genome were *bar*, *gfp*, *gus*, *luc*, *MPF1*, *MPF2*, *MPF3*, *nptII*, *P13*, *P5*, *PF10*, *PF3*, *PF7*, *PFCRC*, *PFGLO1*, *PFGLO2*, *POS1*, *PpPDS*, *RFP*, sgGFP, *SPL8*, *STMAD16,* (**Table S1**, *sheet transformation total*). The outcomes of experiments were obtaining of transient expression of genres or stable transformed plants, (**Table S1**, *sheet transformation total*).

Gene editing. There is only one publication where the results of *P. pubescens* gene

editing were shown [457]. The 2-week-old seedlings were transformed with *A. tumefaciens* LBA4401 [453]. The PFCRC gene was edited and as result knock-out mutants were obtained with changed flower morphology and fertility [453], (**Table S1**, *sheet gene editing total).*

2.46. *Physalis pruinosa* L.
(Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: dwarf groundcherry, strawberry groundcherry [660].

Morphological description. The plants are annual herbs, up to 1,5 m height. Stems are erect, pubescent. Leaves are ovate, 4–9 cm long, apex acuminate. Petioles are 1–5 cm long. Flowers are with pedicel 1–35 mm long, with elongated trichomes. Calyx is 4–9 mm long. Corolla is 10–15 mm in diameter, white or yellow. Anthers are 2.5–3.5 mm long, yellow or bluish. Berries are 10–20 mm diameter. Inflated calyx is 5-angled, 20–70 mm [458] (**S3**, *sheet 9*).

Distribution: in Mexico, Costa Rica, Paraguay, Guatemala, Honduras, Nicaragua, Argentina, El Salvador. Introduced to India, Brazil, Bolivia [458].

Uses: ethnic food (fresh and preserved), ethnomedicine [458]. The plants are produced commercially [458].

Cultivars - Aunt Molly [416].

Medicinal properties: antioxidant, radioprotective [459].

Biochemical composition: flavonoids, carotenoids, polysaccharides, phenols [459].

Biotechnological achievements. The callus initiation [425, 450] (**S2**, *link 1*), shoot regeneration [450] (**S2**, *link 2*), genetic transformation [450], (**S2**, *link 6–12*) and gene editing [457], (**S2**, *link 13–18*) were obtained.

Callus induction was obtained from stem-derived protoplasts, the following combinations and concentrations of growth stimulants were used: 1 mg/L 2,4-D + 1 mg/L BAP, 1 mg/L 2,4-D + 1 mg/L ZEA, 1 mg/L BAP [425]. The efficiency of callus induction was not mentioned [425], (**Table S1,** *sheet regeneration+callus+concentrat.*).

Shoot regeneration. The following combination and concentration of growth stimulants was applied for shoot regeneration from callus tissue obtained from protoplasts: 1 mg/L 2,4-D + 1 mg/L BAP. The regeneration of shoots was not successful [425]. In other experiment the medium was supplied with 1 mg/L Zea and the regenerated shoots were obtained, but the efficiency of regeneration was not mentioned [450], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not described [450], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was not described [450], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted [450], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. There is only one publication where the results of *P. pruinosa* transformation were shown [450]. The transformation of 8-day-old

cotyledons and hypocotyls was conducted with *Agrobacterium tumefaciens* AGL1 strain caring out pJL33 genetic vector with incorporated *nptII* and *sgfp* genes. The transformed plants were obtained, the transformation efficiency reached 24% [450], (**Table S1**, *sheet transformation total*).

Gene editing. There is only one publication where the results of *P. pruinosa* gene editing were shown [457]. The transformation was conducted with *A. tumefaciens* (the details were not described) [457]. After editing of *Ppr-SP5G*, *Ppr-CLV1* and *Ppr-SP* genes, the knockout mutants were obtained with changes in plant architecture, number of flowers and fruits [457], (**Table S1**, *sheet gene editing total*).

2.47. *Physalis philadelphica Lam.* (Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: tomatillo, large-flowered tomatillo [684].

Morphological description. The plants are erect herbs, can reach up to 80 cm height. The stems are pilose near the base but glabrate above [460]. The leaves are up to 10 cm long, ovate, apically acuminate, the margins are dentate [460]. The flowers are 3–8 mm long, relatively broad. The lobed are pubescent with short spreading hairs mostly on the angles. The corolla is 8–15 mm long [460]. The anthers are purple, 2–3 mm long. The fruits are 3–10 mm long, the 5-angled calyces are 20–50 cm long. The berries are globose, 10 mm long, oily or viscid. The color of berries can be green, yellow, or purplish when ripe [460].

Distribution: in Mexico, United States, Canada [460] (**S3**, *sheet 9*).

Uses: ethnomedicine, ethnic food [461].

Medicinal properties: diuretic, used for treating headaches, stomach pains, diarrhea, tonsillitis, alopecia, antidiabetic [461]; antimicrobial, antioxidant, anti-cancer, anti-inflammatory [462].

Biochemical composition: phenolics, flavonoids, withanolides, physalins [462].

Biotechnological achievements. The callus induction [463] and genetic transformation were performed [463–465], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Callus induction. There is only one article where callus initiation was mentioned. The calli were initiated from cotyledons on the medium supplemented with 0.2 mg/L NAA + 3 mg/L BAP [463], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. There is a limited quantity of publications dedicated to genetic transformation [463–465]. The seedlings were mainly used for transformation. And genetic vectors were delivered with *A. tumefaciens* by

different ways: rubbing, agroinoculation, *Agrobacteriu*m-mediated, RNAi, agroinfiltration (VIGS), (**Table S1,** *sheet transformation total*). The following transgenes were delivered into plant tissues: *BC-ATPase*, *gfp*, *PfCNR1*, *PfCNR1-RNAi*, *PfCNR1L1*, *PfCNR1L2* (**Table S1**, *sheet transformation total*). The outcomes of experiments were transgenic plants, knock out plant mRNA transient expression (**Table S1**, *sheet transformation total*).

Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.48. *Alkekengi officinarum* Moench (Clade VI-6, Tribe *Physalideae*, Subtribe *Physalidinae*)

Local/common names: Chinese lantern, Japanese-Lantern, winter cherry [677].

Morphological description. The plants are perennial herbs, sprawling or erect, growing up to 40–60 cm tall. The leaves are ovate or elliptic, apically acute, the margins are dentate, the size of leaves is 6–12 cm long and 4–9 cm wide. The flowers are white, with a five-lobed corolla 10–15 mm long, with an inflated calyx. The fruit is a red globose fleshy berry, 10-25 mm long, yellowish green. The calyx is 20-30 mm long, glabrous [466], (**S3**, *sheet 9*).

Distribution. It is native to Southern Europe, South Asia and Northeast Asia, Caucasus, China, Mongolia, Korea, Kazakhstan, Kirgizistan, Tadzhikistan, Turkmenistan, Uzbekistan, Russia, Iran, Iraq, Lebanon-Syria, Turkey, Pakistan, Belarus, Ukraine, Austria, Slovak republic, Czech Republic, Hungary, Poland, Switzerland, Albania, Bulgaria, Greece, Italy, Romania, Turkey, Slovenia, Serbia, Montenegro, Croatia, Macedonia, France, Spain. It is introduced to Cape Verde, Morocco, Japan, Vietnam, Belgium, Germany, Netherlands, Great Britain, USA [466].

Uses: ethnomedicine, ornamental [467].

Medicinal properties: leishmanicidal, anti-inflammatory, antioxidant, hypoglycemic, analgesic, anti-tumor, immune-regulating, immunosuppressive [467], antibacterial (against *P. cereus*, *Bacillus subtilis and E. faecalis*, *P. aeruginosa*, *K. pneumoniae*, *and E. coli*) [397, 467], cardiovascular [397].

Biochemical composition: flavonoids, alkaloids, phenylpropanoids, sucrose esters, piperazines, polysaccharides [567], physalins [397], withanolides [397], sterols [397]. More detailed description can be found in review [397, 398].

Biotechnological achievements. Only callus was obtained [425, 468, 469] (**S2**, *link 1*), (**Table S1**, *sheet regeneration+callus+concentrat*).

Callus induction. There are only several publications dedicated to callus initiation [425, 468, 469]. The hypocotyl explants were mainly used [468, 469]. The combinations of growth stimulants 1.5 mg/L BAP + 0.4 mg/L NAA and 1.5 mg/L BAP + 0.1 mg/L NAA allowed obtain 100% of callus induction [468, 469], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot elongation was not conducted (**Table S1**, *sheet*

regeneration+callus+concentrat).
Rooting was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).
Genetic transformation was not conducted (**Table S1**, *sheet transformation total).*
Gene editing was not conducted (**Table S1**, *sheet gene editing total*).

2.49. *Lycium ruthenicum* Murray (Clade VI-1, Tribe *Lycieae*)

Local/common names: black goji berry, goji [472].
Morphological description. The shrubs are copiously armed. Leaves are linear. Pedicel is 5–10 mm. Calux is 2–4-lobed, lobes are ciliate. Corolla lobes are oblong ovate. Purple-black berries are globose [470], (**S3**, *sheet 10*).
Distribution: in China, Afghanistan, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Russia, Tajikistan, Turkmenistan, Uzbekistan, Asia, Europe [470].
Uses: food colorant [471], functional food (fresh and dried fruits), food supplements (dried fruits) and in medicine (ethnomedicine and traditional medicine in China) (fresh and dried fruits) [470]. The plants are cultivated commercially.
Medicinal properties: antioxidant [471, 472], anti-fatigue [471], immuno-modulation [471], improve radioresistance [471], anti-aging [471, 472], antiinflammation [472], anticancer [472], organo-protection [472], antifatigue [472], anti-obesity [472], antidiabetic [472], antiviral (against influenza) [472], tyrosinase inhibition [472].
Biochemical composition: Anthocyanins [470]. More detailed information can be found in review [470], polysaccharides [472], anthocyanins [472], phenylpropanoid derivatives [472], polyphenolic glycosides [472].
Biotechnological achievements. For the following species the callus formation [473–481] (**S2**, *link 1*), shoot regeneration [474–476, 479–481], (**S2**, *link 2*), microclonal multiplication [482], (**S2**, *link 3*), genetic transformation (**S2**, *link 6-12*) were obtained.
Callus induction. For callus initiation, the leaf explants were used mainly (4 mentioning) and the media were supplemented with BAP in combination with other growth stimulants (**Table S1**, *sheet regeneration+callus+concentrat.*). According to available information, high callus initiation rates were achieved when the following concentrations and combinations of growth stimulants were used: 1 mg/L BAP + 0.5 mg/L NAA – 100% [474], 0.2 mg/L BAP + 0.1 mg/L NAA – 99.21–100% [476] or when 0.25 mg/L BAP was used separately – 100% regeneration efficiency [483].
Shoot regeneration. The leaf explants were used mainly for shoot regeneration [475, 476, 483]. The addition of following growth stimulants allowed obtain highest shoot regeneration rates: 0.1 mg/L BAP + 0.1 mg/L NAA – 30.11–86.26 and 0.1 mg/L BAP – 86.41–96.67 [476], (**Table S1,** *sheet*

regeneration+callus+concentrat.).

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting was achieved when the media were supplemented with 0.5 mg/L IAA mainly [474] or without addition of growth stimulants [476, 480], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Microclonal multiplication was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. There are already many results that have been obtained (11 mentioning, (**Table S1**, *sheet transformation total*). As the source of explants for transformation the leaves were used mainly [483–487]. In the experiments *A. tumefaciens* GV3101 strain (10 mentioning) or *A. rhizogenes* (9 mentioning) were used (**Table S1**, *sheet transformation total*). The way of transformation was vacuum infiltration (4 mentioning), agroinjection, syringe agroinjection and agrodrench (2 mentioning for each of method) (**Table S1**, *sheet transformation total*). The most used genetic vector was pTRV2-LrChlH (4 mentioning). The following transgenes were successfully incorporated into plant genome: *ChlHM* [485], *gfp* [477], *gus* [483, 486], *hyg* [486], *LbNCED1* [485], *LbNR* [485], *LrCHS* [487], *LrCYP75B1* [487], *LrERF5.1* [487], *LrF3HPro* [487], *LrFLS* [487], *LrKUP8* [477], *LrMYB1* [480], *LrMYB94* [487], *LrTCP4* [486], *LrWRKY32* [487], *LUC* [467], *nptII* [477, 483, 488], PDS [485], *Ruby* [489]. The most quantity of results were obtained with *nptII*, *ChlHM* and *PDS* (4 mentioning for each of gene, (**Table S1**, *sheet transformation total*). The highest transformation efficiency (65.03%) was observed in the experiment when the *A. tumefaciens* LBA4404 with incorporated *gus* and *nptII* genes were used [483]. And highest results of transformation with *A. rhizogenes* R1000 reached 80% [486]. The outcomes of experiments were obtaining of transformed plants, transformed callus, hairy root culture, transient expression (**Table S1**, *sheet transformation total*). The changes which were observed in transgenic plants were change of biochemical composition and color, improved salt tolerance (**Table S1**, *sheet transformation total*).

Gene editing. The leaf explants were used in all experiments [478, 488]. The way of delivery of editing tools was *Agrobacterium*-mediated transformation [478, 488]. The strains pCAMBIA1300 [488] and GV3101 [478] were used.

The following genes were edited*: FW2.2-1/2* [488], *FW2.2-1* [488], *FW2.2-2* [488], *PDS* [478], *HG18103* [478]. The types of Cas which were used: SpCas9 [478] and Cas9 [488]. The outcomes of experiments were obtaining knockout mutants. The efficiency of gene editing reached 93,75% (the gene *FW2.2-1/2* was edited) [488], 95,45% (the gene *FW2.2-1* was edited) [488], 54,55% (the gene *FW2.2-2* was edited) [488], 24,14 % (the *PDS* gene was edited) [478], 41,66% (the *HG18103* was edited) [478]. The changes were described only for *PDS* mutants: changes in biochemical composition and color [478], (**Table S1**, *sheet gene editing total*).

2.50. *Lycium barbarum* L.
(Clade VI-1, Tribe *Lycieae*)

Local/common names: goji, wolfberry [498].

Morphological description. The plants are woody shrubs. Leaves are long elliptic. Pedicel is 1–2 cm long. Calyx usually is 2-lobed, lobes 5–6 mm long, spreading, glabrescent. Orange-yellow berry is oblong [470] (**S3**, *sheet 10*).

Distribution: in China [470, 490], Korea, Japan, Europe, North America, and the Mediterranean [490].

Uses: the plants are cultivated commercially**;** functional food (fresh and dried fruits), food supplements (dried fruits) and in medicine (ethnomedicine and traditional medicine in China) (fresh and dried fruits) [470].

Cultivars: Synthia, Natasha, JB1, GB1, Magestic, Erma, Transilvania [491].

Medicinal properties: anti-hypertensive and cardioprotective [492], antioxidant [493-495], immunomodulation [494], antitumor [494, 495], neuroprotection [494], radioprotection [494], antidiabetic [494], hepatoprotection [494], antiosteoporosis [494] and antifatigue [494]**,** antiviral (against Newcastle disease virus (NDV)) [496], antifungal [497], antibacterial [495], anti-inflammatory [495], prebiotic activities [495].

Biochemical composition: alkaloids, flavonoids, carotenoids. More detailed information can be found in review [470].

Biotechnological achievements. For this species were initiated callus formation [488, 498–517] (**S2**, *link 1*), embryogenesis [488, 498–500, 502–510, 512, 513, 515, 516, 518], shoot regeneration [488, 498–502, 507–513, 516] (**S2**, *link 2*), genetic transformation [484, 485, 519–527], (**S2**, *link 6–12*) and gene editing (**S2**, *link 13–18*).

Callus induction. For callus induction were used following types of explants: leaves, nodes, hypocotyls, stems, protoplasts from leaves, shoot apexes, roots, anthers, internodes, protoplasts from hypocotyls, protoplasts from leaf derived callus, leaves with petioles, nodes (**Table S1**, *sheet regeneration+callus+concentrat.*). The most quantity of results were obtained using leaf explants (16 mentioning), (**Table S1**, *sheet regeneration+callus+concentrat*.). The age of used explants was 7-day old, 3-, 4-week-old. The highest percentage of callus initiation was obtained using leaf explants (96–100%) [488, 498, 528] and hypocotyls (90–100%) [511, 512]. The callus induction was mainly achieved during usage 2,4-D growth stimulant (13 mentioning, see **Table S1,** *sheet regeneration+callus+concentrat.*). The highest percentage (90–100%) of callus induction was obtained on the medium supplemented 0.02–0,4 mg/L 2,4-D [488, 498]; 1 mg/L TDZ and 0.25 mg/L 2,4-D + 0.5 mg/L TDZ [512], 0.3 mg/L 2,4-D + 0.3 mg/L BAP [515], 0.25 mg/L TDZ + 0.1 mg/L IAA [501], 0.5 mg/L BAP + 0.5 mg/L NAA [488]. The high percentage of callus induction which was obtained when the media were supplemented with different growth stimulants indicate about initial good callogenesis potential of the following species.

Shoot regeneration. The types of explants were the same as mentioned for callus initiation, excluding leaves with petioles (**Table S1**, *sheet*

regeneration+callus+concentrat.). The age of explants was the same as mentioned for initiation callus. The majority of experiments were conducted with 3-week-old leaf explants (**Table S1**, *sheet regeneration+callus+concentrat.*).

In the majority of experiments was used BAP (10 mentioning) or BAP in combination with other growth stimulants (**Table S1**, *sheet regeneration+callus+concentrat.*). The highest percentage of regeneration was obtained when following combinations and concentrations of growth stimulants were applied: 0.5 mg/L BAP + 0.5 mg/L NAA – 80% [501], 0.5 mg/L BAP – 100% [511], 1 mg/L BAP + 0.5 mg/L GA_3 + 0.1 mg/L IBA – 89% [529], 0.6 mg/L BAP + 0.6 mg/L NAA – 95% [530], 3 mg/L BAP + 0.25 mg/L IBA - 86.66 [531].

Shoot elongation. The combinations and concentrations of growth stimulants applied for shoot elongation of regenerated shoots in the majority of articles was not mentioned or was not conducted. Only in the one article was mentioned that shoot elongation was conducted with addition 0.1 mg/L BAP + 0.2 mg/L IBA into the medium [499], (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting. The rooting of regenerated shoots was achieved using mainly using 0.1 mg/L NAA (5 mentioning) [502], 0.5 mg/L IBA (4 mentioning) [529–532] (**Table S1**, *sheet regeneration+callus+concentrat.*).

Genetic transformation. The types of explants which were mainly used for genetic transformation – leaves (11 mentioning) 3- or 5-week-old (**Table S1**, *sheet transformation total)*. For transformation were used *A. tumefaciens* (22 mentioning) and *A. rhizogenes* (2 mentioning). Among the strains of *Agrobacterium*, the GV3101 strain was used in majority of experiments (14 mentioning) with variable incorporated genetic vectors. Although higher efficiency of stable transformation of 3-week-old leaf explants was achieved using EHA101 strain – 62.6%, LBA4404 – 46.4%, when the usage of GV3101 strain allowed to achieve only 35,5% of transformation efficiency [522]. The following transgenes were delivered into *L. barbarum* tissues: *ATHK1* [526], *CHLH* [485], *gus* [523, 524, 527], *LbCCD4.1* [484], *LbERF5.1* [484], *LbNCED1* [519], *LbNR* [519], *nptII* [519–521, 523–525], *PDS* [485] (**Table S1**, *sheet transformation total*). The outcomes of the experiments were obtaining of stable transformed plants (9 mentioning), transient expression of genes (13 mentioning), obtaining of hairy roots (2 mentioning), gene silencing (11 mentioning) (**Table S1**, *sheet transformation total*). In the majority of the experiments were used genetic vectors with incorporated *nptII* (9 mentioning) and *gus* genes (5 mentioning). The highest transformation efficiency was observed after delivery of *gus* and *nptII* genes [522].

The following ways of delivery of genetic vectors were used: *Agrobacterium*-mediated transformation (11 mentioning), vacuum infiltration (4 mentioning), agroinjection (4 mentioning), syringe agroinjection (2 mentioning), agrodrench (2 mentioning), VIGS (1 mentioning). After comparison of quantitative results of transformation available in experimental articles, we can highlight that the best results were obtained by Hu and coauthors [527].

Gene editing. The gene editing was not conducted for this species, yet (**Table S1**,

sheet gene editing total).

2.51. *Lycium chinense* Mill (Clade VI-1, Tribe *Lycieae*)

Local/common names: goji, Chinese boxthorn, Chinese tea plant [688].

Morphological description. The plants are woody shrubs, can reach 1–3 m high. The pale gray stems are branched or curved or pendulous, have thorns 0.5–2 cm long. The leaves are ovate, or lanceolate up to 1.5–5 cm long and 0.5–2.5 cm wide. The flowers are in groups (1–3 flowers), the pedicels are 1–2 cm long. The bell-shaped calyx is with densely ciliate lobes. The purple flowers are 9–14 mm wide with 5–6 lobes. The berries are orange-red, ovoid or oblong, 7–15 mm long and 5–8 mm wide [471] (**S3**, *sheet 10*).

Distribution: in China, Taiwan, Japan, Korea, Mongolia, Nepal, Pakistan, Thailand, Asia, Europe [470].

Uses: the plants are cultivated commercially, functional food (fresh and dried fruits), food supplements (dried fruits) and in medicine (ethnomedicine and traditional medicine in China) (fresh and dried fruits) [470].

Medicinal properties: antibacterial (against *S. aureus*, *Bacillus subtilis*, *Listeria monocytogenes*, *E. coli*, *S. typhimurium*), antibacterial activity against antibiotic-resistant bacterial strains, methicillin-resistant *Staphylococcus aureus* (MRSA), and human pathogenic fungi *C. albicans* [533], positive effect on patients with HIV and Parkinsons syndrome, reduce level of cholesterol [534], enhance immunity [535], antioxidant [536].

Biochemical composition: coumarins, terpenoids, alkaloids, flavonoids, carotenoids [470]. More detailed information can be found in review [470].

Biotechnological achievements. For the following species were initiated callus formation (**S2**, *link 1*) and shoot regeneration [537, 538] (**S2**, *link 2*), microclonal multiplication [539, 540] (**S2**, *link 3*) and genetic transformation [542], (**S2**, *link 6 – 12*).

Callus induction. The conditions which were used for callus initiation were not described (**Table S1**, *sheet regeneration+callus+concentrat.*).

Shoot regeneration. Shoot regeneration was mainly achieved when were used the leaf explants (6 mentioning) and 0.2 mg/L BAP growth stimulant (4 mentioning) or was used medium without addition of growth stimulants (4 mentioning) (**Table S1**, *sheet regeneration+callus+concentrat.*). The highest efficiency of regeneration was fixed when the media were supplemented with 0.3 mg/L BAP + 0.06 mg/L NAA – 100% [538], 0.5 mg/L TDZ – 80% [537], 9.6 mg/L ZEA – 93.7% [539] or without addition
of growth stimulants – 96–97% [540, 541].

Shoot elongation was not conducted (**Table S1**, *sheet regeneration+callus+concentrat.*).

Rooting. For rooting of regenerated shoots, the media were supplemented mainly with 0.5–1 mg/L IAA [537, 539–541] (**Table S1**, *sheet*

regeneration+callus+concentrat).

Microclonal multiplication was achieved without addition of growth stimulants [540, 541] (**Table S1**, *sheet regeneration+callus+concentrat*).

Genetic transformation. The results of transformation of *Lycium chinense* were described only in one experimental article [542]. The leaf explants were transformed with *A. rhizogenes*. As a result, the hairy root culture was established and the incorporation of *rolC gene* was confirmed by PCR analysis [542], (**Table S1**, *sheet transformation total*).

Gene editing. There is no any results, yet (**Table S1,** *sheet gene editing total*).

CONCLUSIONS

In this monograph, the findings from 343 experimental studies involving callus induction, shoot regeneration, microclonal multiplication, genetic transformation, and gene editing, were analysed. A comparative assessment of the key parameters influencing the efficiency of genetic transformation and gene editing is presented. The review specifically focuses on the application of these techniques in 51 wild and semi-domesticated *Solanaceae* species. In total, 73 transgenes were successfully incorporated into *Solanaceae* genomes, and 41 genes were edited, targeting traits such as plant structure and growth habit, fruit quality, and resistance to bacterial and viral pathogens.

Additionally, this review compiles data from other 225 articles covering species morphology, geographic distribution, biochemical composition, traditional uses, medicinal properties, and other ethnobotanical attributes. Each species is accompanied by representative photographic panels illustrating flowers, whole plants and fruits.

Callus induction and shoot regeneration of wild *Solanaceae* species were initiated mainly from 7–15-day-old leaf explants (243 mentioning). The following combinations of growth stimulants were used mainly for callus induction: BAP + NAA (48 mentioning), 2,4-D (48 mentioning), 2,4-D + BAP (33 mentioning). The highest rates of callogenesis (up to 100%) were obtained on the media supplemented with BAP + NAA (13 mentioning), 2,4-D + BAP (12 mentioning). The highest rates (100%) of callus initiation were obtained for 10 species: *Alkekengri officinarum*, *L. ruthenicum*, *S. pimpinelifolium*, *S. sesiliflorum*, *P. angulata*, *P. peruviana*, *L. barbarum*, *S. nigrum*, *P. chenopodifolia*, *P. pubescence*; 95 % of callus induction was obtained for *S. sisymbriifolium* and *P. peruviana*.

The combination ZEA + IAA was approbated for shoot regeneration of many *Solanaceae* species. Among 51 investigated species, this combination was successfully applied for regeneration of 12 species and 5 interspecific hybrids: *S. chilense*, *S. stramonifolium*, *S. scabrum*, *S. pennellii*, *S. habrochaites*, *S. sisymbriifolium*, *S. lycopersicoides*, *S. aculeatissimum*, *S. muricatum*, *S. aethiopicum*, *S. pimpinellifolium*, *S. peruvianum*, *S. nigrum*; *S. sisymbriifolium* x *S. lycopersicum*, *S. penellii* x *S. lycopersicoides*, *S. peruvianum* x *S. lycopersicum*. These results confirm the

hypothesis that following combination is the most effective for shoot initiation what allowed obtain 12,5–96% of shoot regeneration.
The combination of BAP + NAA (53 mentioning) allowed obtain shoot regeneration of 14 species, the percentage of shoot regeneration was quite variable – 0–90%, in majority of experiments it was among 65–90% (22 mentioning).
The combination BAP + IAA was used in many experiments (37 mentioning) for regeneration 13 species and 1 interspecific hybrid: *S. americanum*, *S. myriacanthum*, *S. pennellii*, *S. habrochaites*, *S. dulcamara*, *P. ixocarpa*, *S. pimpinelliifolium*, *S. peruvianum*, *P. angulata*, *S. betaceum*, *P. peruviana*, *L. barbarum*, *S. nigrum*; *S. melongena* x *S. anguivi*.
ZEA growth stimulant was used in 38 experiments, what allow obtain shoot regeneration of 16 species: *P. pubescens*, *S. pennellii*, *S. abutiloides*, *S. hyaylasense*, *S. arcanum*, *S. corneliomuleri*, *S. sisymbriifolium*, *L. chinense*, *S. aculeatissimum*, *S. dulcamara*, *P. ixocarpa*, *P. aethiopicum*, *S. pimpinellifolium*, *S. peruvianum*, *P. peruviana*, *S. nigrum*, *P. pruinosa* and 1 interspecific hybrid from 2 parent plants *S. melongena* x *S. sisymbriifolium* and 1 triple interspecific hybrid (*S. pennellii* x *S. lycopersicum*) x *S. melongena*.
The following combinations of growth stimulants were used mainly for shoot regeneration: BAP + NAA (53 mentioning), ZEA + IAA (51 mentioning), ZEA (38 mentioning), KIN + IAA (31 mentioning).
According to experimental articles, the highest percentage (90-100%) was obtained for 19 species: *S. pennellii*, *P. chenopodifolia*, *S. huaylasense*, *S. arcanum*, *S. macrocarpon*, *L. chinense*, *S. dulcamara*, *S. aethiopicum*, *S. pimpinellifolium*, *S. peruvianum*, *P. angulata*, *S. betaceum*, *P. peruviana*, *L. barbarum*, *S. nigrum*, *P. pubescens*, *S. aviculare* and 2 interspecific hybrids *S. melongena* x *S. aethiopicum* and (*S. pennellii* x *S. lycopersicum*) x *S. lycopersicoides*.
The genetic transformation experiments were mainly performed with *Solanum nigrum* (33 mentioning) and *Physalis pubescens* (36 mentioning), *S. peruvianum* (30 mentioning). Totally 26 plant species were transformed*: Lycium barbarum*, *L. ruthenicum*, *L. chinense*, *Physalis angulata*, *P. grisea*, *P. ixocarpa*, *P. peruviana*, *P. philadelphica*, *P. pruinosa*, *P. pubescens*, S. *aculeatissimum*, *S. aethiopicum*, *S. americanum*, *S. aviculare*, *S. betaceum*, *S. dulcamara*, *S. galapagense*, *S. lycopersicoudes*, *S. mammosum*, *S. muricatum*, *S. nigrum*. The leaf explants (86 mentioning) and stem explants (47 mentioning) 7–15-day-old (32 mentioning) were mainly used. Mainly *A. tumefaciens* GV3101 (58 mentioning), LBA 4404 (37 mentioning) were used which carrying out different genetic vectors. The highest percentage of transformation were obtained when LBA 4404 (10.02%–100% and EHA 105 (9,3–100% strains were used.
There are 73 genes which were transferred and incorporated into genomes of wild and semidomesticated *Solanaceae* species: *AcMYB110*, *als*, *AtGA20ox1*, *ATHK1, AtPAP1, bar, BC-ATPase, cas, Chl H, CmGA20ox1v, cry1A, DOLL1, DsRed2, GFP, gus, HBsAg, hmgr, hyg, INFA2β, JIP21, LbCCD4.1, LbERF5.1, LbNCED1,*

LbNR, LrCHS, LUC, LrERF5.1, LrF3HPro, LrFLS, LrKUP8, LrMYB1, LrMYB94, LrTCP4, LrWRKY32, MmGAox1, MmGAox2, MPF1, MPF2, MPF3, NEP-TC, NobPDS, nptII, P13, P5, PcGA2ox1, PDS, PF10, PF3, PF7, PfCNR1, PfCNR1L1, PfCNR1L2, PFCRC, PFGLO1, PFGLO2, POS1, PpPDS, RFP, rolA, rolB, rolD, Ruby, Rx4, Rx4CDS, sgfp, SgHKT1;1, SgHKT1;2, SmMYB113, SPL8, STMAD16, SYSFR, vir C. The following genes were used mainly: *hyg* (26 mentioning), *npt II* (101 mentioning), *gus* (29 mentioning), *INFA2β* (26 mentioning), *cry*A (12 mentioning) and *gfp* (12 mentioning).

The gene editing experiments were conducted mainly with *S. pimpinellifolium* (35 mentioning) and *P. grisea* (16 mentioning), 14–day old (12 mentioning) cotyledons (24 mentioning) and leaves (17 mentioning) were used. The usage of *A. tumefaciens* LBA4404 (pTC321 genetic vector, 26 mentioning and pTC603 vector, 4 mentioning) or pCAMBIA1300 strain (3 mentioning, different vectors) and AtCas9 (30 mentioning) or Cas9 (43 mentioning) resulted in highest editing efficiency (54.55–100%) what resulted in obtaining knockout mutants.

The following 46 genes were edited: *APETALA2, CLE9H, CycB, DHNA, FAS (CLV3), FW2, GGH, GGP1, HG18103, MULT (S), O, PDS, PFCRC, PgAN1, PgDEF, PgEJ2, PgER, PgGLO1, PgGLO2, PgLIN, PgMPF2, PgMPF3, PgRIN, PgSP, PgTAG1, PgTAGL1, PgTM6, Ppr-CLV1, Ppr-SP, Ppr-SP5G, Rx4, SnS, SnAN2, SnLazy1, SnMYB1, SnSP, SP, SP5G, SpRDR6, SpSGS3*; *SpPR-1, SpProSys, SpMlo1, WF2, WUS, Y*. The types of changes associated with editing of mentioned genes were following: changes of plant architecture (13 mentioning), changes of biochemical composition and fruit size (6 mentioning for each), changes in plant physiology (4 mentioning), changes susceptibility to bacteria and viruses (2 mentioning for each), change of fruit size (1 mentioning) what reflects main recent directions of *de novo* domestication of wild *Solanaceae* plants.

The comprehensiveness of the compiled data and analyses underscores their tremendous importance for advancing future research, providing a robust foundation for integrative studies aimed at elucidating broader perspectives in biotechnology and agriculture within the *Solanaceae* family.

SUPPLEMENTARY MATERIALS

The following supporting information can be downloaded at: https://drive.google.com/drive/folders/1sK1jLZP0VdQdx4F_MBVfZvG1HopZl6r- , **Table S1**: Biotechnology of orphan *Solanaceae* crops; **S2**: Links on graphics created in Flourish.com from experimental data; **S3**: Representative photos of *Solanaceae* species with legends.

The order of mentioning of each plant species in this review was organized according to recent approved taxonomy for *Solanaceae* species [543, 544]. Thus, authors of this review unified the names of several plant species according to the last approved norms of *Solanaceae* taxonomy [543, 544].

Author Contributions: Conceptualization, O.Y.; methodology, O.Y.; software, O.Y.; validation, O.Y.; formal analysis, O.Y.; investigation, O.Y.; resources, T.P.; data curation, O.Y.; writing—original draft preparation, O.Y.; writing—review and editing, O.Y and T.P.; visualization, O.Y.; supervision, T.P.; project administration, O.Y.; funding acquisition, O.Y. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: All data dedicated to biotechnological improvement, genetic engineeringand gene editing used for this review have been included in the **Supplementary tables**.

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Conflicts of Interest: The authors declare no conflicts of interest.

SUPPLEMENTARY S2: Links on graphics created in Flourish.com from experimental data

Link 1. Callus induction with growth regulators

https://public.flourish.studio/visualisation/22096845/

Numbers on the left show how many times particular plant species was obtained callus induction. Numbers in the center show in how many cases for specific plant species was obtained callus induction during usage particular combination of growth stimulants. Numbers on the right show how many times totally particular combination of growth stimulants was used for callus induction. n.c. – not conducted, n.d. – no data.

Link 2. Shoot regeneration achieved with growth regulators

https://public.flourish.studio/visualisation/23768643/

Numbers on the left show how many times for specific plant species was obtained shoot regeneration. Numbers in the center show in how many cases for concrete plant species was obtained shoot regeneration during usage particular combination of growth stimulants. Numbers on the right show how many times totally particular combination of growth stimulants was used for shoot regeneration. n.c. – not conducted, n.d. – no data.

Link 3. Shoot elongation initiated with growth regulators

https://public.flourish.studio/visualisation/23768976/

Numbers on the left show how many times for specific plant species was obtained shoot elongation. Numbers in the center show in how many cases for specific plant species was obtained shoot elongation during usage particular combination of growth stimulants. Numbers on the right show how many times totally particular combination of growth stimulants was used for shoot elongation. n.c. – not conducted, n.d. – no data.

Link 4. Rooting initiated with growth regulators

https://public.flourish.studio/visualisation/23768886/

Numbers on the left show how many times for specific plant species was obtained rooting. Numbers in the center show in how many cases for concrete plant species was obtained rooting during usage particular combination of growth stimulants. Numbers on the right show how many times totally particular combination of growth stimulants was used for rooting. n.c. – not conducted, n.d. – no data.

Link 5. Microclonal multiplication obtained with growth regulators

https://public.flourish.studio/visualisation/23769058/

Numbers on the left show how many times specific plant species were multiplicated microclonaly. Numbers in the center show in how many mentioning specific plant species were multiplicated microclonaly during usage concrete combination of growth stimulants. Numbers on the right show how many times totally particular combination of growth stimulants was used for microclonal multiplication. n.c. – not conducted, n.d. – no data.

Link 6. Results after shoot initiation, callus initiation, shoor elongation, rooting, microclonal multiplication, etc.

https://public.flourish.studio/visualisation/23769154/

Numbers on the left show in how many cases specific plant species was used for biotechnological manipulations. Numbers in the center show in how many cases with specific plant species were obtained particular types of results. Numbers on the right show how many times totally particular types of results were obtained. n.c. – not conducted, n.d. – no data.

Link 7. Transgenes incorporated into plant tissues after genetic transformation

https://public.flourish.studio/visualisation/23827396/

Numbers on the left show in how many cases specific plant species were used for genetic transformation. Numbers in the center show in how many cases into specific plant species were incorporated particular transgenes. Numbers on the right show in how many cases totally particular transgene was used for genetic transformation. n.c. – not conducted, n.d. – no data.

Link 8. Plant organs used for genetic transformation

https://public.flourish.studio/visualisation/23769671/

Numbers on the left show in how many cases specific plant species were used for genetic transformation. Numbers in the center show in how many cases from specific plant species was used particular type for explants for genetic transformation. Numbers on the right show in how many cases totally particular type of explant was used for genetic transformation. n.c. – not conducted, n.d. – no data.

Link 9. Plant species transformed with agrobacteria species

hflps://public.flourish.studio/visualisation/23769771/

Numbers on the left show in how many cases specific plant species were used for genetic transformation. Numbers in the center show in how many cases specific plant species were transformed with particular bacteria species. Numbers on the right show in how many cases particular agrobacteria species were used for genetic transformation.

Link 10. Agrobacteria species and agrobacteria strains used for genetic transformation

hflps://public.flourish.studio/visualisation/23769907/

Numbers on the left show in how many cases specific agrobacteria species were used for genetic transformation. Numbers in the center show in how many cases particular agrobacteria strains of particular agrobacteria species were used for genetic transformation. Numbers on the right show in how many cases particular agrobacteria strains were used for genetic transformation.

Link 11. Transformation of plant species achieved *via* different methods of transformation

hflps://public.flourish.studio/visualisation/23769876/

Numbers on the left show in how many cases specific plant species were used for genetic transformation. Numbers in the center show in how many cases specific plant species were transformed *via* particular transformation methods. Numbers on the right show in how many cases totally particular method of transformation was used.

Link 12. Results of genetic transformation

hflps://public.flourish.studio/visualisation/23769940/

Numbers on the left show in how many cases specific plant species were used for genetic transformation. Numbers in the center show in how many cases for specific plant species obtained particular type of results. Numbers on the right show in how many cases particular type of result was obtained after genetic transformation.

Link 13. Types of changes obtained after gene editing

hflps://public.flourish.studio/visualisation/22057375/

Diagram show which types of changes were obtsained after gene editing.

Link 14. Analysis of genes, which were edited

hflps://public.flourish.studio/visualisation/23770311/

Numbers on the left show in how many cases specific plant species were used for gene editing. Numbers in the center show in how many cases in specific plant species were edited particular genes. Numbers on the right show in how many cases totally particular gene was edited. n.c. – not conducted, n.d. – no data.

Link 15. Analysis of Cas types used for editing

hflps://public.flourish.studio/visualisation/23770344/

Numbers on the left show in how many cases specific plant species were used for gene editing. Numbers in the center show in how many cases specific plant species were edited with particular Cas type. Numbers on the right show in how many cases totally particular Cas type was used. n.c. – not conducted, n.d. – no data.

Link 16. Analysis of types of plant organs which were used for editing

hflps://public.flourish.studio/visualisation/23770378/

Numbers on the left show in how many cases specific plant species were used for gene editing. Numbers in the center show in how many cases from specific plant species was used particular type of explant for gene editing. Numbers on the right show in how many cases totally particular type of explant was used for gene editing. n.c. – not conducted, n.d. – no data.

Link 17. Strains of agrobacteria used for gene editing

hflps://public.flourish.studio/visualisation/23770391/

Numbers on the left show in how many cases specific plant species were used for gene editing. Numbers in the center show in how many cases specific plant species were edited with particular *Agrobacterium* strain. Numbers on the right show in how many cases totally particular Agrobacterium strain was used for gene editing. n.c. – not conducted, n.d. – no data.

Link 18. Analysis of changes types after editing of particular plant species

hflps://public.flourish.studio/visualisation/23770413/

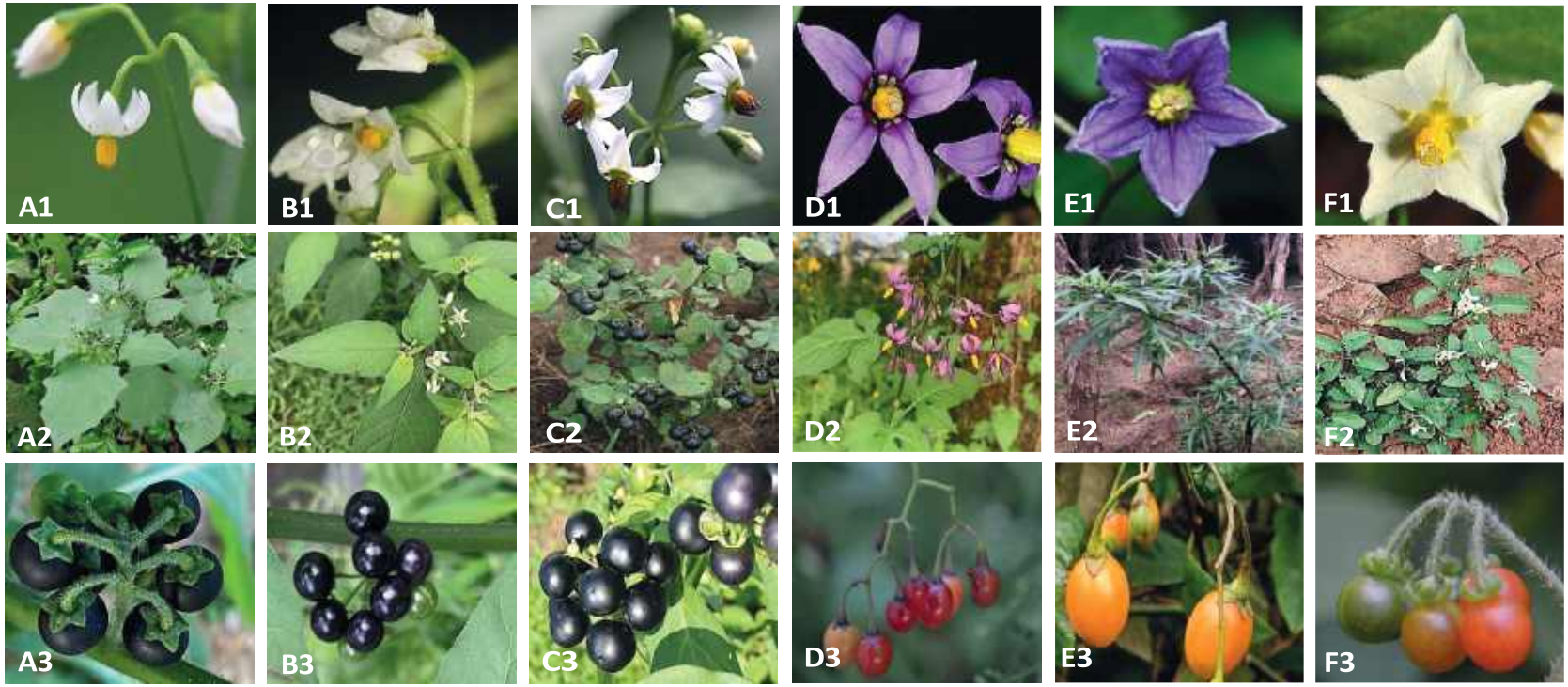
Numbers on the left show in how many cases specific plant species were used for gene editing. Numbers in the center show in how many cases for specific plant species were obtained particular type of changes. Numbers on the right show in how many cases particular type of changes was obtained after gene editing. n.c. – not conducted, n.d. – no data.

Link 19. Analysis of genes which were edited and changes in mutant plants

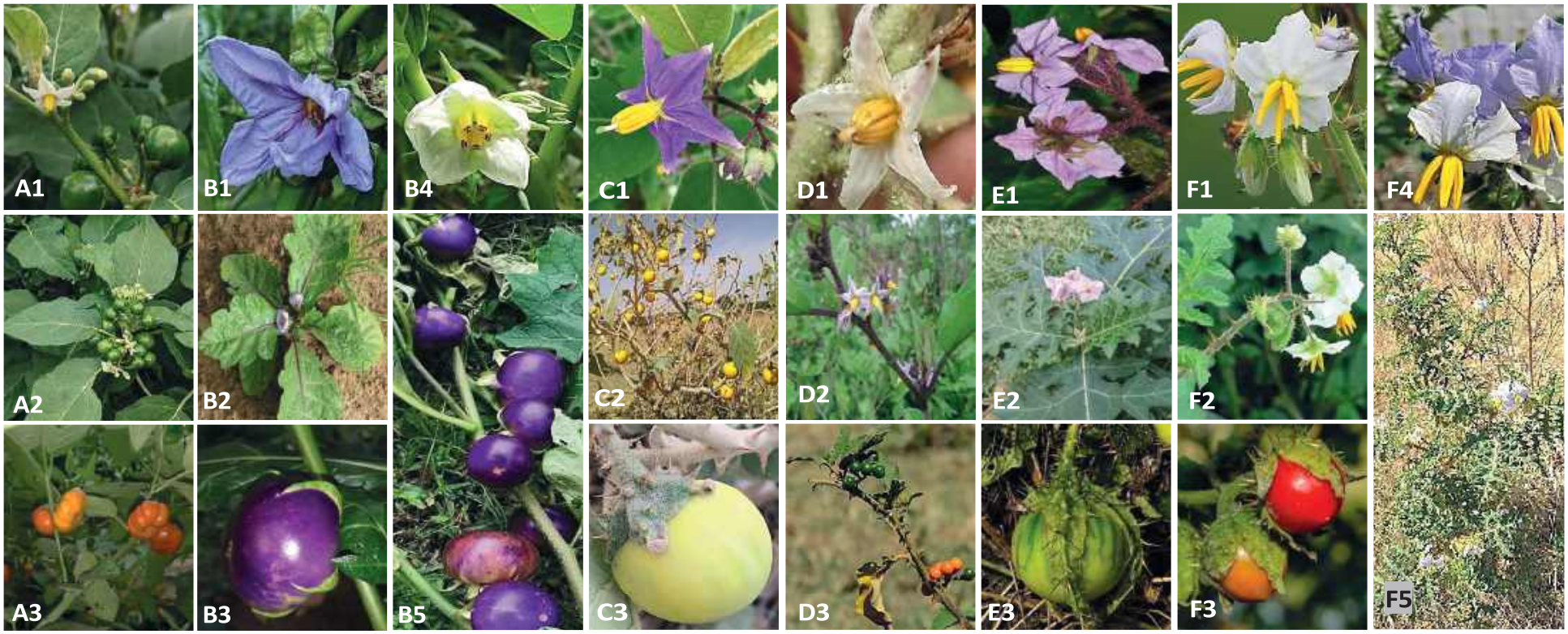
hflps://public.flourish.studio/visualisation/23770445/

Numbers on the right show in how many cases totally particular gene was edited. Numbers in the center show which type of changes associated with editing of particular gene. Numbers on the right show in how many cases particular type of changes was obtained after gene editing. n.c. – not conducted, n.d. – no data.

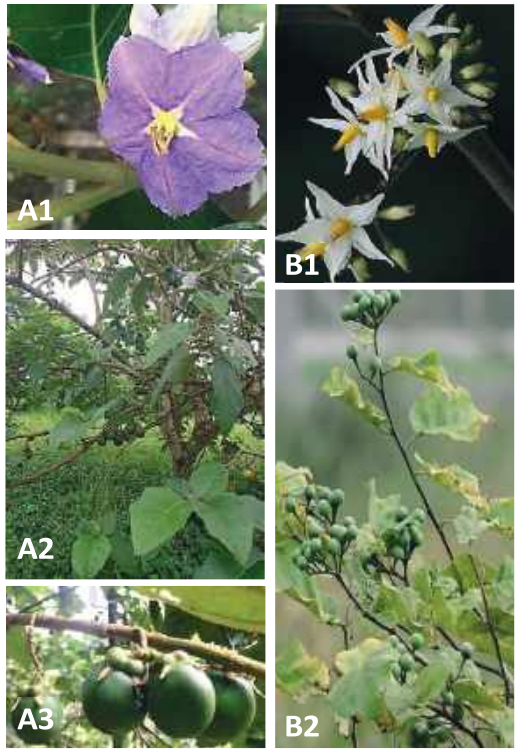
SUPPLEMENTARY S3: Representative photos of *Solanaceae* species



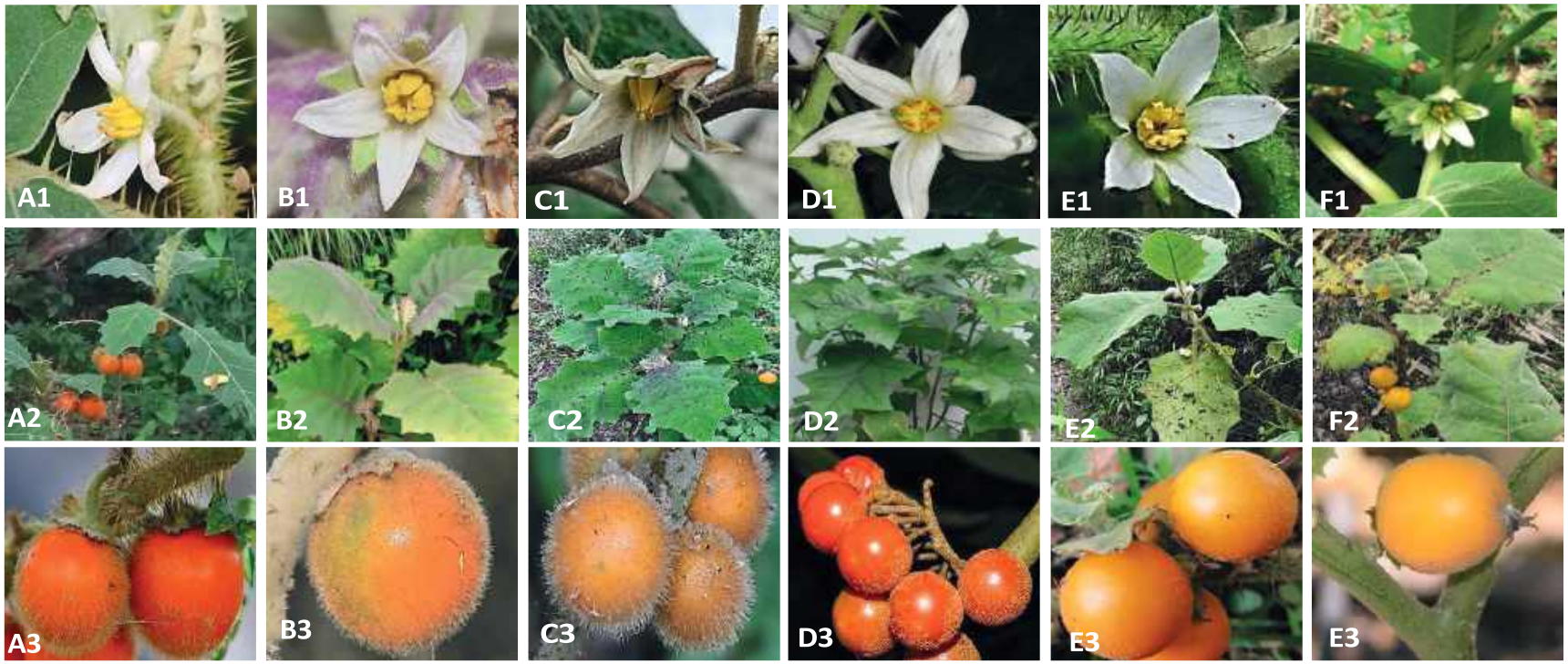
Clade I. Major clade DuIMo (A, D, C, E) and VANAns (D, F,). A1 [545], A2 [546], A3 [547], B1 [548], B2 [549], B3 [549], C1[550], C2 [550], C3 [551], D1 [552], D2 [553], D3 [554], E1 [555], E2 [556], E3 [557], F1 [558], F2 [559], F3 [560], **A -** ***Solanum nigrum,*** **B -** ***Solanum americanum*** **, C -*****Solanum scabrum*** **, D -** ***Solanum dulcamara,*** **E -** ***Solanum aviculare*** **, F -** ***Solanum villosum***



Clade II. Major clade ***Leptostemonum.*** A1 [566], A2 [567], A3 [568], B1 [569], B2 [570], B3 [571] , B4 [572] , B5 [573], C1 [574] , C2 [575], C3 [575], D1 [576], D2 [577], D3 [578], E1 [579], E2 [580], E3 [581], F1 [582], F2 [583], F3 [584], F4 [585], F5 [586], **A -** ***Solanum aethiopicum,*** **B -** ***Solanum macrocarpon,*** **C -** ***Solanum incanum*** **, D1 -** ***Solanum anguivi,*** **E -** ***Solanum dasyphyllum,*** **F -** ***Solanum sisymbriifolium***

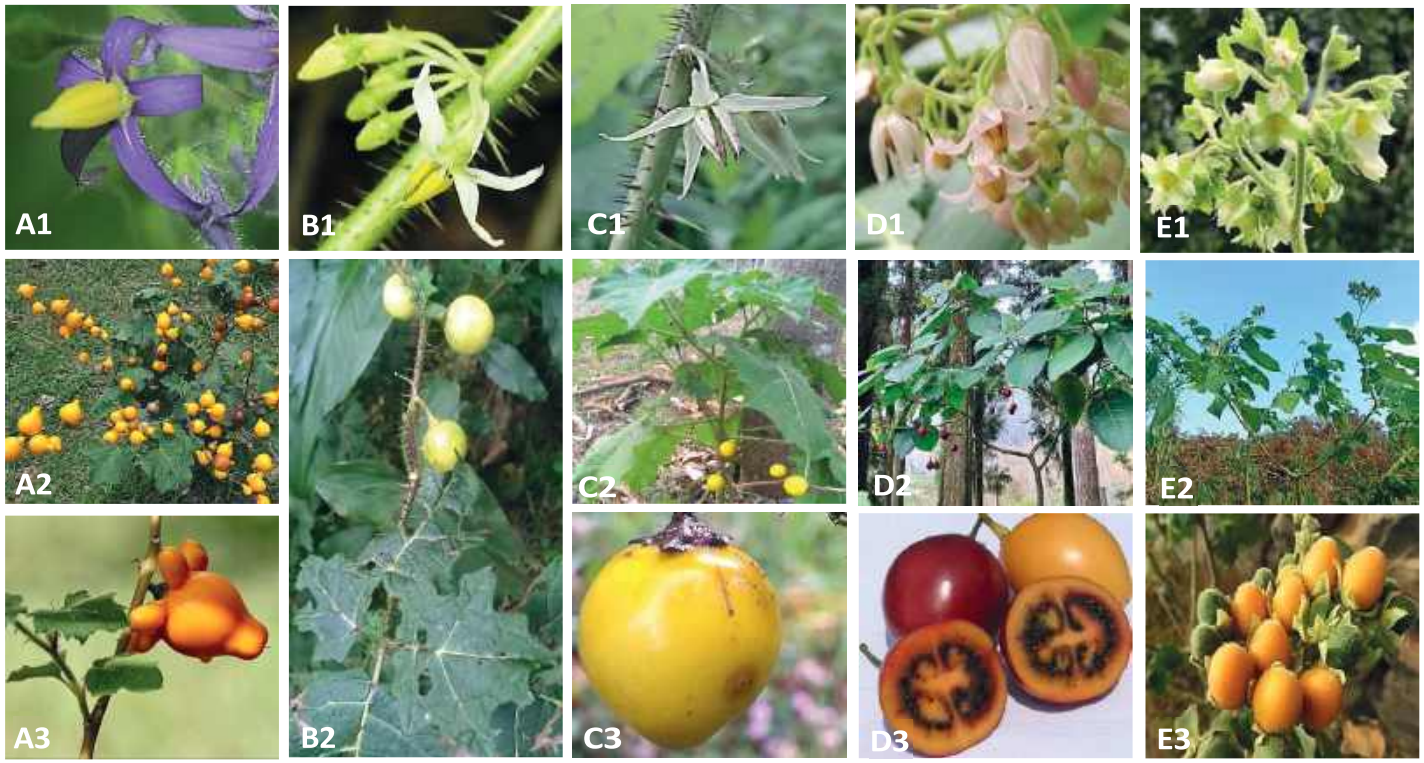


Clade II. Major clade *Leptostemonum.* A1 [561], A2 [562], A3 [563], B1 [564], B2 [565], **A** - *Solanum grandiflorum*, **B** – *Solanum torvum*

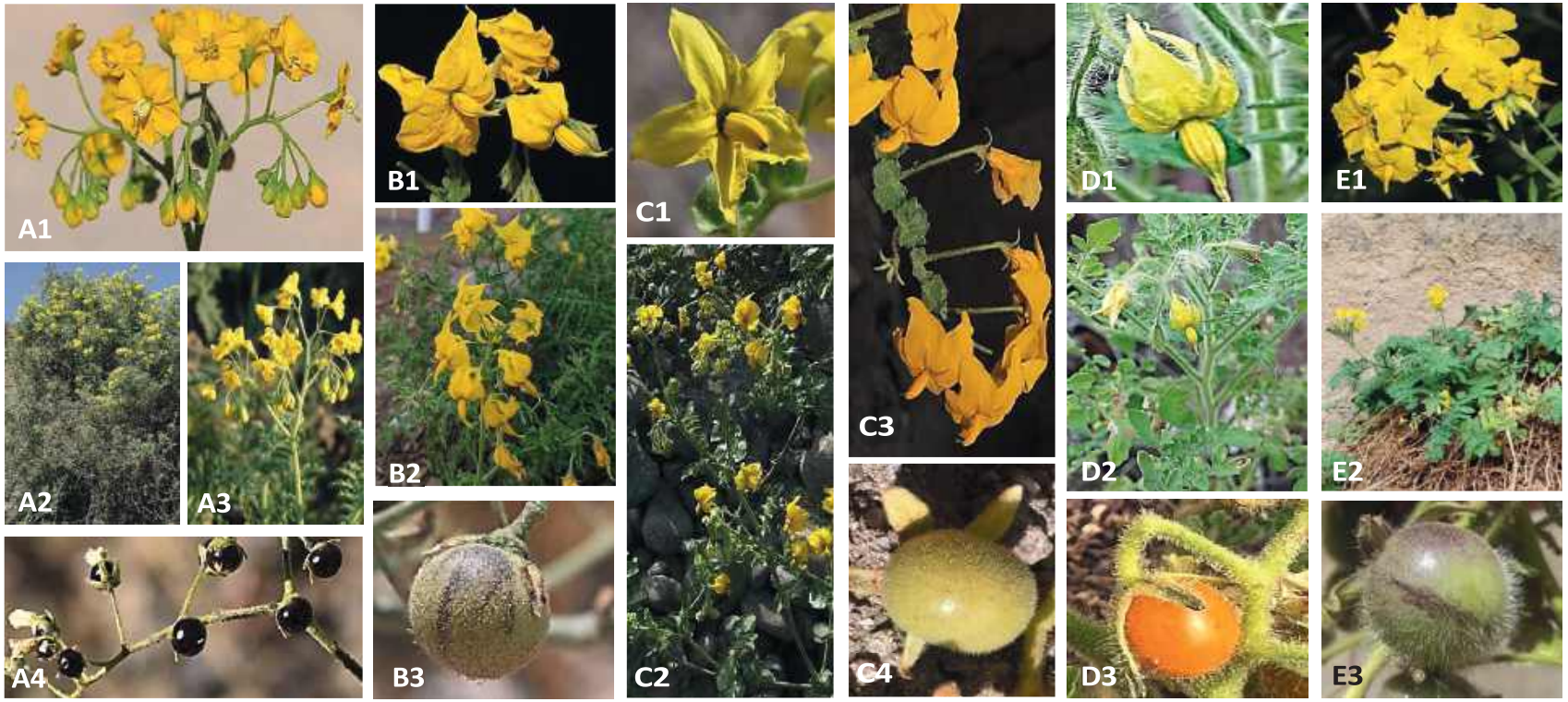


Solanum candidum *Solanum quitoense* *Solanum lasiocarpum* *Solanum stramoniifolium* *Solanum pseudolulo* *Solanum sessiliflorum*

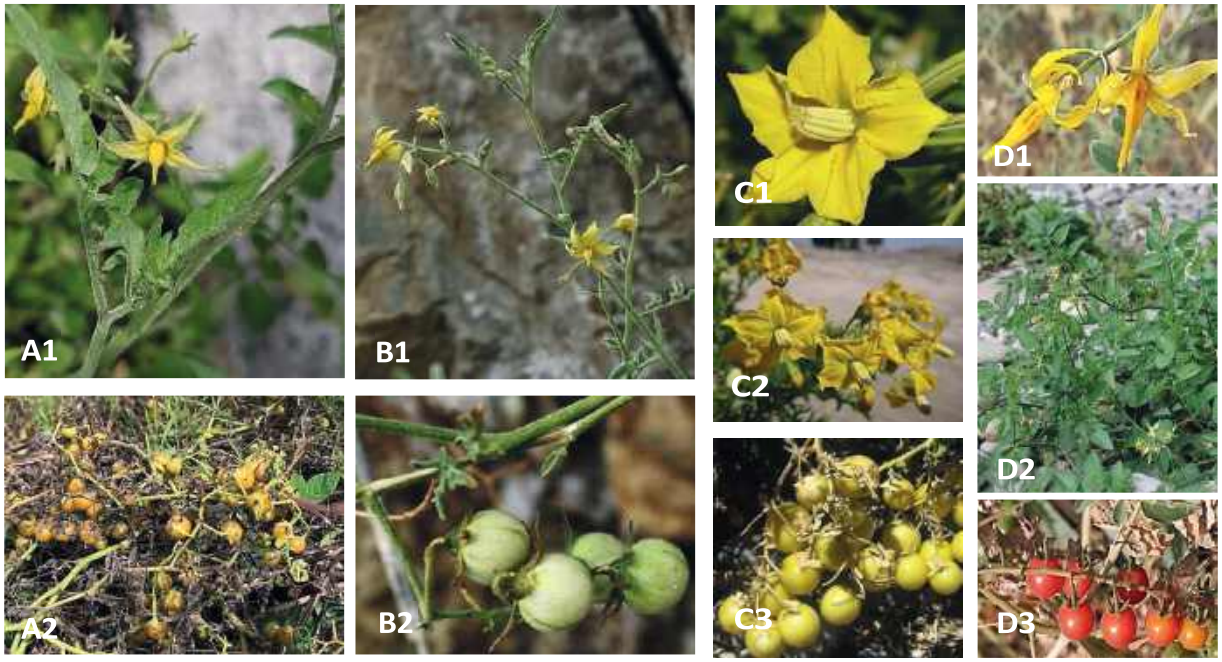
Clade II. Major clade ***Leptostemonum.*** A1 [587], A2 [588], A3 [589], B1 [590], B2 [591], B3 [590], C1 [592], C2 [593], C3 [594], D1 [595], D2 [596], D3 [597], E1 [598], E2 [599], E3 [600], F1 [601], F2 [602], F3 [603], **A-** ***Solanum candidum*****, B -** ***Solanum quitoense*****, C -** ***Solanum lasiocarpum*****, D -** ***Solanum stramoniifolium*****, E -** ***Solanum pseudolulo*****, F -** ***Solanum sessiliflorum***



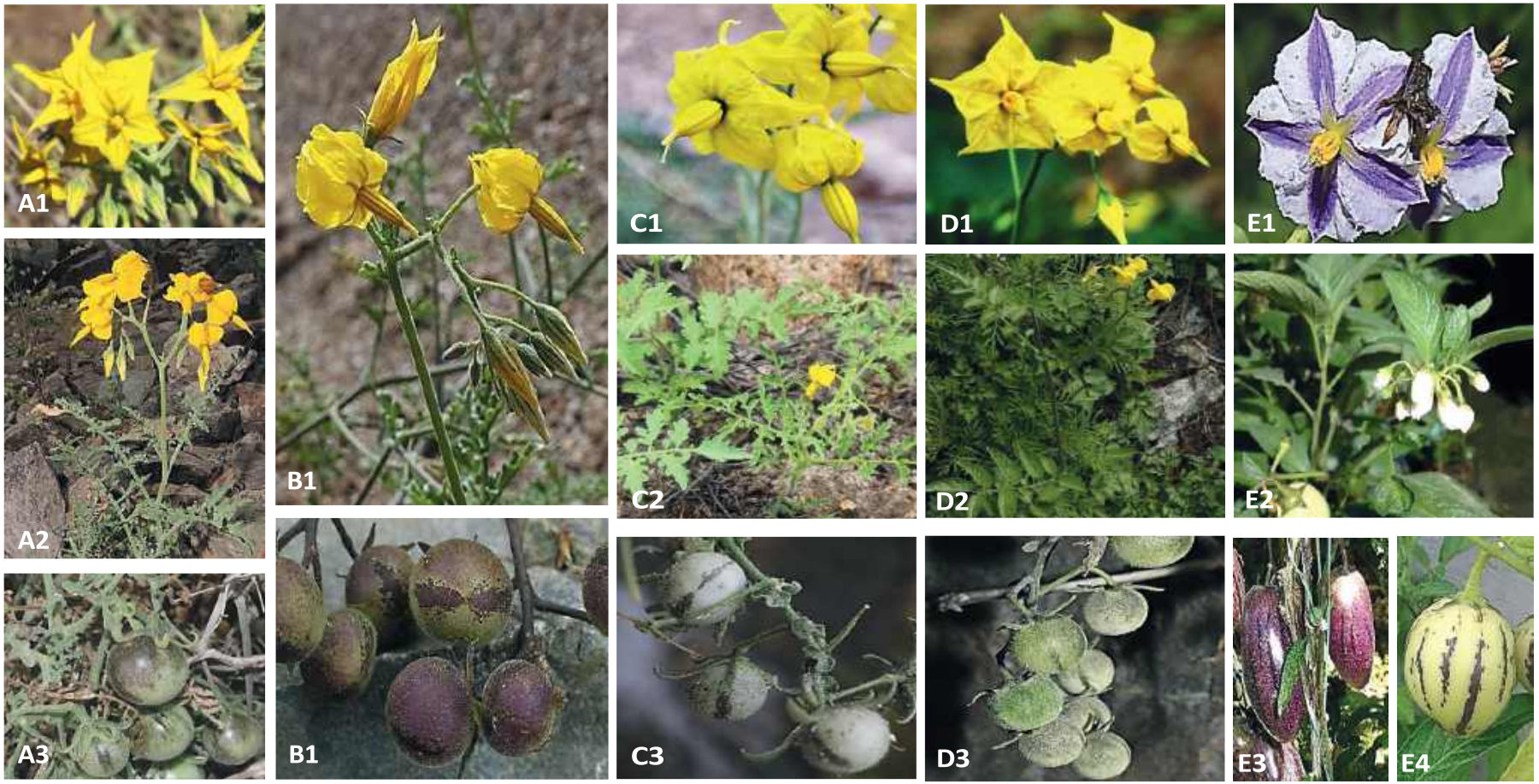
Clade II. Major clade *Leptostemonum* (A, B, C), Subgenus *Cyphomandra* (D3), subgenus *Brevantherum* (E). A1 [602], A2 [605], A3 [606], B1 [607], B2 – [608], C1 [609], C2 [610], C3 [611], D1 [612], D2 [613], D3 [614], E1 [615], E2 [616], E3 [617], **A – *Solanum mammosum*, B – *Solanum aculeatissimum*, C – *Solanum myriacanthum*, D – *Solanum betaceum*, E – *Solanum abutiloides***



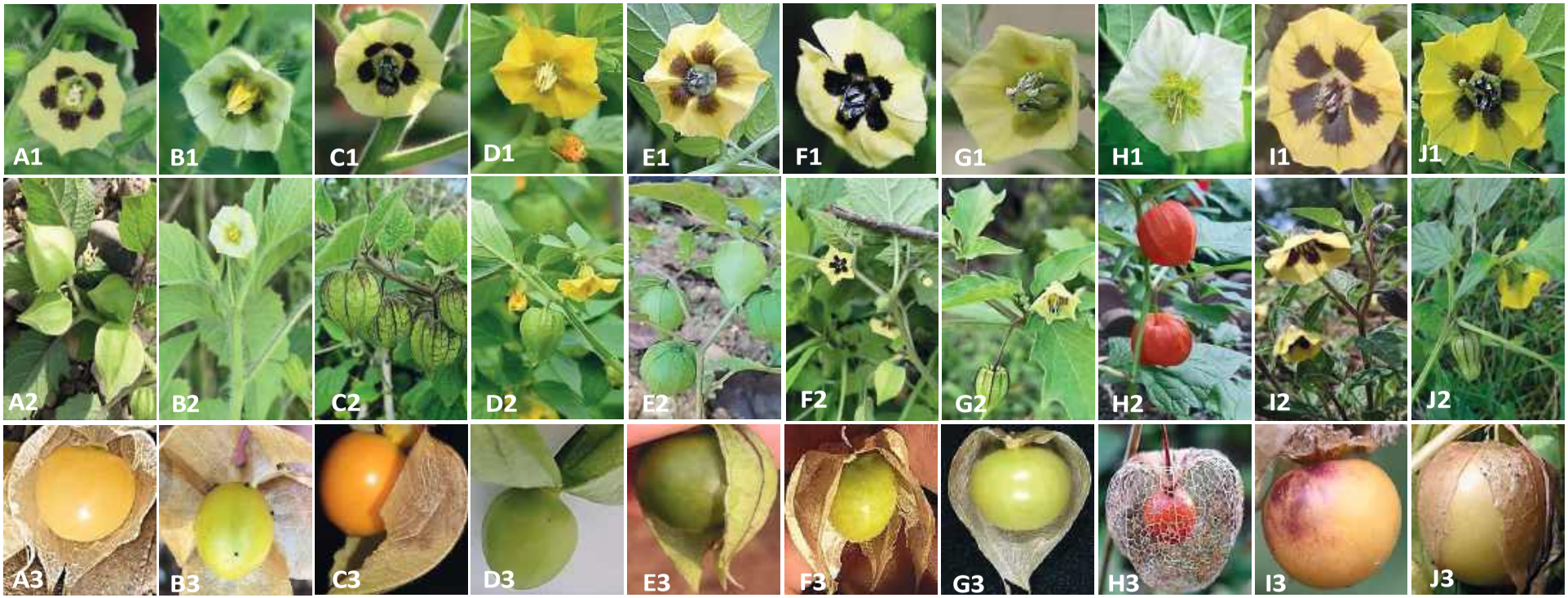
Clade I. Major clade *Potato*. A1 [618], A2 [619], A3 [620], A4 [621], B1 [622], B2 [623], B3 [625], C1 [625], C2 [626], C3 [627], C4 [628], D1 [629], D2 [630], D3 [630], E1 [631], E2 [632], E3 [633]. **A - *Solanum lycopersicoides*, B - *Solanum peruvianum*, C - *Solanum peruvianum*, D - *Solanum galapagense*, E - *Solanum habrochaites***



Clade I. Major clade *Potato*. A1 [634], A2 [635], B1 [636], B2 [637], C1 [638], C2 [639], C3 [640], D1 [641], D2 [642], D3 [643], **A - *Solanum cheesemaniae*, B - *Solanum chmielewskii*, C - *Solanum sitiens*, D - *Solanum pimpinellifolium***

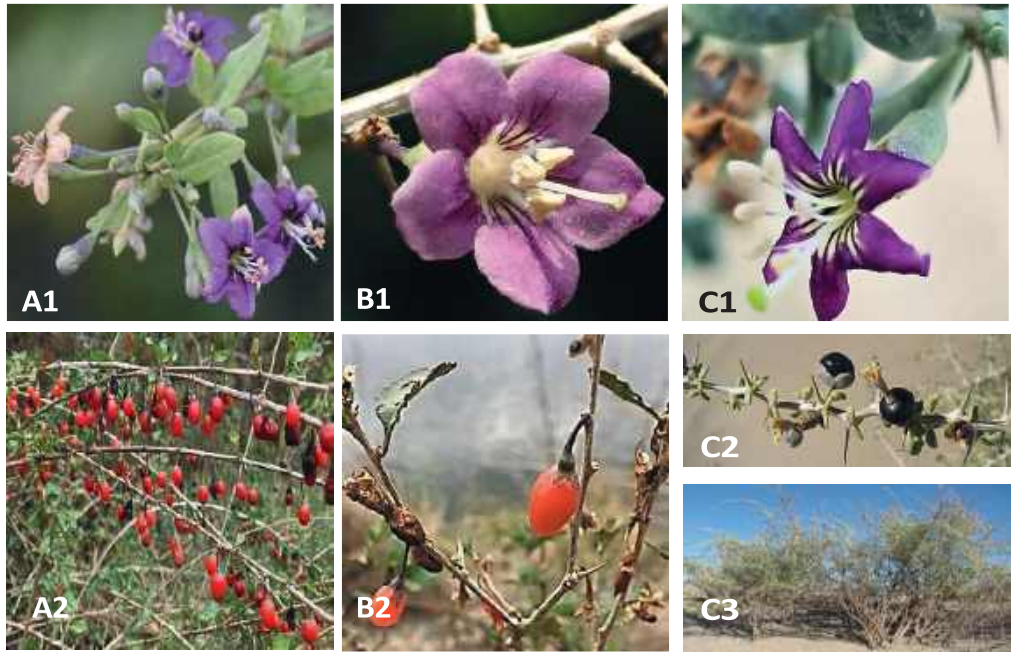


Clade I. Major clade ***Potato.*** A1 [644], A2 [645], A3 [646], B1 [647], B2 [648], C1 [649], C2 [650], C3 [651], D1 [652], D2 [653], D3 [655], E1 [655], E2 [656], E3 [657], E4 [658], **A -** ***Solanum chilense*****, B -** ***Solanum huaylasense*****, C -** ***Solanum corneliomulleri*****, D –** ***Solanum arcanum*****, E –** ***Solanum muricatum***



P. grisea *P. pruinosa* *P. peruviana* *P. ixocarpa* *P. ixocarpa* *P. pubescence* *P. angulata* *A. officinarum* *P. chenopodiifolia* *P. philadelphica*

Clade VI-7. Subgenus ***Solanoideae***. A1[659], A2 [660], A3 [660], B1 [661], B2 [662], B3 [663], C1 [664], C2 [665], C3 [666], D1 [667], D2 [667], D3 [668], E1 [669], E2 [670], E3 [671], F1 [672], F2 [673], F3 [674], G1 [675], G2 [676], G3 [676], H1 [677], H2 [678], H3 [679], I1 [680], I2 [681], I3 [682], J1 [683], J2 [684],J3 [685], A - ***P. grisea,*** **B** **-** ***P. pruinosa,*** **C** **-** ***P. peruviana,*** **D** and **E** **-*****P. ixocarpa,*** **F** **-** ***P. pubescence,*** **G** **-** ***Ph. angulata,*** **H** **-*****Alkekengi officinarum,*** **I** **-** ***P. Chenopodiifolia,*** **J** **-** ***P. philadelphica***



Lycium barbarum *Lycium chinense* *Lycium ruthenicum*

Clade VI-1. Subfamily *Solanoideae, tribe Lycieae*. A1 [686], A2 [687], B1 [688], B2 [689], C1 [690], C2 [691], C3 [691], **A -** ***Lycium barbarum***, **B -** ***Lycium chinense***, C - ***Lycium ruthenicum***

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НОВІ ПІДХОДИ ДО ОДОМАШНЕННЯ ДИКИХ ПАСЛЬОНОВИХ: МОРФОЛОГІЧНЕ РІЗНОМАНІТТЯ, БІОХІМІЧНИЙ СКЛАД, ГЕНЕТИЧНА ТРАНСФОРМАЦІЯ ТА РЕДАГУВАННЯ ГЕНІВ

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