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Networking, partnerships and tools to enhance in situ conservation of
European plant genetic resources

***In situ* plant genetic resources in Europe: landraces**

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https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2020/06/D1.2_in_situ_PGR_in_Europe_landraces.pdf

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Executive Summary

One of the aims of the Farmer's Pride project is to increase knowledge of plant genetic resources *in situ* in Europe. To this end, extensive data have been collected on landrace populations maintained *in situ* using a standard data collection format, involving collaborators in the Farmer's Pride project and members of the European Cooperative Programme for Plant Genetic Resources.

A total of 19,335 records of landraces¹ conserved *in situ* were collected from 17 institutions, including forage, cereal, pulse and garden crops and fruit trees. The data presented constitute the largest ever produced database of *in situ* maintained landraces and the first example of an inventory for an entire region of the world that can serve the European Commission to better plan conservation activities and policies.

In addition, to learn why and how landraces are currently conserved and managed *in situ* and which tools can be used to promote their cultivation, we collected more than 100 detailed case studies from 14 European countries. Analysis of the case studies shows that the varieties are mainly grown for their resistance to and good productivity under harsh climatic conditions, for traditional reasons, or for organoleptic peculiarities which make them highly valued on the local and city markets. Management of landraces varies significantly, but they are generally grown using modern agricultural equipment and tools, often under low input or organic conditions. Farmers, alone or grouped in consortia, are the main actors carrying out seed multiplication with seed companies only playing a marginal role. This landrace case study collection is being used to create a best practice online free database and to prepare guidelines for landrace *in situ* management and access which can help new farmers in starting landrace cultivation and farmers maintaining landraces to promote their products.

¹ 'Landraces' are considered here in a broad sense and include true landraces, conservation and amateur varieties, populations and old cultivars.

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1.0 Introduction

Crop diversity maintained in the fields is a vital resource for food, nutrition and economic security, which maintains its evolutionary potential and continuously sustains the local livelihood and the local culture. One of the objectives of the Farmer's Pride project is to develop regional conservation and promote strategies for landraces (*i.e.* heterogeneous crop populations).

Some information on *in situ* (on-farm/in-garden) maintained landraces was available at the beginning of the Farmer's Pride project (Veteläinen et al. 2009; 2012) that was gathered through activities carried out during the previous EC funded projects (see AEGRO, <http://aegro.julius-kuehn.de/aegro/> and PGR SECURE, <http://vnr.unipg.it/PGRSecure/>) and by the "On-Farm Working Group" of the European Cooperative Program on Genetic Resources (ECPGR).

Since no conservation strategy can be developed without knowing where landraces are, which species they belong to, why and how they are still maintained, the project activities initially focused on gaining a detailed view of landraces still maintained *in situ* (on-farm/in-garden) in Europe and creating a

European inventory of *in situ* landraces. Then detailed information was collected on landrace case studies across Europe.

2.0 Knowledge of landrace resources maintained *in situ*

2.1 Building the first European inventory of *in situ* maintained landraces

2.1.1 Data collection

As an initial step an online survey was carried out to gain an understanding of the range of stakeholders involved, or with an interest in, *in situ* conservation and sustainable use of plant genetic resources (PGR) and to help ensure full stakeholder representation in the proposed European network for PGR *in situ* conservation and sustainable use². The survey, available in ten different languages, yielded a total of 1,022 responses from stakeholders working in 35 different countries³.

To gather information on *in situ* (on-farm/in garden) maintained landraces, a second online survey was planned. However, complications due to the inception of new data protection regulations arose. Therefore, such data were collated using an *ad hoc* template prepared for collecting anonymous data on *in situ* maintained landraces using a subset of descriptors from those described in Negri *et al.* (2012) (Table 1). The use of a subset of the descriptors was intended to maximize the number of responses (*i.e.* the number of recorded on-farm landraces) by reducing the time needed by the respondents to complete the template.

To be very inclusive regarding populations that could potentially be included in the proposed European network, thus increasing its value, information was asked on:

- true landraces
- conservation and amateur varieties as defined in the Commission Directives 2008/62/EC and 2009/145/EC (EC, 2008, 2009)
- populations as defined in the Commission Implementing Decision of 18 March 2014 (EC, 2014)
- obsolete cultivars

In fact, all these materials can be referred to as landraces (in a broad sense) following the definition of ECPGR (2017)⁴.

² <https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2020/03/Farmers-Pride-Network-Concept.pdf>

³ <https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2019/10/D1.1 Identify in situ stakeholders.pdf>

⁴ https://www.ecpgr.cgiar.org/fileadmin/bioversity/publications/pdfs/ECPGR_Concept_for_on_farm_final_05_05_2017_bis.pdf

In May 2019 the template was sent to Farmer's Pride Consortium Members, Farmer's Pride Ambassadors (experts collaborating with the project partners) and ECPGR National Coordinators asking for data on known sites of cultivations (records) of landraces in their respective countries. Among others, collected information included: landraces name, genus, species, location of cultivation (including geographic coordinates where available) and country. To avoid the possibility of uniquely associating a certain landrace to the maintainer who cultivates it, geographic coordinates of the location where landraces are cultivated were purposely requested with a relatively low level of accuracy. This approach guarantees farmer anonymity in compliance with the General Data Protection Regulation (GDPR)⁵.

Finally, some existing information on on-farm/in-garden conserved landraces (Veteläinen *et al.* 2009; 2012) was included in the database.

⁵ https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2016.119.01.0001.01.ENG

Table 1. List of fields used for on-farm landraces data recording (adapted from Negri et al. 2012).

FIELD	ACRONYM
0. Progressive Number*	PN
1. INVENTORY IDENTIFICATION	
1.1. National Inventory code (NICODE) * Country code identifying the National in situ landrace (LR) Inventory; the code of the country preparing the National Inventory. For country codes use the three-letter ISO 3166-1 (see: http://unstats.un.org/unsd/methods/m49/m49alpha.htm).	NICODE
2. TAXON IDENTIFICATION	
2.1. Genus (GENUS) * Genus name for taxon, in Latin. Initial uppercase letter required.	GENUS
2.2. Species (SPECIES) * Specific epithet portion of the scientific name, in Latin, in lower case letters.	SPECIES
2.4. Subtaxa (SUBTAXA) This field can be used to store any additional taxonomic identifier (in Latin, in lower case letters) preceded by the rank (for example: subspecies, convariety, variety, form, cultivar group). The following abbreviations are foreseen for the rank: 'subsp.' (for subspecies); 'convar.' (for convariety); 'var.' (for variety); 'f.' (for form), 'Group' (for cultivar group).	SUBTAXA
2.7. Common crop name (CROPNAME) Name of the crop in colloquial language, preferably English if any.	CROPNAME
3. LANDRACE/POPULATION IDENTIFICATION	
3.3. Landrace local name/s (LRNAME) * Local name/s of the LR in the colloquial language of the farm. Free text.	LRNAME
4. SITE/LOCATION IDENTIFICATION	
4.1. Farm location: primary administrative subdivision of the country where farm is located (FARMFIRSTADMIN) Name of the primary administrative subdivision of the country where the farm is located for the most part of its extension. Free text.	FARMFIRST ADMIN
4.2. Farm location: secondary administrative subdivision (FARMSECONDADMIN) Name of the secondary administrative subdivision (within the primary administrative subdivision) of the country where the farm is located.	FARMSECOND ADMIN
4.7.1. Latitude of LR site (LRSLATDMS) Degrees (2 digits) minutes (2 digits), and seconds (2 digits) followed by N (North) or S (South).	LRSLATDMS
4.7.1.BIS Latitude of LR site (LRSLATDD) * Latitude expressed in decimal degrees.	LRSLATDD
4.7.2. Longitude of LR site (LRSLONGDMS) Degrees (3 digits), minutes (2 digits), and seconds (2 digits) followed by E (East) or W (West)	LRSLONG DMS
4.7.2. BIS Longitude of LR site (LRSLONGITUDEDD) * Longitude expressed in decimal degrees.	LRSLONGITUD EDD
4.8. Elevation of LR site (LRSELEVATION) * Elevation of LR site expressed in meters above sea level. Negative values are allowed.	LRSELEVATION

6. THE LANDRACE	
6.1. Landrace total area (LRTOTAREA) The total area (ha) cultivated under the inventoried LR on that farm as from farmer statement.	LRTOTAREA
8. REMARKS The remarks field is used to add notes or to elaborate on descriptors with value 99 or 999 (=Other). Prefix remarks with the field name they refer to and make them follow by a colon (:). Distinct remarks referring to different fields are separated by semicolons (;) without space.	REMARKS

* Mandatory fields.

2.1.2 Results and discussion

A total of 19,335 on-farm/in-garden conserved landraces were recorded by respondents from 17 institutions (Table 2) in November 2019. It is worth noting that 19.8% of the total records (3,831 out of 19,335) are located in Natura 2000 protected areas.

Table 2. List of Institutions that provided information on in situ maintained landraces.

Institution Name	Institution acronym	Role*	Country	Provided records
Arche Noah	ARCN	FP Partner	AUS	4489
Banco Portugues de Germoplasma Vegetal	BPGV	FP Partner	PRT	3050
Banca de Resurse Vegetal "Mihai Cristea" Suceava	SV genebank	ECPGR Member	ROU	128
Centro Ricerche Produzioni Vegetali	CRPV	FP Ambassador	ITA	36
Crop Research Institute	CRI	FP Ambassador	CZE	196
Danish Seed Savers	DSS	FP Partner	DNK	103
Estonian Crop Research Institute	-	FP Ambassador	EST	17
Federal Office for Agriculture and Food	BLE	ECPGR member	DEU	214
Hellenic Agricultural Organisation	DIMITRA	FP Partner	GRC	4688
The Scottish Crofting Federation	SCF	FP Ambassador	GBR	10
Natural Resources Institute	LUKE	FP Partner	FIN	213
Swedish Board of Agriculture	-	FP Ambassador	SWE	137
Università degli Studi di Perugia	UNIPG	FP Partner	ITA	5399
University of Birmingham	UOB	FP Coordinator	GBR	254
University of Zagreb	-	FP Ambassador	HRV	24
Universitat Politècnica de València	UPV	FP Partner	ESP	61
Universidad Rey Juan Carlos	URJC	FP Partner	ESP	316

* Role of the person who provided the data.

The number of records obtained across the 14 countries for which data were provided or available was highly variable: Austria (4,489), Croatia (24), Czech Republic (196), Denmark (103), Estonia (17), Finland (213), Germany (214), Greece (4,688), Italy (5,435), Portugal (3,050), Romania (128), Spain (377), Sweden (137) and United Kingdom (264) (Figure 1). Italy is the country where the highest number of cultivation records was collected, followed by Greece, Austria and Portugal.

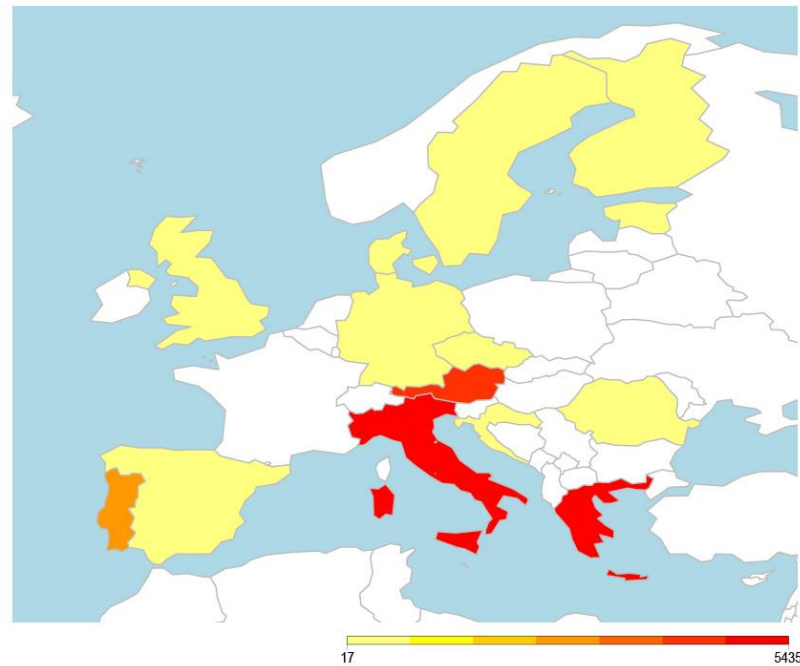


Figure 1. Heatmap of number of records by country. In the figure colours range from yellow (very low number) to dark red (very high number) in relation to the maximum number of records.

The 19,335 records of *in situ* landraces belong to 121 genera (Table 3). *Triticum* (2,498 records), *Phaseolus* (1,870), *Solanum* (1,175), *Malus* (1,072), *Prunus* (958), *Cucurbita* (942), *Secale* (780), *Fagopyrum* (775), *Pyrus* (748) and *Cucumis* (723) are the ten genera encompassing the largest numbers of records (about 60% of the total).

Table 3. List of genera to which recorded landraces belong with the relative number of records by genus.

Genus	n.	Genus	n.	Genus	n.	Genus	n.
<i>Abelmoschus</i>	88	<i>Cuminum</i>	3	<i>Luffa</i>	7	<i>Rheum</i>	21
<i>Allium</i>	613	<i>Cydonia</i>	16	<i>Lupinus</i>	28	<i>Ribes</i>	2
<i>Amaranthus</i>	14	<i>Cynara</i>	73	<i>Lycopersicon</i>	17	<i>Rorippa</i>	2
<i>Anethum</i>	48	<i>Daucus</i>	37	<i>Maclura</i>	1	<i>Rosa</i>	3
<i>Apium</i>	79	<i>Diospyros</i>	40	<i>Malus</i>	1072	<i>Rubia</i>	5
<i>Arachis</i>	10	<i>Dipsacus</i>	1	<i>Matricaria</i>	1	<i>Rumex</i>	1
<i>Arbutus</i>	3	<i>Elettaria</i>	5	<i>Medicago</i>	47	<i>Salsola</i>	1
<i>Asparagus</i>	5	<i>Eriobotrya</i>	25	<i>Melissa</i>	1	<i>Salvia</i>	2
<i>Atriplex</i>	6	<i>Eruca</i>	13	<i>Mentha</i>	4	<i>Satureja</i>	2
<i>Avena</i>	246	<i>Fagopyrum</i>	775	<i>Mespilus</i>	5	<i>Scolymus</i>	1
<i>Beta</i>	72	<i>Ficus</i>	111	<i>Morus</i>	43	<i>Secale</i>	780
<i>Borago</i>	1	<i>Foeniculum</i>	14	<i>Nicotiana</i>	4	<i>Sesamum</i>	26
<i>Brassica</i>	679	<i>Fragraria</i>	5	<i>Ocimum</i>	69	<i>Setaria</i>	9
<i>Calendula</i>	2	<i>Glycyrrhiza</i>	1	<i>Olea</i>	228	<i>Sinapis</i>	12
<i>Camelina</i>	110	<i>Gossypium</i>	1	<i>Onobrychis</i>	44	<i>Solanum</i>	1175
<i>Capsicum</i>	491	<i>Hedysarum</i>	5	<i>Opuntia</i>	9	<i>Sorbus</i>	24

<i>Carthamus</i>	1	<i>Helianthus</i>	35	<i>Origanum</i>	22	<i>Sorghum</i>	51
<i>Castanea</i>	80	<i>Helichrysum</i>	1	<i>Oryza</i>	5	<i>Spinacia</i>	41
<i>Ceratonia</i>	6	<i>Hordeum</i>	150	<i>Panicum</i>	20	<i>Tanacetum</i>	1
<i>Chaenomeles</i>	1	<i>Humulus</i>	18	<i>Papaver</i>	560	<i>Thymus</i>	2
<i>Cicer</i>	149	<i>Hypericum</i>	1	<i>Pastinaca</i>	8	<i>Trifolium</i>	132
<i>Cichorium</i>	60	<i>Jasminum</i>	2	<i>Petroselinum</i>	112	<i>Trigonella</i>	11
<i>Citrullus</i>	177	<i>Juglans</i>	27	<i>Phaseolus</i>	1870	<i>Triticum</i>	2498
<i>Citrus</i>	29	<i>Lablab</i>	13	<i>Phleum</i>	4	<i>Vicia</i>	267
<i>Coriandrum</i>	89	<i>Lactuca</i>	213	<i>Pimpinella</i>	9	<i>Vigna</i>	270
<i>Cornus</i>	4	<i>Lagenaria</i>	71	<i>Pistacia</i>	5	<i>Vitis</i>	445
<i>Corylus</i>	41	<i>Lathyrus</i>	114	<i>Pisum</i>	216	<i>Zea</i>	623
<i>Crataegus</i>	11	<i>Lavandula</i>	1	<i>Prunus</i>	958	<i>Ziziphus</i>	6
<i>Crocus</i>	1	<i>Lens</i>	151	<i>Punica</i>	33	-	-
<i>Cucumis</i>	723	<i>Levisticum</i>	1	<i>Pyrus</i>	748	-	-
<i>Cucurbita</i>	942	<i>Linum</i>	23	<i>Raphanus</i>	45	-	-

The results show that at least 190 crop species are still cultivated as landraces (Table 4). *Triticum spelta* (1,820 records), *Phaseolus vulgaris* (1,785), *Malus domestica* (1,061), *Solanum lycopersicum* (838), *Fagopyrum esculentum* (775), *Pyrus communis* (748), *Secale cereale* (669), *Zea mays* (623), *Cucumis melo* (574), *Papaver somniferum* (560), *Prunus avium* (525), *Brassica oleracea* (461), *Cucurbita pepo* (457), *Capsicum annuum* (446) and *Vitis vinifera* (445) are the 15 species accounting for the highest number of records (about 60% of the total).

Table 4. List of crop species still cultivated as landraces with the relative number of records.

Species	n.	Species	n.	Species	n.	Species	n.
<i>Abelmoschus esculentus</i>	88	<i>Corylus avellana</i>	41	<i>Lupinus albus</i>	27	<i>Ribes nigrum</i>	1
<i>Allium ampeloprasum</i>	4	<i>Crataegus azarolus</i>	10	<i>Lycopersicon esculentum</i>	17	<i>Ribes plicatus</i>	1
<i>Allium ascalonicum</i>	3	<i>Crataegus laevigata</i>	1	<i>Maclura pomifera</i>	1	<i>Rorippa nasturtium-aquaticum</i>	2
<i>Allium cepa</i>	284	<i>Crocus sativus</i>	1	<i>Malus baccata</i>	1	<i>Rosa gallica</i>	3
<i>Allium porrum</i>	46	<i>Cucumis melo</i>	574	<i>Malus domestica</i>	1061	<i>Rubia tinctorum</i>	5
<i>Allium sativum</i>	274	<i>Cucumis sativus</i>	149	<i>Malus pumila</i>	7	<i>Rumex rugosus</i>	1
<i>Allium schoenoprasum</i>	2	<i>Cucurbita ficifolia</i>	23	<i>Malus sylvestris</i>	3	<i>Salsola soda</i>	1
<i>Amaranthus cruentus</i>	1	<i>Cucurbita maxima</i>	231	<i>Matricaria recutita</i>	1	<i>Salvia officinalis</i>	1
<i>Amaranthus retroflexus</i>	13	<i>Cucurbita moschata</i>	231	<i>Medicago sativa</i>	47	<i>Salvia x auriculata</i>	1

<i>Anethum graveolens</i>	48	<i>Cucurbita pepo</i>	457	<i>Melissa officinalis</i>	1	<i>Satureja hortensis</i>	2
<i>Apium graveolens</i>	79	<i>Cuminum cyminum</i>	3	<i>Mentha pulegium</i>	2	<i>Scolymus hispanicus</i>	1
<i>Arachis hypogaea</i>	10	<i>Cydonia oblonga</i>	16	<i>Mentha spicata</i>	2	<i>Secale cereale</i>	669
<i>Arbutus unedo</i>	3	<i>Cynara cardunculus</i>	17	<i>Mespilus germanica</i>	5	<i>Secale multicaule</i>	111
<i>Asparagus acutifolius</i>	1	<i>Cynara scolymus</i>	56	<i>Morus alba</i>	21	<i>Sesamum indicum</i>	26
<i>Asparagus officinalis</i>	4	<i>Daucus carota</i>	37	<i>Morus nigra</i>	22	<i>Setaria italica</i>	9
<i>Atriplex hortensis</i>	6	<i>Diospyros kaki</i>	40	<i>Nicotiana tabacum</i>	4	<i>Sinapis alba</i>	2
<i>Avena nuda</i>	82	<i>Dipsacus fullonum</i>	1	<i>Ocimum basilicum</i>	69	<i>Sinapis arvensis</i>	5
<i>Avena orientalis</i>	4	<i>Elettaria cardamomum</i>	5	<i>Olea europaea</i>	228	<i>Sinapis nigra</i>	5
<i>Avena sativa</i>	117	<i>Eriobotrya japonica</i>	25	<i>Onobrychis viciifolia</i>	44	<i>Solanum lycopersicum</i>	838
<i>Avena strigosa</i>	43	<i>Eruca sativa</i>	7	<i>Opuntia ficus-indica</i>	9	<i>Solanum melongena</i>	137
<i>Beta vulgaris</i>	72	<i>Eruca vesicaria</i>	6	<i>Origanum majorana</i>	5	<i>Solanum tuberosum</i>	200
<i>Borago officinalis</i>	1	<i>Fagopyrum esculentum</i>	775	<i>Origanum vulgare</i>	17	<i>Sorbus domestica</i>	24
<i>Brassica juncea</i>	1	<i>Ficus carica</i>	111	<i>Oryza sativa</i>	5	<i>Sorghum bicolor</i>	51
<i>Brassica napobrassica</i>	4	<i>Foeniculum vulgare</i>	14	<i>Panicum miliaceum</i>	20	<i>Spinacia oleracea</i>	41
<i>Brassica napus</i>	41	<i>Fragraria vesca</i>	5	<i>Papaver somniferum</i>	560	<i>Tanacetum cinerariifolium</i>	1
<i>Brassica nigra</i>	7	<i>Glycyrrhiza glabra</i>	1	<i>Pastinaca sativa</i>	8	<i>Thymus vulgaris</i>	2
<i>Brassica oleracea</i>	461	<i>Gossypium hirsutum</i>	1	<i>Petroselinum crispum</i>	112	<i>Trifolium alexandrinum</i>	1
<i>Brassica rapa</i>	165	<i>Hedysarum coronarium</i>	5	<i>Phaseolus coccineus</i>	84	<i>Trifolium hydridum</i>	1
<i>Calendula officinalis</i>	2	<i>Helianthus annuus</i>	35	<i>Phaseolus lunatus</i>	1	<i>Trifolium pratense</i>	121
<i>Camelina sativa</i>	110	<i>Helichrysum italicum</i>	1	<i>Phaseolus vulgaris</i>	178 5	<i>Trifolium repens</i>	8
<i>Capsicum annuum</i>	446	<i>Hordeum vulgare</i>	150	<i>Phleum pratense</i>	4	<i>Trifolium squarrosum</i>	1
<i>Capsicum chinense</i>	5	<i>Humulus lupulus</i>	18	<i>Pimpinella anisum</i>	9	<i>Trigonella caerulea</i>	5
<i>Capsicum frutescens</i>	40	<i>Hypericum perforatum</i>	1	<i>Pistacia vera</i>	5	<i>Trigonella foenum-graecum</i>	6
<i>Carthamus tinctorius</i>	1	<i>Jasminum officinale</i>	2	<i>Pisum sativum</i>	216	<i>Triticum aestivum</i>	256

<i>Castanea sativa</i>	80	<i>Juglans regia</i>	27	<i>Prunus armeniaca</i>	54	<i>Triticum dicoccum</i>	95
<i>Ceratonia siliqua</i>	6	<i>Lablab purpureus</i>	13	<i>Prunus avium</i>	525	<i>Triticum monococcum</i>	233
<i>Chaenomeles japonica</i>	1	<i>Lactuca sativa</i>	213	<i>Prunus cerasifera</i>	2	<i>Triticum spelta</i>	1820
<i>Cicer arietinum</i>	149	<i>Lagenaria siceraria</i>	71	<i>Prunus cerasus</i>	28	<i>Triticum turgidum</i>	83
<i>Cichorium endivia</i>	8	<i>Lathyrus cicera</i>	2	<i>Prunus domestica</i>	152	<i>Vicia ervilia</i>	16
<i>Cichorium intybus</i>	52	<i>Lathyrus clymenum</i>	13	<i>Prunus dulcis</i>	68	<i>Vicia faba</i>	243
<i>Citrullus lanatus</i>	177	<i>Lathyrus ochrus</i>	31	<i>Prunus fruticosa</i>	7	<i>Vicia narbonensis</i>	1
<i>Citrus limon</i>	7	<i>Lathyrus sativus</i>	68	<i>Prunus persica</i>	121	<i>Vicia sativa</i>	7
<i>Citrus lumia</i>	1	<i>Lavandula officinalis</i>	1	<i>Prunus x eminens</i>	1	<i>Vigna unguiculata</i>	270
<i>Citrus medica</i>	1	<i>Lens culinaris</i>	151	<i>Punica granatum</i>	33	<i>Vitis vinifera</i>	445
<i>Citrus reticulata</i>	2	<i>Levisticum officinale</i>	1	<i>Pyrus communis</i>	748	<i>Zea mays</i>	623
<i>Citrus sinensis</i>	18	<i>Linum usitatissimum</i>	23	<i>Raphanus raphanistrum</i>	5	<i>Ziziphus jujuba</i>	6
<i>Coriandrum sativum</i>	89	<i>Luffa acutangula</i>	4	<i>Raphanus sativus</i>	40	-	-
<i>Cornus mas</i>	4	<i>Luffa cylindrica</i>	3	<i>Rheum rhabarbarum</i>	21	-	-

As from the collected data a quite different number of crop species are still cultivated as landraces in different European countries: Austria (23), Croatia (7), Czech Republic (11), Denmark (21), Estonia (10), Finland (20), Germany (11), Greece (93), Italy (107), Portugal (45), Romania (21), Spain (45), Sweden (13) and United Kingdom (26). Of the 190 identified crop species 109 are unique of a certain country (*i.e.* we got records of cultivation as landrace in one country only): Italy (40), Greece (31), Spain (8), Austria, Croatia and Finland (5), Portugal (4), Czech Republic, United Kingdom and Sweden (2), and Germany, Denmark and Romania (1). Estonia was the only country for which unique species records were not recorded. The full list of “records” belonging to each identified species still cultivated as landraces and sorted by country is reported in Appendix A.

As expected, since the Mediterranean area is a hotspot of diversity (Myers *et al.* 2000; Pacicco *et al.* 2016; Vincent *et al.* 2013), Italy is the country where the highest number of crop species is still cultivated as landraces followed by Greece and Portugal. This is true even though some important species, *i.e.* *Olea europea* and *Vitis vinifera*, are not recorded as being cultivated as landraces in some of these countries while they certainly are and in a great number.

The reported differences in both number of landrace records and number of crop species by country could be representative of the number of on-farm/in-garden materials, but is likely also to be influenced by the available knowledge of respondents. Furthermore, landrace records that lacked detailed or recent data were not included in the analysis. It is therefore likely that the reported numbers are an under-estimation. However, and in spite of the reported differences in the numbers of crop species and landrace records among countries, the research reveals strong evidence that landraces of a large number of species are still maintained throughout Europe, and in all climatic regions.

Although it was not possible to collect data from all European countries, the data presented here constitutes the largest ever produced database regarding *in situ* maintained landraces (in a broad sense) and the first attempt to create a European landrace inventory. In the context of the Farmer's Pride project, these data will also be used to identify hotspots of diversity. The authors believe that this inventory, although still partial, constitutes the first example of an on-farm/in-garden landrace inventory for an entire region of the world. Importantly, it can serve the European Commission in improved planning of PGR conservation activities and policies.

2.2 Landraces: reasons for continuing cultivation, adding value and management

2.2.1 Data collection

In order to have insights that can be used in conservation planning, Farmer's Pride also aims to understand i) why and how landraces are currently conserved and managed on-farm/in-garden in Europe, and ii) how their cultivation can be promoted. To this end, a number of landrace case studies were collated by asking the Farmer's Pride Consortium Partners and Ambassadors. The case studies include (besides general information on the crop) a description of the landrace, information on how it is cultivated, multiplied and marketed, what kind of added value characterises it, who are the actors in promotion activities, and if and how the propagation material can be obtained. A format sheet to collect the needed information was initially discussed in the Project Consortium, prepared and circulated in May 2019 with the request of filling in information as soon as possible (Table 5).

Table 5. Structure of the landrace case study data sheet

CROP

1. Type
 - Garden crop
 - Open field crop
 - Tree crop
2. Name
 - common name
 - scientific name
3. Breeding system
 - Predominantly autogamous
 - Predominantly allogamous
4. Description
5. References

LANDRACE

1. Name
2. Country
3. Description
4. Geographical distribution (area, latitude and longitude, altitude)
5. Farmer(s) description
6. Reproduction
 - Sexual
 - Asexual
7. Multiplication procedures and consequences on landrace diversity
8. Management plan existence
9. Added/adding value
 - market: existing and novel
 - others (brands and special traits)
10. External support given to the landrace and implication for on-farm conservation
11. Access
12. Pictures
13. Acknowledgements
14. References
15. Added/adding value keywords

2.2.2 Results and discussion

One hundred and four case studies of broad sense landraces maintained *in situ* were collected from 14 European countries in December 2019 (Table 6); an additional case study from Mexico was worked out from available bibliography (Bellon and Brush 1994). The collected case studies belong to 49 different crops (including garden, open field and industrial crops) characterised by different reproduction systems (*i.e.* autogamous, allogamous) propagated by seed or vegetatively propagated. A full description of some of these case studies is available in [Issue 5 of Landraces](#)⁶.

Table 6. List of species covered by the landrace case studies and the countries in which they are cultivated.

Species	n.	Country	Species	n.	Country
<i>Allium ampeloprasum</i>	1	ITA	<i>Papaver somniferum</i>	1	HUN
<i>Allium cepa</i>	4	AUS, GRC, PRT, SWE	<i>Phaseolus coccineus</i>	2	ESP, HUN
<i>Allium sativum</i>	1	HUN	<i>Phaseolus lunatus</i>	1	HUN
<i>Apium graveolens</i>	1	ITA	<i>Phaseolus vulgaris</i>	8	ITA (3), ESP (2), HUN, PRT, SWE
<i>Armoracia rusticana</i>	1	FIN	<i>Phleum pratense</i>	1	GBR
<i>Asparagus officinalis</i>	1	DNK	<i>Pisum sativum</i>	4	CHE, DNK, ITA, SWE
<i>Avena strigosa</i>	1	GBR	<i>Prunus domestica</i>	1	ITA
<i>Beta vulgaris</i>	1	DNK	<i>Prunus persica</i>	1	ITA
<i>Brassica napus</i>	2	SWE (2)	<i>Pyrus communis</i>	2	ITA (2)
<i>Brassica oleracea</i>	4	ITA (2), PRT, UK	<i>Secale cereale</i>	6	FIN (3), PRT (2), GBR
<i>Brassica rapa</i>	3	CHE, ESP, ITA	<i>Solanum lycopersicum</i>	12	HUN (6), ESP (3), AUS, GRC, ITA
<i>Capsicum annuum</i>	2	GRC, HUN	<i>Solanum melongena</i>	1	ESP
<i>Cichorium intybus</i>	1	CZE	<i>Solanum tuberosum</i>	3	CHE, FIN, GBR
<i>Citrullus lanatus</i>	2	ESP, HUN	<i>Trifolium pratense</i>	1	FIN
<i>Cucurbita pepo</i>	1	ESP	<i>Trifolium repens</i>	1	GBR
<i>Cynaria cardunculus</i>	1	CHE	<i>Triticum monococcum</i>	2	GRC, HUN
<i>Daucus carota</i>	3	CHE (2), ROU	<i>Triticum dicoccum</i>	2	ITA
<i>Helianthus tuberosus</i>	1	CHE	<i>Triticum spelta</i>	1	GBR
<i>Hordeum vulgare</i>	2	ITA, GBR	<i>Triticum durum</i>	1	GRC
<i>Ipomoea batatas</i>	1	ESP	<i>Triticum aestivum</i>	3	AUS, GBR, ITA
<i>Lactuca sativa</i>	3	ESP (2), HUN	<i>Vicia faba</i>	1	ITA
<i>Lathyrus clymenum</i>	1	GRC	<i>Vigna unguiculata</i>	1	ITA
<i>Lathyrus sativus</i>	1	GRC	<i>Vitis vinifera</i>	2	SRB, PRT
<i>Lens culinaris</i>	2	AUS, GRC	<i>Zea mays</i>	4	ITA (2), CHE, MEX
<i>Malus domestica</i>	3	ITA (3)	-	-	-

⁶ https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2020/02/Landraces-issue-5_final.pdf.

Analysis of the case studies reveals some relevant aspects about on-farm/in-garden conservation and management of landraces. Firstly, as already mentioned, interest in cultivating landraces still exists across Europe, and especially for cultivation in marginal areas (mainly under low-input or organic conditions) and for the restricted (local or national) market of high quality products. The reasons for continuing landrace cultivation are diverse: quality of the product, market request for typical food of an area, resistance/tolerance to the particular pedo-climatic or biotic conditions of an area, preferences of certain families or groups of people for a specific food, use in sustainable (mostly organic) agriculture of heterogeneous materials, specific uses, particular rites of a certain area, simple willingness to increase the biodiversity of an area or love for a heritage, and existence of specific country funds to increase the diversity of a crop in an area. The prevalent motivations for continuing the cultivation of a particular landrace vary for different materials, and more than one motivation for continuing cultivation is often recorded.

In many of the analysed cases, on-farm conservation of landraces was favoured by numerous activities that were put in place by national (in some cases also international) or local public or private entities. Public support often took advantage of the agricultural policies set by the European Union. These entities gave, or are still giving, scientific and/or financial support for landrace characterisation (*i.e.* the description of the landrace) and valorization. Among the means of valorization of the landrace product, the acquisition of quality marks awarded by the European Union – such as the Protected Designation of Origin (PDO) or the Protected Geographical Indication (PGI) – and/or of other brands were recorded. These quality marks help in increasing the commercial value of the landrace products by adding value, which, in turn, makes landrace cultivation attractive – also for new generations of farmers. These aspects are of great importance to guarantee long-term conservation of landraces through their continued use. In other cases, promotion mainly relied/relies on local fairs, festivals and traditional events, showing the profound link between landraces and local culture.

Although product processing was not included in the case study collection, we gathered clear evidences that it plays a key role in enhancing the landrace market extent, product marketability and added value of some landraces. For example, see the case studies “Arakas for Fava Santorinis” (*Lathyrus clymenum*), “Aglione della Val di Chiana” (*Allium ampeloprasum* var. *holmense*) and “Slezská cicory” (*Cichorium intybus*) in Issue 5 of Landraces. Regarding cultivation, landraces are mostly grown using modern agricultural techniques, which include the use of mechanical tools for soil preparation and, sometimes, the use of chemicals. However, quite a large number of them are managed using low input (often organic) agricultural techniques.

Regarding the on-farm/in-garden management practices that are carried out to propagate plant materials for cultivation, most of the collected evidence demonstrates that farmers (alone or grouped

in consortia) are the main actors in carrying out these activities, while seed companies have only a marginal role. The few seed companies involved are of small-scale and are concerned only for those landraces that are registered within the European seed legislation frame (*i.e.* “conservation varieties” and “amateur varieties”). See for example what was reported in a document prepared for the Department for Environment, Food and Rural Affairs of UK⁷. The limited involvement of seed companies in landrace seed multiplication and commercialisation is fairly well justified by their limited market, while a major involvement of them in propagation activities could bring important technical advantages in seed quality. In this context, the registration of landraces in the European catalogue of varieties could be an important tool to scale up their conservation, use and market in a certain area (Spataro and Negri 2013).

Gathered evidences also show that landraces of the same crop are managed using slightly different multiplication strategies and selection methods, a fact that can affect their main genetic features. However, key management elements within the diverse identified crop categories were identified. Therefore, common management guidelines for landraces can be drawn up that can help new farmers to start their cultivation on-farm. Unfortunately, only little information on the genetic outcomes of the reported multiplication procedures was collected, while such information could provide evidence on how to maximise the level of on-farm/in-garden conserved genetic diversity to favour its maintenance and evolution. This opens space for future studies aimed at specifically addressing such effects of multiplication procedures. The landrace case studies collection will be published in a searchable online database hosted by the ECPGR Secretariat.

⁷ http://randd.defra.gov.uk/Document.aspx?Document=IF0164_8209_FRA.pdf

3.0 Conclusions

Considering that most of European agriculture is based on the use of modern, high yielding genetically uniform varieties, we were impressed by the fact that it was possible to retrieve a high number of information on broad sense landraces and to take a snapshot of the current situation of their *in situ* conservation. Even if not all European countries were covered by our investigation, what is presented here is the largest ever produced set of information on *in situ* landraces and the first attempt to create a European inventory so far. Although still partial, collected data can serve the European Commission, which funded the Farmer's Pride project, to better plan conservation activities and policies. Policies and motivations exist across Europe, and especially in the European Union, on which to rely for promoting the landrace maintenance in cultivation.

Overall this first report on occurrence of landraces in Europe shows that the coordinated actions of single stakeholders and national and sovranational institutions can result in the effective conservation of such important PGR in the future.

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Appendix: Number of crop landrace records grouped by country.

Species	AUT	CZE	DEU	DNK	ESP	EST	FIN	GBR	GRC	HRV	ITA	PRT	ROU	SWE
<i>Abelmoschus esculentus</i>	0	0	0	0	0	0	0	0	88	0	0	0	0	0
<i>Allium ampeloprasum</i>	0	0	0	0	3	0	0	0	1	0	0	0	0	0
<i>Allium ascalonicum</i>	0	0	0	1	0	0	0	0	0	0	0	2	0	0
<i>Allium cepa</i>	31	1	0	0	33	1	38	5	71	0	48	51	0	6
<i>Allium porrum</i>	0	0	0	0	0	0	0	4	29	0	1	12	0	0
<i>Allium sativum</i>	0	0	0	2	0	0	0	0	61	0	55	15 6	0	0
<i>Allium schoenoprasum</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Amaranthus cruentus</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Amaranthus retroflexus</i>	0	0	0	0	0	0	0	0	13	0	0	0	0	0
<i>Anethum graveolens</i>	0	0	0	0	0	0	0	0	48	0	0	0	0	0
<i>Apium graveolens</i>	0	0	0	0	0	0	0	1	53	0	25	0	0	0
<i>Arachis hypogaea</i>	0	0	0	0	1	0	0	0	9	0	0	0	0	0
<i>Arbutus unedo</i>	0	0	0	0	0	0	0	0	0	0	3	0	0	0
<i>Asparagus acutifolius</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Asparagus officinalis</i>	0	0	0	1	0	0	0	0	0	0	3	0	0	0
<i>Atriplex hortensis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	6
<i>Avena nuda</i>	82	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Avena orientalis</i>	4	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Avena sativa</i>	0	0	35	6	3	0	1	0	50	0	1	20	1	0
<i>Avena strigosa</i>	26	0	0	0	0	0	0	17	0	0	0	0	0	0
<i>Beta vulgaris</i>	0	0	0	2	1	1	0	7	52	0	4	5	0	0
<i>Borago officinalis</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Brassica juncea</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Brassica napobrassica</i>	0	0	0	0	0	0	0	4	0	0	0	0	0	0
<i>Brassica napus</i>	0	0	0	0	2	0	1	0	1	0	1	22	0	14
<i>Brassica nigra</i>	0	0	0	1	0	0	0	0	5	0	1	0	0	0
<i>Brassica oleracea</i>	0	0	0	1	17	0	0	34	11 2	0	11 7	18 0	0	0
<i>Brassica rapa</i>	4	0	0	0	3	0	3	2	2	0	66	82	0	3
<i>Calendula officinalis</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	0
<i>Camelina sativa</i>	110	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Capsicum annuum</i>	0	0	0	0	24	0	0	0	19 7	0	12 9	74	22	0
<i>Capsicum chinense</i>	0	0	0	0	0	0	0	0	0	0	0	5	0	0
<i>Capsicum frutescens</i>	0	0	0	0	0	0	0	0	0	0	0	40	0	0
<i>Carthamus tinctorius</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Castanea sativa</i>	0	0	0	0	0	0	0	0	0	0	80	0	0	0
<i>Ceratonja siliqua</i>	0	0	0	0	0	0	0	0	0	0	6	0	0	0
<i>Chaenomeles japonica</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Cicer arietinum</i>	0	0	0	0	6	0	0	0	55	0	40	48	0	0
<i>Cichorium endivia</i>	0	0	0	0	0	0	0	0	7	0	1	0	0	0
<i>Cichorium intybus</i>	0	1	0	0	0	0	0	0	2	0	49	0	0	0
<i>Citrullus lanatus</i>	0	0	0	0	4	0	0	0	13 5	0	11	26	1	0
<i>Citrus limon</i>	0	0	0	0	0	0	0	0	0	0	7	0	0	0
<i>Citrus lumia</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Citrus medica</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Citrus reticulata</i>	0	0	0	0	0	0	0	0	0	0	2	0	0	0
<i>Citrus sinensis</i>	0	0	0	0	0	0	0	0	1	0	17	0	0	0

<i>Coriandrum sativum</i>	0	0	0	0	0	0	0	0	3	0	0	86	0	0
<i>Cornus mas</i>	0	0	0	0	0	0	0	0	0	0	4	0	0	0
<i>Corylus avellana</i>	0	0	0	0	0	0	0	0	0	0	41	0	0	0
<i>Crataegus azarolus</i>	0	0	0	0	0	0	0	0	0	0	10	0	0	0
<i>Crataegus laevigata</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Crocus sativus</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Cucumis melo</i>	0	0	0	0	13	0	0	0	40 1	0	88	71	1	0
<i>Cucumis sativus</i>	0	0	0	0	3	0	0	4	11 8	0	5	17	2	0
<i>Cucurbita ficifolia</i>	0	0	0	0	0	0	0	0	0	0	0	23	0	0
<i>Cucurbita maxima</i>	0	0	0	0	3	0	0	0	66	0	18	14 2	2	0
<i>Cucurbita moschata</i>	0	0	0	0	2	0	0	0	95	0	16	11 8	0	0
<i>Cucurbita pepo</i>	0	0	0	0	8	0	0	6	19 8	0	29	21 4	2	0
<i>Cuminum cyminum</i>	0	0	0	0	0	0	0	0	3	0	0	0	0	0
<i>Cydonia oblonga</i>	0	0	0	0	0	0	0	0	0	0	16	0	0	0
<i>Cynara cardunculus</i>	0	0	0	0	0	0	0	0	8	0	9	0	0	0
<i>Cynara scolymus</i>	0	0	0	0	1	0	0	0	0	0	55	0	0	0
<i>Daucus carota</i>	0	0	0	2	6	0	0	3	10	0	13	2	0	1
<i>Diospyros kaki</i>	0	0	0	0	0	0	0	0	0	0	40	0	0	0
<i>Dipsacus fullonum</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Elettaria cardamomum</i>	0	0	0	0	0	0	0	0	5	0	0	0	0	0
<i>Eriobotrya japonica</i>	0	0	0	0	0	0	0	0	0	0	25	0	0	0
<i>Eruca sativa</i>	0	0	0	0	0	0	0	0	7	0	0	0	0	0
<i>Eruca vesicaria</i>	0	0	0	0	0	0	0	0	0	0	6	0	0	0
<i>Fagopyrum esculentum</i>	774	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Ficus carica</i>	0	0	0	0	0	0	0	0	0	0	11 1	0	0	0
<i>Foeniculum vulgare</i>	0	0	0	0	0	0	0	0	12	0	2	0	0	0
<i>Fragaria vesca</i>	0	0	0	0	0	0	0	0	0	0	5	0	0	0
<i>Glycyrrhiza glabra</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Gossypium hirsutum</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Hedysarum coronarium</i>	0	0	0	0	0	0	0	0	0	0	5	0	0	0
<i>Helianthus annuus</i>	0	0	0	0	0	0	0	0	30	0	0	3	2	0
<i>Helichrysum italicum</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Hordeum vulgare</i>	12	0	27	6	0	0	2	14	75	0	9	5	0	0
<i>Humulus lupulus</i>	0	0	0	0	0	0	18	0	0	0	0	0	0	0
<i>Hypericum perforatum</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Jasminum officinale</i>	0	0	0	0	0	0	0	0	0	0	2	0	0	0
<i>Juglans regia</i>	0	0	0	0	0	0	0	0	0	0	27	0	0	0
<i>Lablab purpureus</i>	0	0	0	0	0	0	0	0	13	0	0	0	0	0
<i>Lactuca sativa</i>	0	0	0	1	19	0	0	6	10 6	0	1	78	2	0
<i>Lagenaria siceraria</i>	0	0	0	0	0	0	0	0	44	0	7	20	0	0
<i>Lathyrus cicera</i>	0	0	0	0	1	0	0	0	0	0	1	0	0	0
<i>Lathyrus clymenum</i>	0	0	0	0	0	0	0	0	11	2	0	0	0	0
<i>Lathyrus ochrus</i>	0	0	0	0	0	0	0	0	31	0	0	0	0	0
<i>Lathyrus sativus</i>	0	0	0	0	2	0	0	0	26	0	27	13	0	0
<i>Lavandula officinalis</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Lens culinaris</i>	0	0	0	0	0	0	0	0	74	0	72	5	0	0
<i>Levisticum officinale</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	0
<i>Linum usitatissimum</i>	14	0	0	0	0	0	0	0	1	0	0	8	0	0
<i>Luffa acutangula</i>	0	0	0	0	0	0	0	0	4	0	0	0	0	0

<i>Luffa cylindrica</i>	0	0	0	0	0	0	0	0	3	0	0	0	0	0
<i>Lupinus albus</i>	0	0	0	0	0	0	0	0	7	0	0	20	0	0
<i>Lycopersicon esculentum</i>	0	0	0	0	0	0	0	17	0	0	0	0	0	0
<i>Maclura pomifera</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Malus baccata</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Malus domestica</i>	0	12 5	0	0	39	2	83	0	0	0	81 2	0	0	0
<i>Malus pumila</i>	0	0	0	0	0	0	0	0	7	0	0	0	0	0
<i>Malus sylvestris</i>	0	0	0	0	3	0	0	0	0	0	0	0	0	0
<i>Matricaria recutita</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Medicago sativa</i>	0	0	0	0	0	0	0	0	2	0	45	0	0	0
<i>Melissa officinalis</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Mentha pulegium</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	0
<i>Mentha spicata</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	0
<i>Mespilus germanica</i>	0	0	0	0	0	0	0	0	0	0	5	0	0	0
<i>Morus alba</i>	0	0	0	0	0	0	0	0	0	0	21	0	0	0
<i>Morus nigra</i>	0	0	0	0	0	0	0	0	0	0	22	0	0	0
<i>Nicotiana tabacum</i>	0	0	0	0	0	0	0	0	4	0	0	0	0	0
<i>Ocimum basilicum</i>	0	0	0	0	0	0	0	0	57	0	12	0	0	0
<i>Olea europaea</i>	0	0	0	0	0	0	0	0	0	0	22 8	0	0	0
<i>Onobrychis viciifolia</i>	0	0	0	0	0	0	0	0	0	0	44	0	0	0
<i>Opuntia ficus-indica</i>	0	0	0	0	0	0	0	0	0	0	9	0	0	0
<i>Origanum majorana</i>	0	0	0	0	0	0	0	0	5	0	0	0	0	0
<i>Origanum vulgare</i>	0	0	0	0	0	0	0	0	17	0	0	0	0	0
<i>Oryza sativa</i>	0	0	0	0	4	0	0	0	0	0	0	1	0	0
<i>Panicum miliaceum</i>	16	0	0	0	0	0	0	0	4	0	0	0	0	0
<i>Papaver somniferum</i>	552	0	0	0	0	0	0	0	0	8	0	0	0	0
<i>Pastinaca sativa</i>	0	0	0	0	0	0	0	8	0	0	0	0	0	0
<i>Petroselinum crispum</i>	0	0	0	0	0	0	0	2	71	0	1	37	1	0
<i>Phaseolus coccineus</i>	0	0	0	0	0	0	0	8	30	0	16	26	4	0
<i>Phaseolus lunatus</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Phaseolus vulgaris</i>	2	0	0	8	29	2	0	4	57 9	0	32 9	76 7	40	25
<i>Phleum pratense</i>	0	0	0	0	0	0	3	1	0	0	0	0	0	0
<i>Pimpinella anisum</i>	0	0	0	0	0	0	0	0	8	0	1	0	0	0
<i>Pistacia vera</i>	0	0	0	0	0	0	0	0	0	0	5	0	0	0
<i>Pisum sativum</i>	0	0	0	50	9	1	0	7	41	0	22	26	1	59
<i>Prunus armeniaca</i>	0	0	0	0	0	0	0	0	0	0	54	0	0	0
<i>Prunus avium</i>	0	12	0	0	15	0	0	0	1	0	49 7	0	0	0
<i>Prunus cerasifera</i>	0	0	0	0	0	0	0	0	0	0	2	0	0	0
<i>Prunus cerasus</i>	0	0	0	0	0	0	3	0	0	0	25	0	0	0
<i>Prunus domestica</i>	0	1	2	0	0	0	5	0	0	0	14 4	0	0	0
<i>Prunus dulcis</i>	0	0	0	0	0	0	0	0	1	0	67	0	0	0
<i>Prunus fruticosa</i>	0	7	0	0	0	0	0	0	0	0	0	0	0	0
<i>Prunus persica</i>	0	0	0	0	0	0	0	0	0	0	12 1	0	0	0
<i>Prunus x eminens</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Punica granatum</i>	0	0	0	0	0	0	0	0	0	0	33	0	0	0
<i>Pyrus communis</i>	0	45	0	0	0	3	9	0	0	0	69 1	0	0	0
<i>Raphanus raphanistrum</i>	0	0	0	0	5	0	0	0	0	0	0	0	0	0
<i>Raphanus sativus</i>	0	0	0	0	0	0	0	4	21	0	1	14	0	0
<i>Rheum rhabarbarum</i>	0	0	0	0	0	0	19	2	0	0	0	0	0	0

<i>Ribes nigrum</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Ribes plicatus</i>	0	0	0	1	0	0	0	0	0	0	0	0	0	0
<i>Rorippa nasturtium-aquaticum</i>	0	0	0	0	0	0	0	0	0	0	0	2	0	0
<i>Rosa gallica</i>	0	0	0	0	0	0	0	0	0	0	3	0	0	0
<i>Rubia tinctorum</i>	0	0	5	0	0	0	0	0	0	0	0	0	0	0
<i>Rumex rugosus</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	1
<i>Salsola soda</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Salvia officinalis</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Salvia x auriculata</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Satureja hortensis</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	0
<i>Scolymus hispanicus</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Secale cereale</i>	419	0	45	2	0	1	11	11	68	0	5	10 5	1	1
<i>Secale multicaule</i>	111	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sesamum indicum</i>	0	0	0	0	0	0	0	0	26	0	0	0	0	0
<i>Setaria italica</i>	0	0	0	0	3	0	0	0	0	0	0	6	0	0
<i>Sinapis alba</i>	0	0	0	0	0	0	0	0	0	0	1	0	1	0
<i>Sinapis arvensis</i>	0	0	0	0	0	0	0	0	5	0	0	0	0	0
<i>Sinapis nigra</i>	0	0	0	0	0	0	0	0	5	0	0	0	0	0
<i>Solanum lycopersicum</i>	0	0	0	2	63	0	0	0	43 3	0	17 2	14 1	27	0
<i>Solanum melongena</i>	0	0	0	0	11	0	0	0	11 6	0	9	0	1	0
<i>Solanum tuberosum</i>	34	0	42	1	1	4	4	73	11	2	28	0	0	0
<i>Sorbus domestica</i>	0	1	0	0	0	0	0	0	0	0	23	0	0	0
<i>Sorghum bicolor</i>	10	0	1	0	1	0	0	0	35	0	1	0	2	1
<i>Spinacia oleracea</i>	0	0	0	0	1	0	0	0	39	0	1	0	0	0
<i>Tanacetum cinerariifolium</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Thymus vulgaris</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	0
<i>Trifolium alexandrinum</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Trifolium hydridum</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Trifolium pratense</i>	119	0	0	0	0	0	1	0	0	0	1	0	0	0
<i>Trifolium repens</i>	0	0	0	0	0	0	8	0	0	0	0	0	0	0
<i>Trifolium squarrosus</i>	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Trigonella caerulea</i>	5	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Trigonella foenum-graecum</i>	0	0	0	0	0	0	0	0	6	0	0	0	0	0
<i>Triticum aestivum</i>	51	0	39	7	0	0	1	5	10 2	0	27	23	1	0
<i>Triticum dicoccum</i>	32	0	9	1	0	0	0	0	0	0	53	0	0	0
<i>Triticum monococcum</i>	224	0	1	1	0	0	0	0	5	0	2	0	0	0
<i>Triticum spelta</i>	1,804	1	8	4	0	0	0	0	3	0	1	0	0	0
<i>Triticum turgidum</i>	0	0	0	3	0	0	0	0	71	0	8	1	0	0
<i>Vicia ervilia</i>	0	0	0	0	0	0	0	0	9	0	7	0	0	0
<i>Vicia faba</i>	0	0	0	0	6	1	0	15	11 1	0	20	71	0	17
<i>Vicia narbonensis</i>	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Vicia sativa</i>	0	0	0	0	0	1	0	0	6	0	0	0	0	0
<i>Vigna unguiculata</i>	0	0	0	0	1	0	0	0	12 9	0	53	86	0	0
<i>Vitis vinifera</i>	0	0	0	0	5	0	0	0	0	9	43 1	0	0	0
<i>Zea mays</i>	53	0	0	0	8	0	0	0	29 9	0	52	19 6	13	2
<i>Ziziphus jujuba</i>	0	0	0	0	0	0	0	0	0	0	6	0	0	0

