CHAPTER 1

Europe

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We start our series of graphs with European weed spectra as the Weed Mapping Working Group of the EWRS collected data for Europe first, and most data were available in the beginning for this continent. Holzner and Immonen (1982) tried to use phytogeographical zones and chorological groups to describe the distribution of weeds in Europe more than 30 years ago. Guillerm and Maillet (1982) use bioclimatic sub-regions for this purpose. They list *Lolium rigidum* and *Avena* species among the most frequent grass weed species as well as *Papaver rhoeas* and *Cirsium arvense* among the dicot species in western Mediterranean cereals. Some of the weeds they mention are still quite common today. The agricultural situation, however, has changed considerably in the meantime. According to EUROSTAT, the European cropping areas (EU27) for cereals (including maize and rice) in 2007 were 57.4 million hectares, for forage and grain, maize 13.3 million ha, and for oilseed rape 6.6 million ha, and the total arable land equalled 99.5 million ha. In consequence, three crops amount to almost two-thirds of all arable land in Europe. Wheat, maize and oilseed rape were selected as the most important crops for our maps here. Weed infestation in Turkish wheat is referred to in more detail in Chapter 2. Due to similarities in some areas of Turkey, the maps for Europe contain the most frequent weeds in Turkey also. Large areas of Russian wheat production are characterized by continental climates similar to Kazakhstan and are referred to in detail under Asia in Chapter 2. Literature from 23 countries with frequency data was used as listed in the references for Europe. Many European countries have a rich source of survey data, such as the Czech Republic, Finland, Hungary, Latvia or Russia. A compilation of data in English is, however, not always available. This is why local experts are important for the interpretation of historical data. Sometimes, overviews are provided by western European authors, such as a German overview on plant production in the former Commonwealth of Independent States (Spaar & Schuhmann 2000). The results of surveys of different authors for the same country may differ considerably. For some countries, finer and more precise maps are required. This becomes apparent when considering the climatic and agronomic differences in Italy, for instance, as described by Franzini (1982) more than 30 years ago.

In a few countries, the information on weed infestation was very limited (Belarus: Soroka et al. 2000; Bulgaria: Atanassova & Koteva 2005; Dimitrova 2002; Glemnitz et al. 2007; Spaar & Schuhmann 2000; Ukraine: Ivashchenko 2000). For others, a great amount of data was available but only one source is listed as an example (France: Reboud & El Mjiyad 2005, the background is a whole database with all sorts of data available at: www2.dijon.inra.fr/bga/araf2009/). For the following countries, personal contacts with experts exist but only a few publications are listed (Croatia: Knežević et al. 2003; Greece: Dhima & Eleftherohorinos 2001; Travlos et al. 2008; Italy: Berti et al. 1992; Zanin et al. 1992; Norway: Torresen & Skuterud 2002; Poland: Zajac & Zaja, 2001; Golebiowska & Rola 2006; Romania: Chirla & Berca 2002; Berca & Chirla 2004; Serbia: Stanojević et al. 2001; Radivojevic et al. 2006; Šilc et al. 2009; Vrbničanin et al. 2009; Spain: Gonzalez-Andujar & Saavedrab 2003; Torra & Recasens 2006; Sweden: Boström et al. 2002, 2003; Switzerland: Delabays et al. 2006).

Some countries have a long tradition of surveys and several sources were used for the preparation of maps, at the same time, discussions with country representatives were possible (Czech Republic: Kropáč 2006; Soukup et al. 2006; Juroch & Lvončik 2007; Lososová et al. 2008; Beranék & Juroch 2009, 2010; Kolářová et al. 2013a, 2013b; Denmark: Andreasen et al. 1991, 2008, 2009; Andreasen & Streibig 2011; Estonia: rankings and literature were provided by Lauringson et al. 2001, 2002; Talgre et al. 2004, 2005, 2008; Uusna 2006; Finland: Salonen et al. 2001, 2011; Germany: Albrecht & Bachthaler 1989; Arlt et al. 1995, Tóth et al. 1999; Zwerger et al. 2004; Mehrtens et al. 2005; Goerke et al. 2008; Hungary: Dorner et al. 2004; Nagy et al. 2004; Dancza 2006; Tamas et al. 2006; Novák et al. 2009; Pál & Csete 2008; Pinke et al. 2009; Latvia: rankings and literature were provided by Ineta Vanaga: – Vanaga 2001a, 2001b, 2002a, 2002b, 2003a, 2003b, 2004, 2005; Vanaga & Lapins 2000; Vanaga et al. 2002, 2006; Vanaga & Gurkina 2004; Vanaga & Zarina 2008; Lithuania: rankings were provided by Albinas Auškalnis; literature provided by Pilipavicius & Lazauskas 2000; Čiuberkis 2001; Velykis & Satkus 2006; Nedzinskiene et al. 2008; Turkey: rankings and most publications were provided by Professor F.N. Uygur and Professor S. Uygur: Uygur et al. 1986; Boz 2000; Kaya & Zengin 2000; Oksar & Uygur 2000; Kitis & Boz 2003; Mennan & Isik 2003; the UK: Clarke et al. 2000; Marshall et al. 2002; Preston et al. 2002; Moss et al. 2005; Bayer CropScience, 2006; Green 2006; Walker et al. 2006).

Our final decision on which results to use in our maps may be regarded as biased. We hope that these maps will, however, offer

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an opportunity for experts to discuss different views and to derive conclusions for future and more precise presentations.

Wheat

Growing conditions

North of the Alps, winter wheat is the dominant crop in most European countries. It is usually planted in autumn (September to December) and harvested in the summer of the following year (June to August). It only flowers after vernalization induced by low winter temperatures. Winter cereals in many Mediterranean areas (e.g. in Spain or in Israel) are actually spring wheat forms planted in autumn. They do not need the very low temperatures of winter cereals in the north for flower induction. In Italy, soft wheat and durum wheat are planted between September and December, depending on the area. Soft wheat is harvested then between July and August. Durum can be harvested a little earlier, that is, between June and July.

Spring wheat in northern Europe is normally planted between March and May and harvested in July and August. Tillage and climate have a large influence on the occurrence and emergence of weeds.

Statistics

Wheat was grown on an area of about 25,5 million ha in the EU (harvested area, FAO, 2012 data), the countries with the largest areas were France (5.3 million ha), Germany (3.1 million ha) and Poland (2.1 million ha). Most of the wheat planted is rain-fed. The acreage of spring wheat in northern Europe is rather low compared with the acreage of winter wheat. In Germany, for example, spring wheat was grown on around 50,000 ha, whereas winter wheat was grown on about 3 million ha in 2013 (destatis, 29 May 2013).

Weeds

Monocots

Winter wheat north of the Alps

The dominant grass weeds of winter wheat are *Alopecurus myosuroides* Huds. or blackgrass and *Apera spica-venti* (L.) P. Beauv. or silky bentgrass, as shown in Fig. 1.1. In the more recent past, fields were usually infested either with blackgrass or silky bentgrass. Both did not often occur in the same fields, but this seems to have changed now. *A. myosuroides* is often associated with the dicot *Galium aparine* L. or cleavers, as shown in Fig. 1.2. *A. myosuroides* and *A. spica-venti* start emerging in autumn and continue germinating all over winter and spring. Late germinating plants usually escape herbicide treatments. These late emerging individuals remain small due to the dominant crop. They are, however, able to plant seeds for the next planting period. Both species are of high economic importance in northern Europe. *Apera* is more common but less difficult to control. Both species have developed resistance to a number of herbicides. *Poa annua* L. is frequent in the winter wheat of Great Britain (blue in Fig. 1.1). It is, however, not regarded as a serious weed problem in most cases.

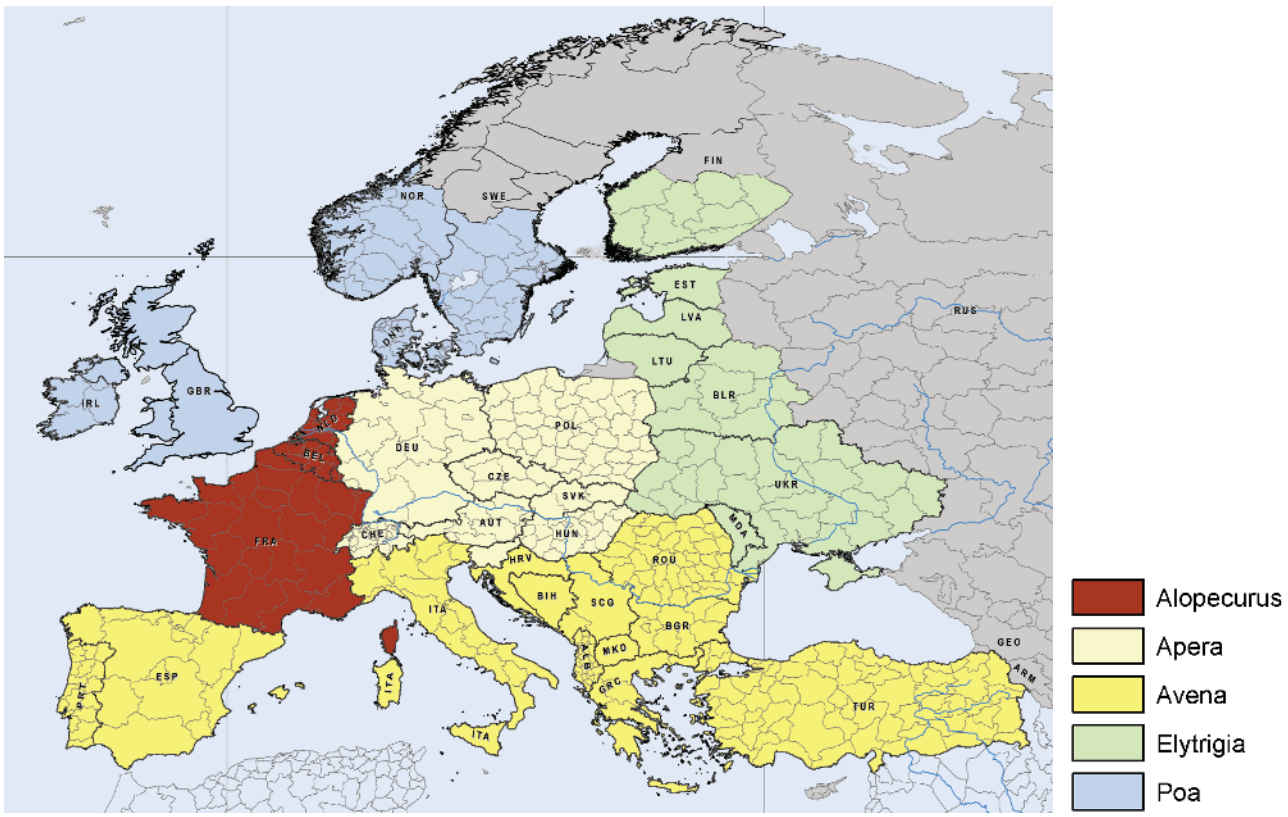

Figure 1.1 Average weed infestation in cereals, most frequent grasses.

Figure 1.2 Cleavers and blackgrass in a wheat field near Stuttgart, Germany, 10 June 2009.

Spring wheat north of the Alps

Wild oats, *Avena fatua L.* and *Avena sterilis L.*, used to be the dominant weed in northern Europe until the last quarter of the twentieth century when spring crops and especially oats were grown on much larger acreages there (Krähmer & Stübler 2012). Today, this weed problem is only minor in Northern Europe. *Poa annua* is a common grass weed of spring cereals in Scandinavia and Finland (Figs 1.1 & 1.3). Quackgrass, *Elytrigia repens* (L.) Nevski, used to be a considerable weed problem before the advent of selective grass herbicides and of glyphosate all over Europe. Despite these tools, this perennial species is still rather widespread in the spring wheat fields of the North. It is also dominant on a number of large eastern European farms with low or no tillage practice. It is of less importance in the Mediterranean area. *Alopecurus geniculatus* L. may occur in a few fields of Finland and Scandinavia. *Equisetum arvense* L. seems to be rather frequent there also (e.g. Salonen et al. 2011). This has to be stressed as this species does not fit into the monocot/dicot frame.

Wheat in the Mediterranean region

As mentioned above, wild oats are still the most frequent weed problem in the Mediterranean region (Fig. 1.1), including North Africa. Wild oats are even presumably the most frequent weed of arable crops in the world. This can be found on every continent and in various crops. Its drought tolerance allows growth even under extreme conditions.

Lolium multiflorum Lam. (Italian ryegrass), *Lolium rigidum* Gaudin (Wimmera ryegrass) and *Lolium perenne* L. (Perennial ryegrass) often become problem weeds in southern Europe (Fig. 1.3). They can be found in many habitats where wild oats also grow. The Mediterranean climate with cool but mild and rainy winters favours spring wheat planting in winter. Similar growth conditions can be found in Australian, Argentinian and Chilean wheat areas and will be referred to later on. *Setaria* species and *Phalaris minor*

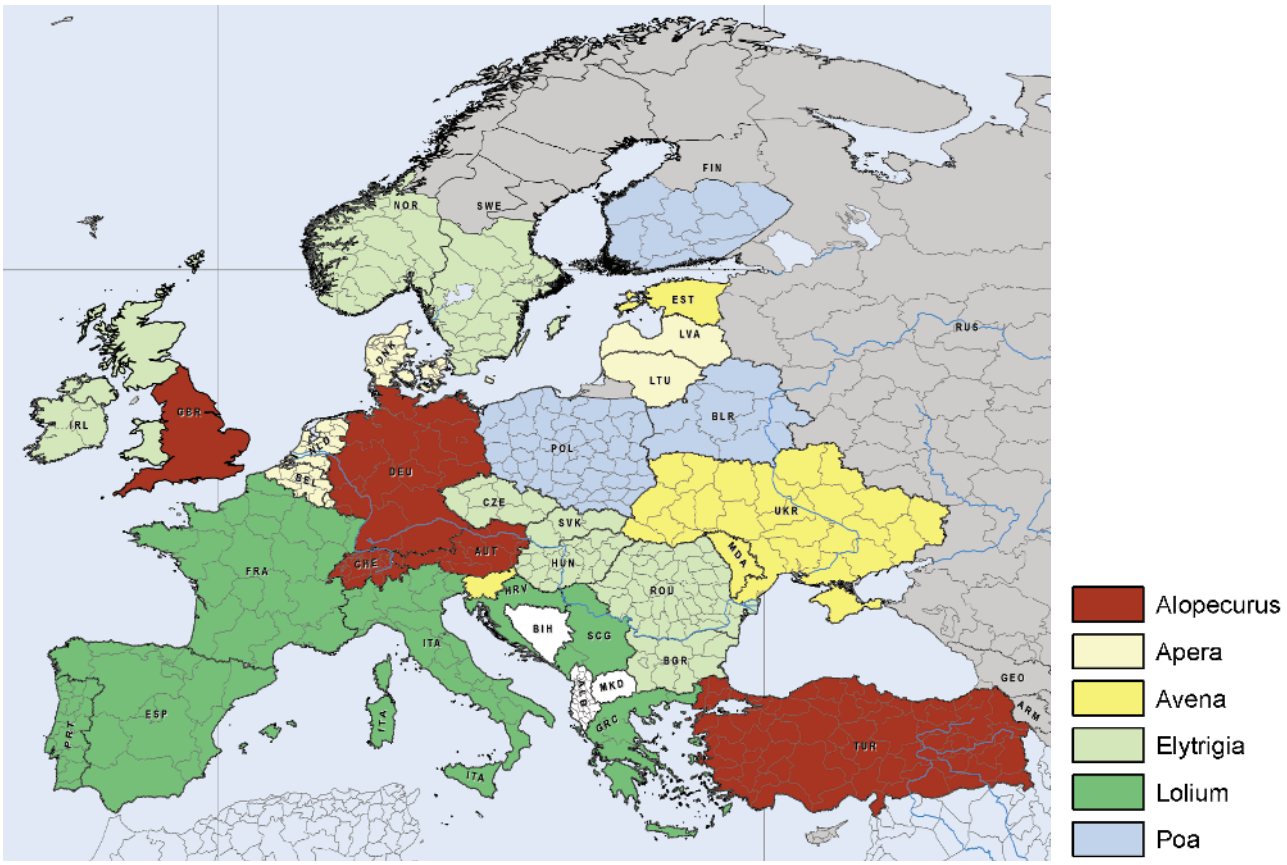

Figure 1.3 Average weed infestation in wheat, the second most frequent grasses.

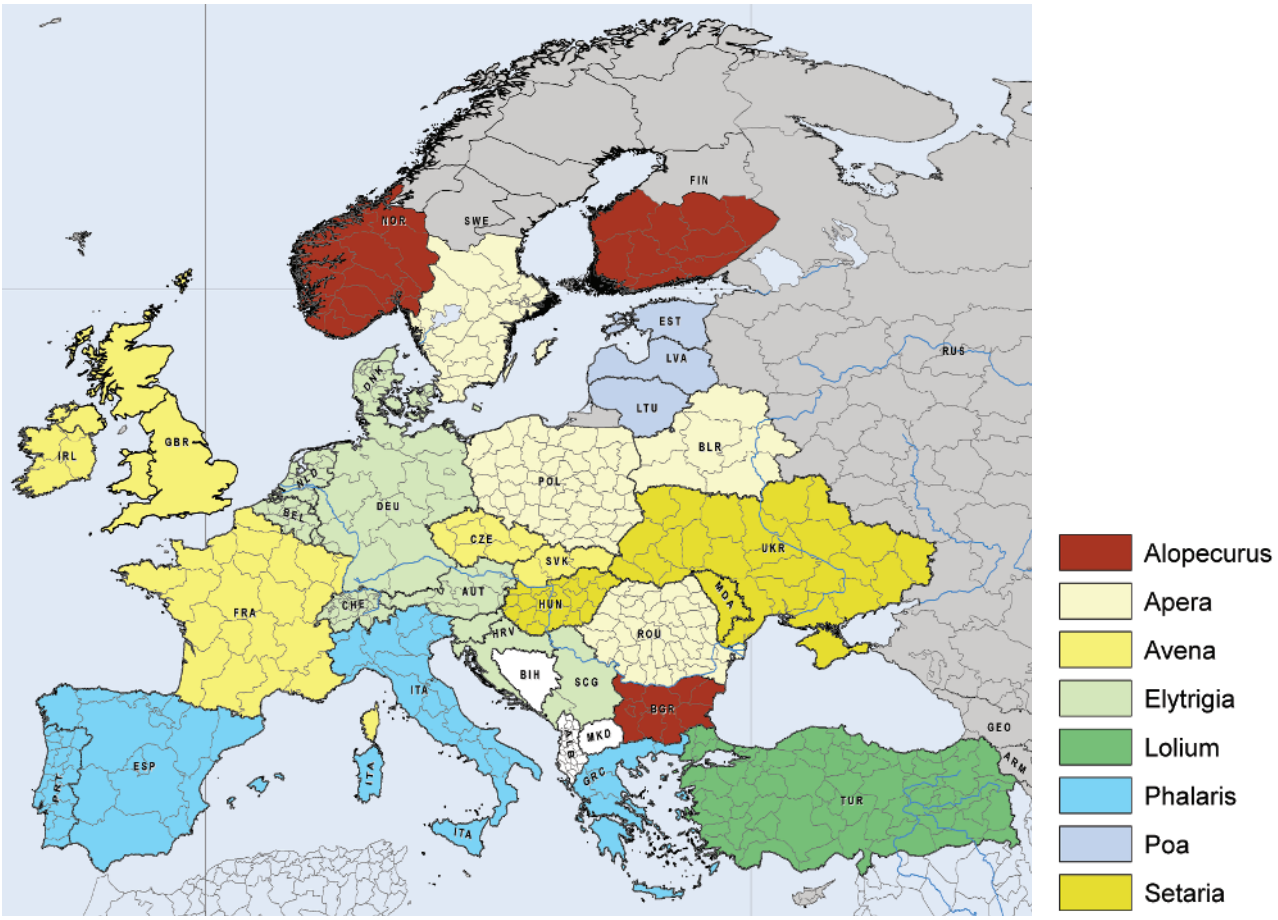

Figure 1.4 Average weed infestation in wheat, the third most frequent grasses. Note: The *Alopecurus* species in Scandinavia and Finland is *A. geniculatus*.

are rather frequent as additional grass weed species in southern and south-eastern Europe when it comes to the third most common grass weeds (Fig. 1.4).

Dicots

Winter wheat north of the Alps

The number of different dicot species in European wheat fields is usually much higher than the number of grass species. *Galium aparine* L. or cleavers, is one of the species that is regularly found in wheat fields of central and northern Europe (Fig. 1.5). The absolute number of individuals per field is usually not very high. Farmers, however, do not tolerate cleavers in their fields due to its biomass development, its strong competition with the crop and its negative influence on crop harvesting. *Stellaria media* (L.) Vill. is growing in many parts of Europe also. It is one of the most frequent species in Great Britain and Scandinavia. *Veronica* species (primarily *V. persica* and *V. hederifolia*) often escape herbicide treatments and are therefore found quite frequently in winter cereals (Fig. 1.6). *Tripleurosporum maritimum* (L.) W.D.J. Koch, *Anthemis*- and *Matricaria*-species are other common species in European winter wheat (all three genera are represented by 'Matricaria' in Figs 1.5–1.7). *Cirsium arvense* (L.) Scop. is a common perennial weed of eastern European countries with large low-tillage agricultural areas. This is also true for *Convolvulus arvensis* L (Fig. 1.7).

Wheat in the Mediterranean region

Poppy, *Papaver rhoeas* L., grows in many parts of Europe. This species appears to be the most frequent dicot weed in wheat of the Mediterranean area. An invasive species that has become of major importance in south-eastern Europe is *Ambrosia artemisiifolia* L.

Spring wheat weeds

Chenopodium album L. is a characteristic broadleaf weed of European spring wheat on both sides of the Alps (Figs 1.5–1.7). *Viola arvensis* Murray can often be found in the Baltic States and in Finland. *Thlaspi arvense* L. and *Galeopsis tetrahit* L. are also quite common species of spring wheat.

In some Mediterranean areas, it is rather difficult to decide which weeds are the most common ones due to strong climate contrasts within the same country. The growing conditions in the Çukurova region of Turkey and the Central Anatolian region are so different that weed spectra cannot easily be compared within the same crop. Also, borders between Europe and Asia change from time to time.

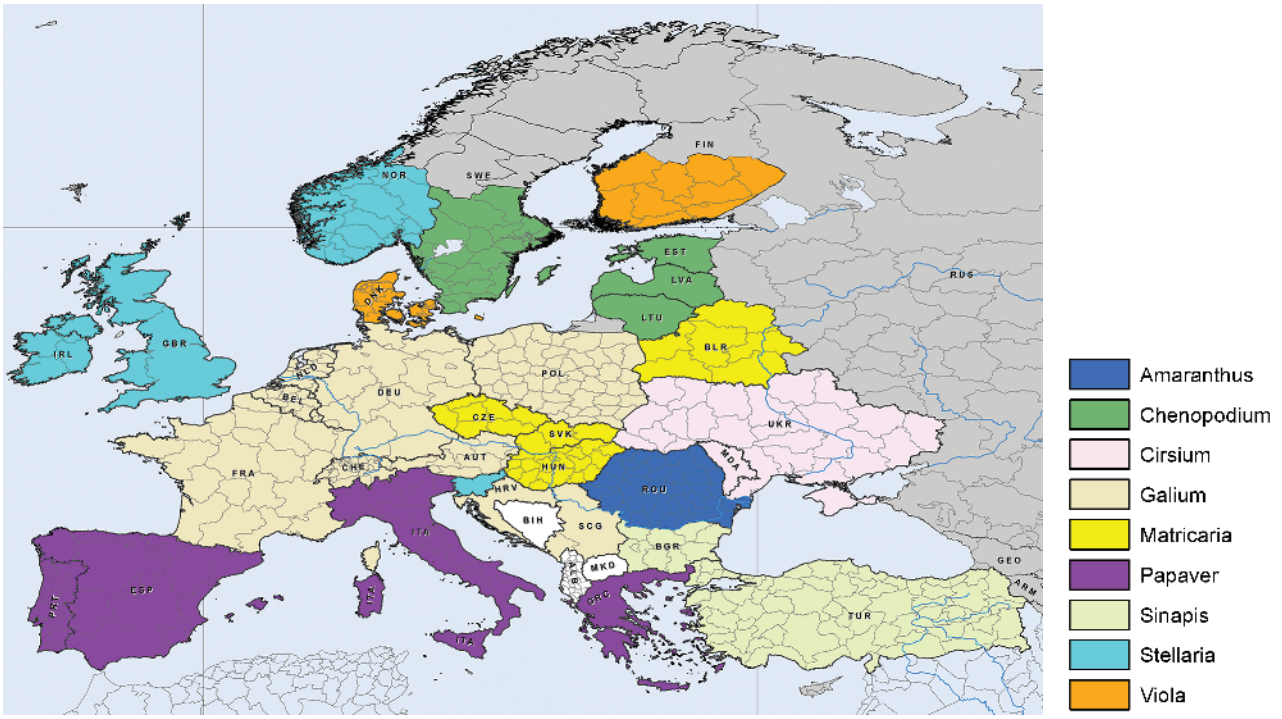

Figure 1.5 Average weed infestation in cereals, most frequent dicots.

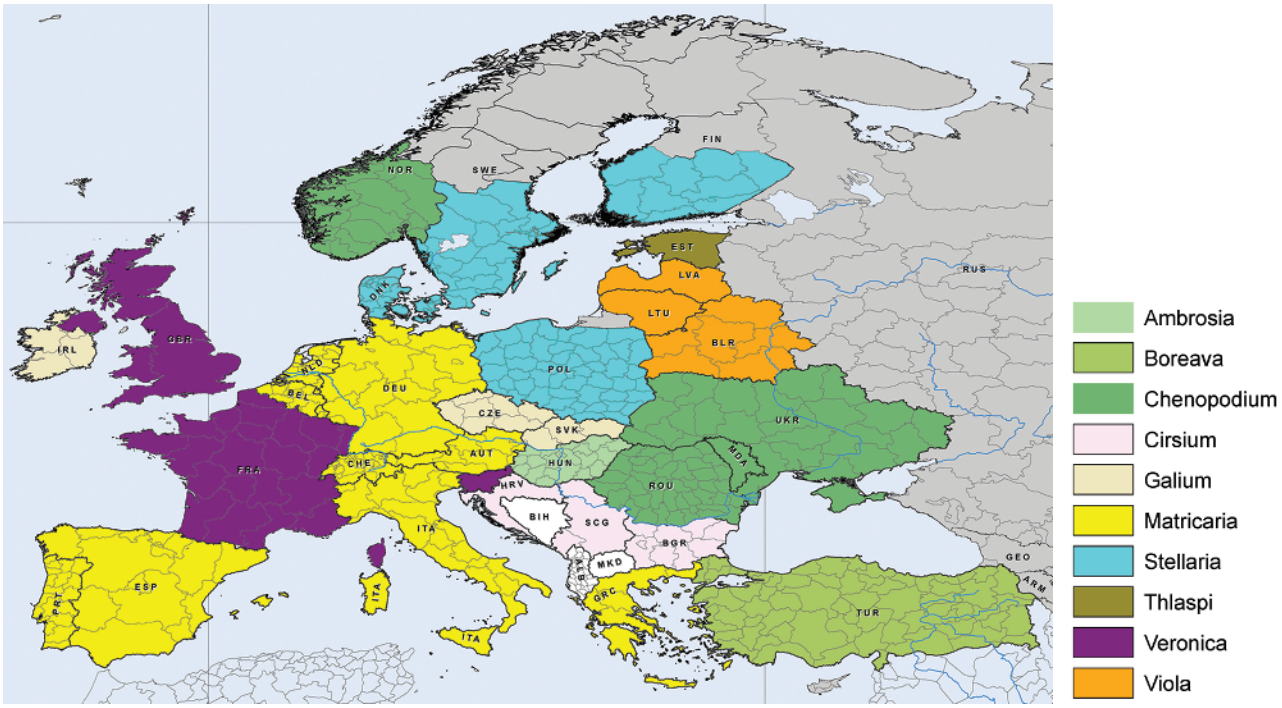

Figure 1.6 Average weed infestation in cereals, second most frequent dicots.

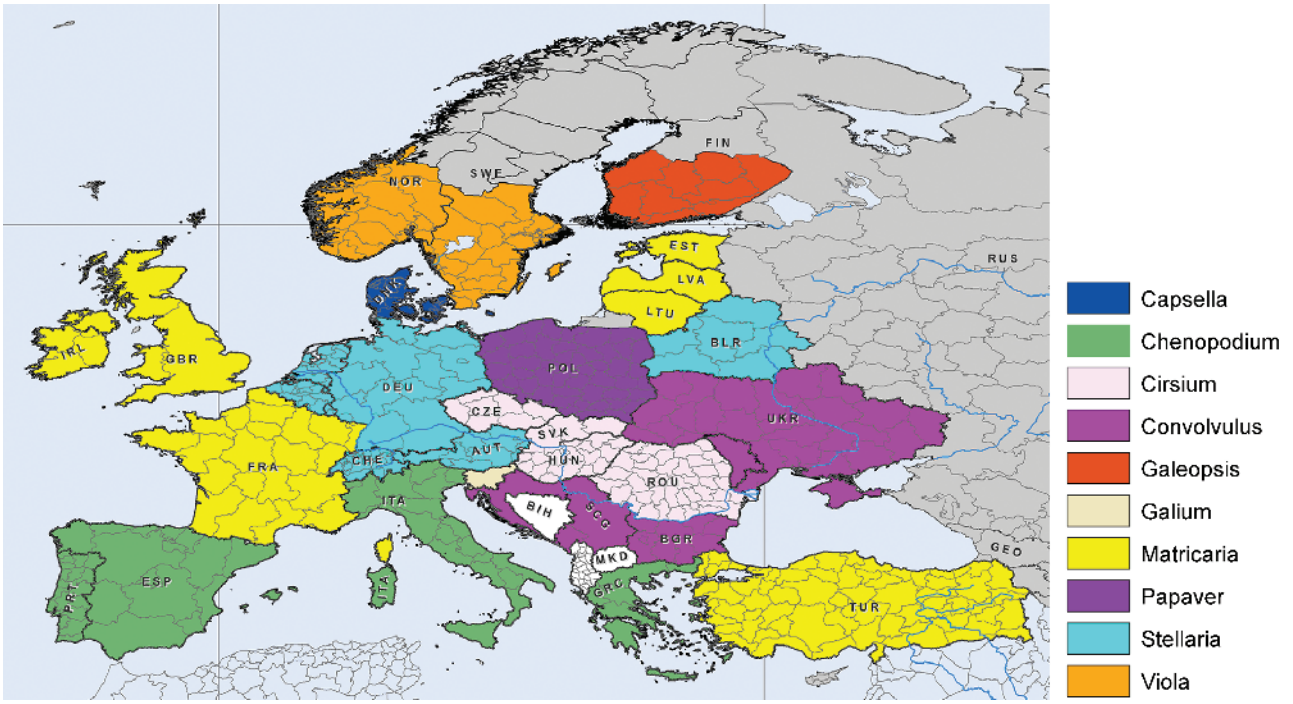

Figure 1.7 Average weed infestation in cereals, third most frequent dicots.

This is why a more detailed view of Turkish crops is presented in Chapter 2.

Maize

Growing conditions

European maize will only fully develop between spring and autumn due to its high temperature requirements and its cool weather sensitivity. Its high water requirements limit its growing areas to some extent also. In most northern parts of Europe, maize is not planted before April or May. The acreage of this crop has increased considerably in the past 20 years. One major reason for the success of maize in Europe is its short-season, early maturing varieties. Excellent weed control tools have also contributed to the relatively large acreage. Maize reacts very efficiently to nitrogen fertilizers such as manure from animal production and it is one of the most suitable crops for biogas production. Genetically engineered maize is only grown in Spain (129,000 ha in 2012; Clive 2012). This maize is insect-resistant.

Statistics

Maize was grown on 18.3 million ha in Europe in 2012 (EU27) compared with 13.4 million ha in 2002 (FAOSTAT). It is important to stress that a clear distinction in the data for green maize and grain maize is often not easy when using official data. Regional statistics can differ to some extent in comparison to globally compiled FAO data. According to the Deutsches Maiskomitee e.V. (the German Maize Committee) (www.maiskomitee.de/web/public/Fakten.aspx/Statistik/Europäische_Union), the proportion of harvested green maize to grain maize in the 16 most important maize-producing countries in the EU amounted to around 8 million ha (grain maize) vs. 5 million ha (silage maize) in 2007 and 9.4 million ha vs. 5.8 million ha in 2012 respectively.

Weeds

Monocots

Echinochloa crus-galli is by far the most widespread grass weed in European maize (Fig. 1.8). The second most frequent grass weeds are *Setaria* species, primarily *Setaria viridis* (L.) P. Beauv., *Setaria glauca* (L.) P. Beauv. syn. *Setaria lutescens* (Weigel) Hubbard. and *Setaria verticillata* (L.) P. Beauv (Figs 1.9 & 1.10). Andreasen and Streibig (2011) have noted recently that *Setaria viridis* and *Echinochloa* spp., C4 plants native to warmer climates, were able to gain footholds in the open maize crop. This is a species that had not previously succeeded in invading Scandinavian crops. *Sorghum halepense* (L.) Pers. and *Cynodon dactylon* grow primarily in the Mediterranean area due to their temperature requirements (Figs 1.8–1.10). Both species play a special role in the Çukurova region of Turkey.

Dicots

Chenopodium species, primarily *Chenopodium album* L. and *Chenopodium hybridum* L. can be found in most European maize fields (Fig. 1.11). *Convolvulus arvensis* is also rather widespread. It seems, however, to dominate especially in the Mediterranean area. *Amaranthus* species are very common weeds in maize fields, primarily *Amaranthus retroflexus* L. One species that has become a dominant weed problem in southern European countries – especially in some Balkan states – in recent years is *Ambrosia*

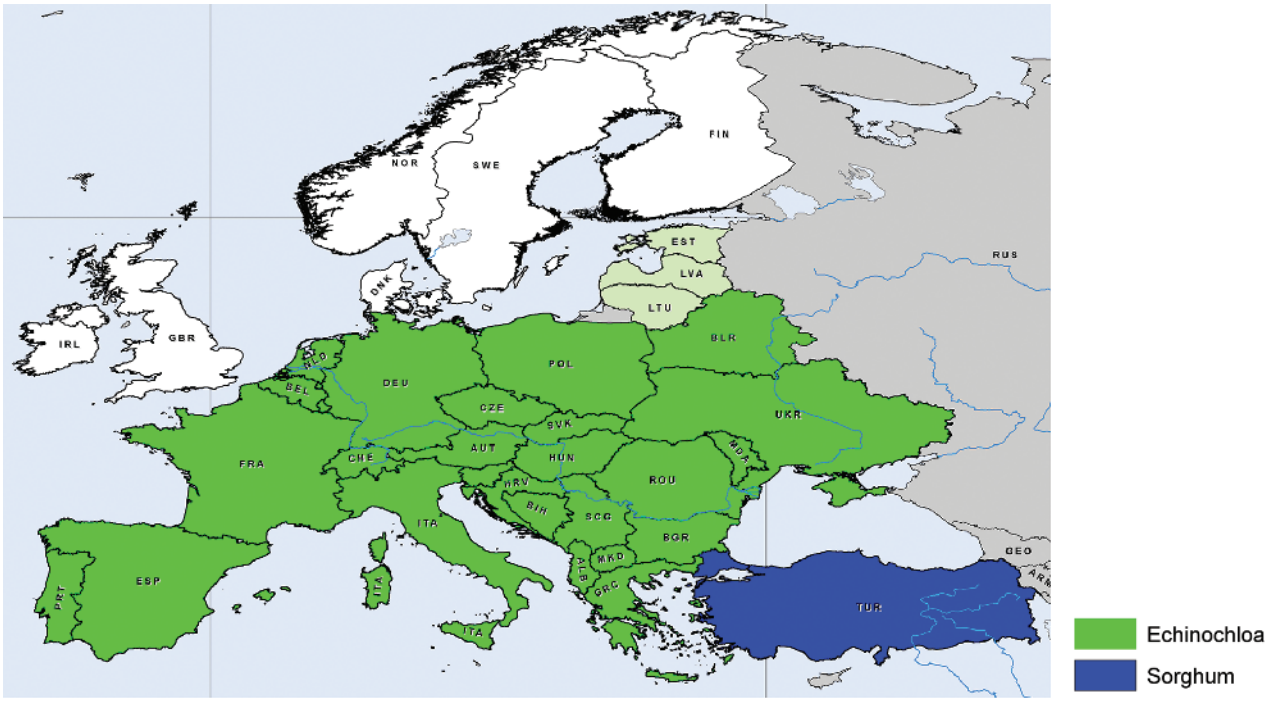

Figure 1.8 Average weed infestation in maize, most frequent grasses.

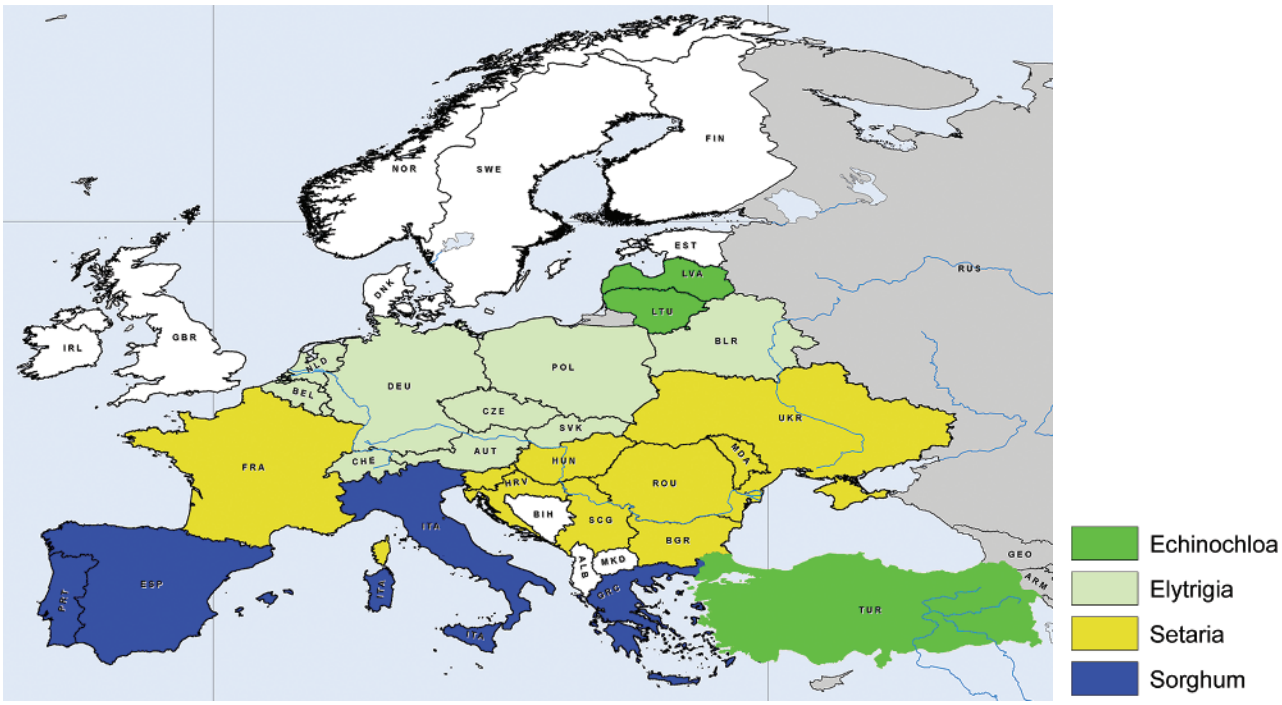

Figure 1.9 Average weed infestation in maize, second most frequent grasses.

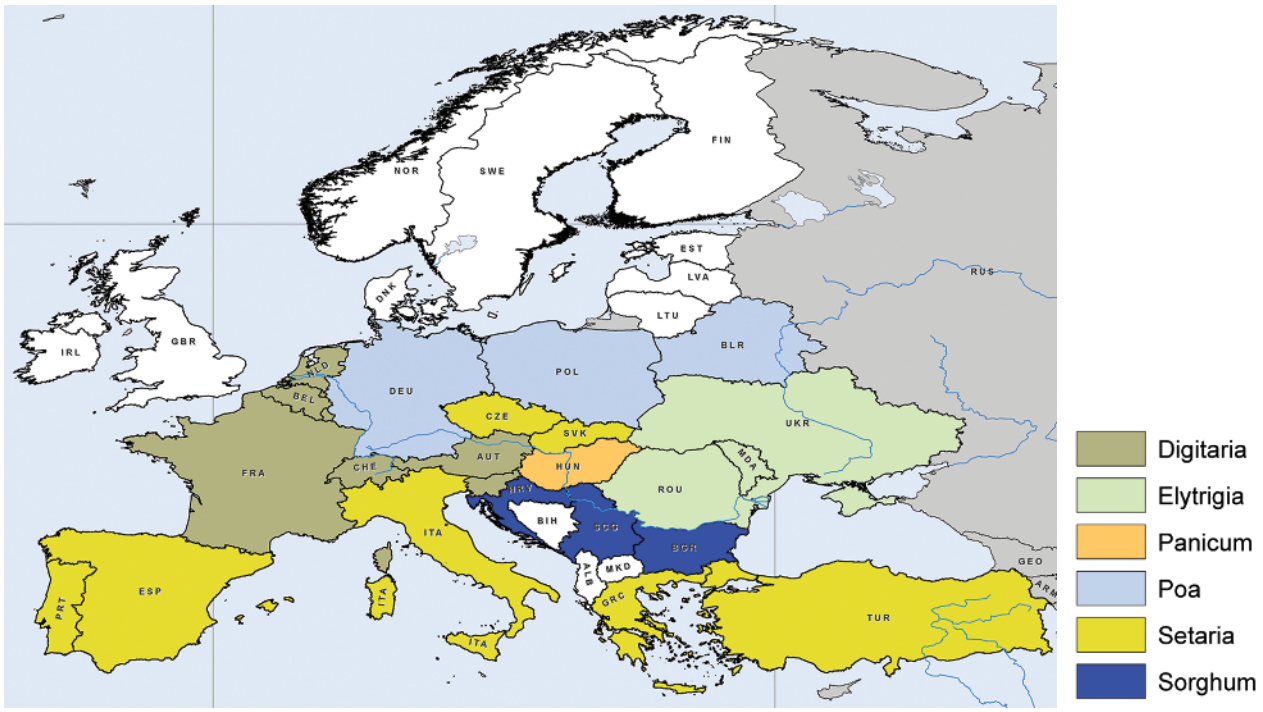

Figure 1.10 Average weed infestation in maize, third most frequent grasses.

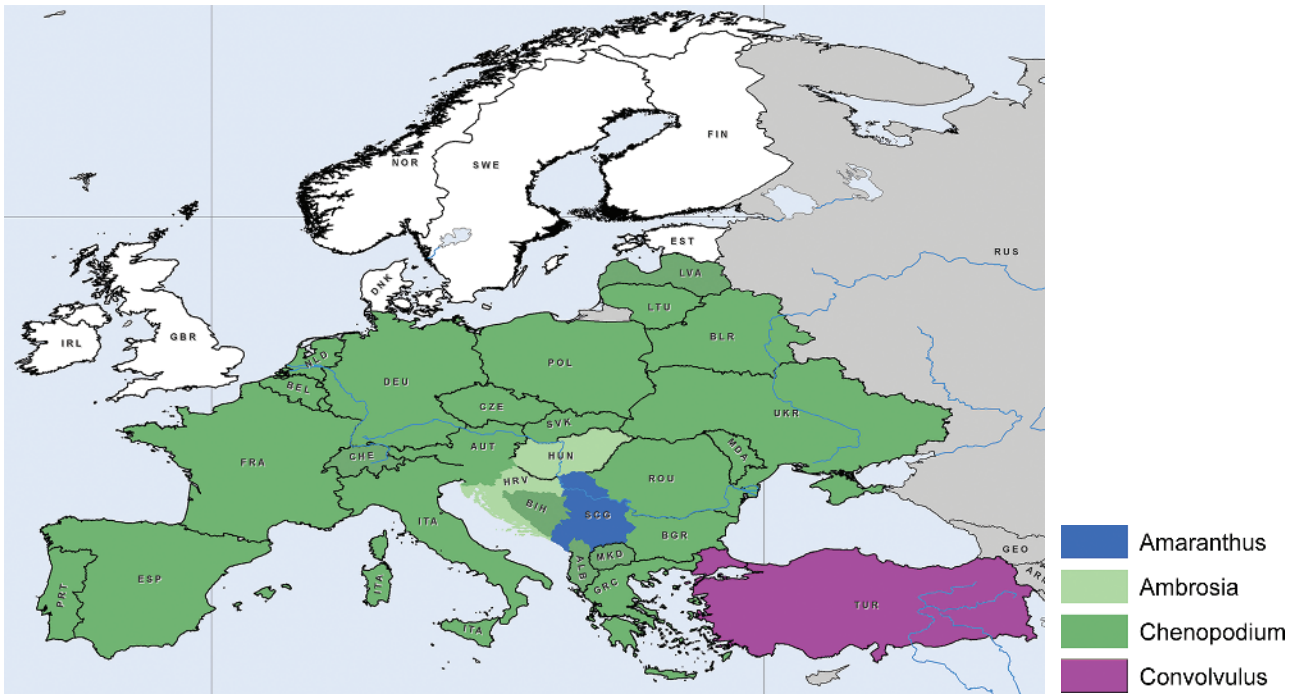

Figure 1.11 Average weed infestation in maize, most frequent dicots.

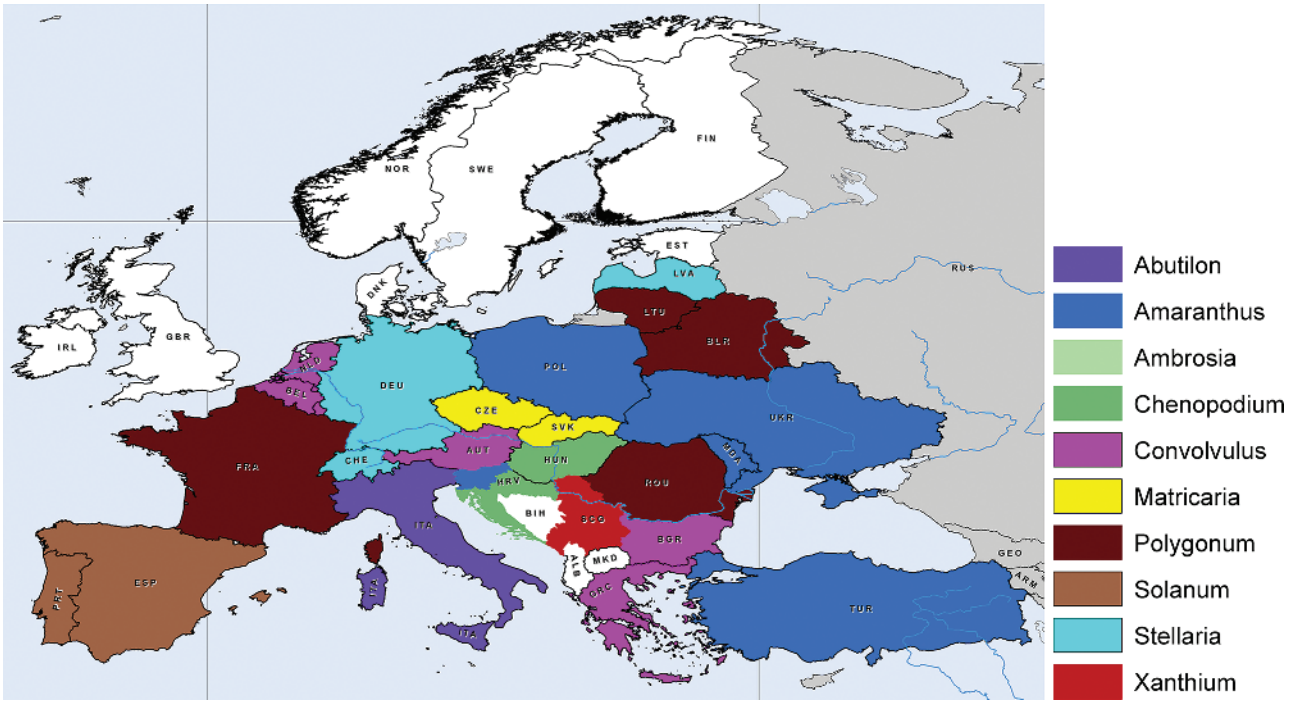

Figure 1.12 Average weed infestation in maize, second most frequent dicots.

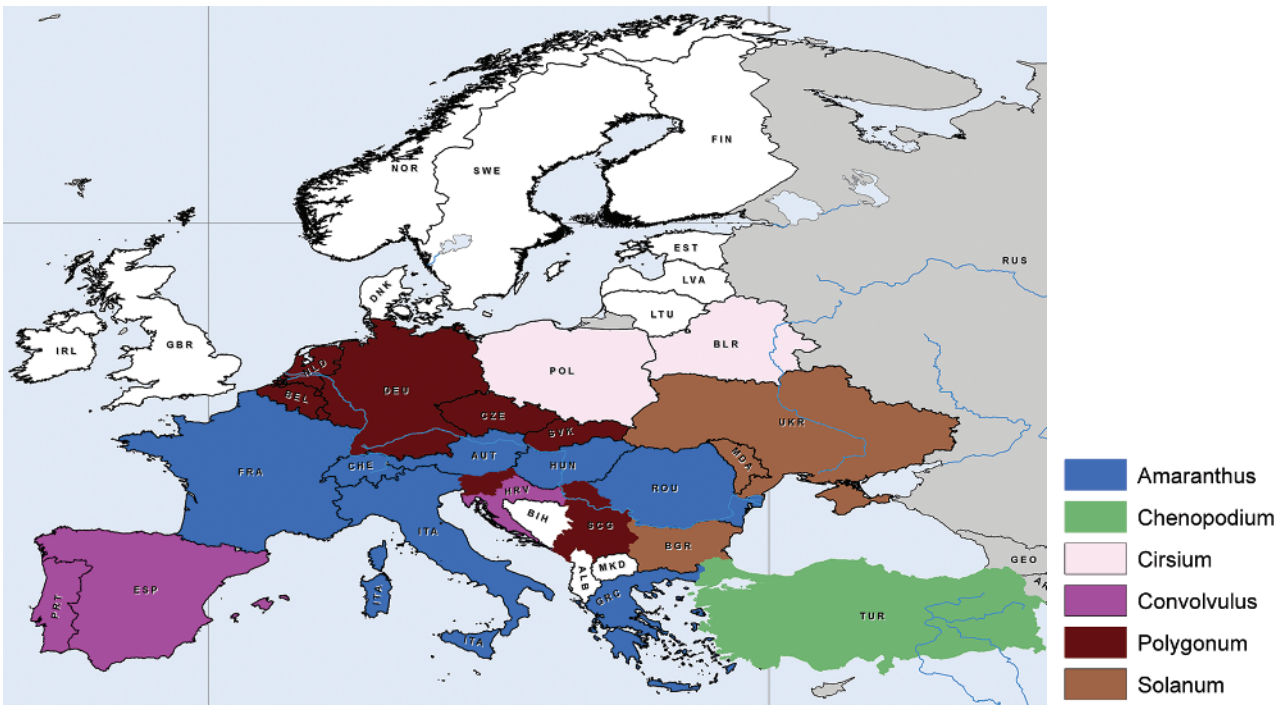

Figure 1.13 Average weed infestation in maize, third most frequent dicots.

artemisiifolia L. (Figs 1.11 & 1.12). *Xanthium strumarium* L. needs high temperatures for its development and grows preferably in Mediterranean countries such as Serbia (Fig. 1.13) and in the Çukurova region of Turkey. *Solanum nigrum* can be found quite frequently all over Europe. Some species of the genus *Solanum* prefer warm weather and are usually more common in southern European countries such as Spain (Fig. 1.12). There, *Abutilon theophrasti* is increasingly causing problems as an invasive species in maize (Recasens et al. 2005) similar to the situation in Italy.

A recent publication by Jensen et al. (2011) confirms some findings that were posted on the EWRS Weed Mapping WG website for maize from 2009 onwards.

Figure 1.14 Flowering oilseed rape near Frankfurt, Germany, 11 May 2012.

Figure 1.15 Volunteer cereals in oilseed rape near Frankfurt, Germany; 1 December 2012 – both suffering from frost.

Figure 1.16 *Tripleurospermum maritimum* in oilseed rape near Frankfurt, Germany, 7 June 2009.

Oilseed rape

Growing conditions

Most of European oilseed rape (Fig. 1.14) is grown as a winter crop. Spring rape is of minor importance. The winter crop is usually planted from August to September and harvested between June and July. Spring rape is sown during March and April; it is harvested between August and September.

Statistics

In 2010, oilseed rape was grown on 7 million ha arable land in Europe (EU27, source: USDA/FRS, February 2012), of which 1.5 million ha were found in France and Germany each, 0.9 million ha in Poland, and 0.6 million ha in the UK and in Romania respectively. The acreage of spring rape in Germany amounted to around 4000 ha only (www.ufop.de/3813.php).

Weeds

By far the most frequent monocot weeds in Europe are volunteer cereals (Figs 1.15 & 1.17), followed by blackgrass, silky bentgrass (Fig. 1.18) and couch or quack-grass (Fig. 1.19). *Tripleurospermum maritimum subsp. inodorum* (Merat) M. Laínz (synonym *Matricaria inodora* L.) (Fig. 1.16) is the most common dicot weed. The occurrence of lamb's quarters – *Chenopodium album* – is typical of spring rape, for example, in the Baltic States (Fig. 1.20). A number of weeds occurring in winter cereals are quite frequently found in oilseed rape also (*Alopecurus*, *Apera*, *Tripleurospermum*, *Galium*, *Viola*, *Stellaria*, for instance, Figs 1.21 & 1.22). *Cirsium arvense* as a perennial weed is not too common; where it occurs, however, it can cause severe damage to the crop (Fig. 1.23).

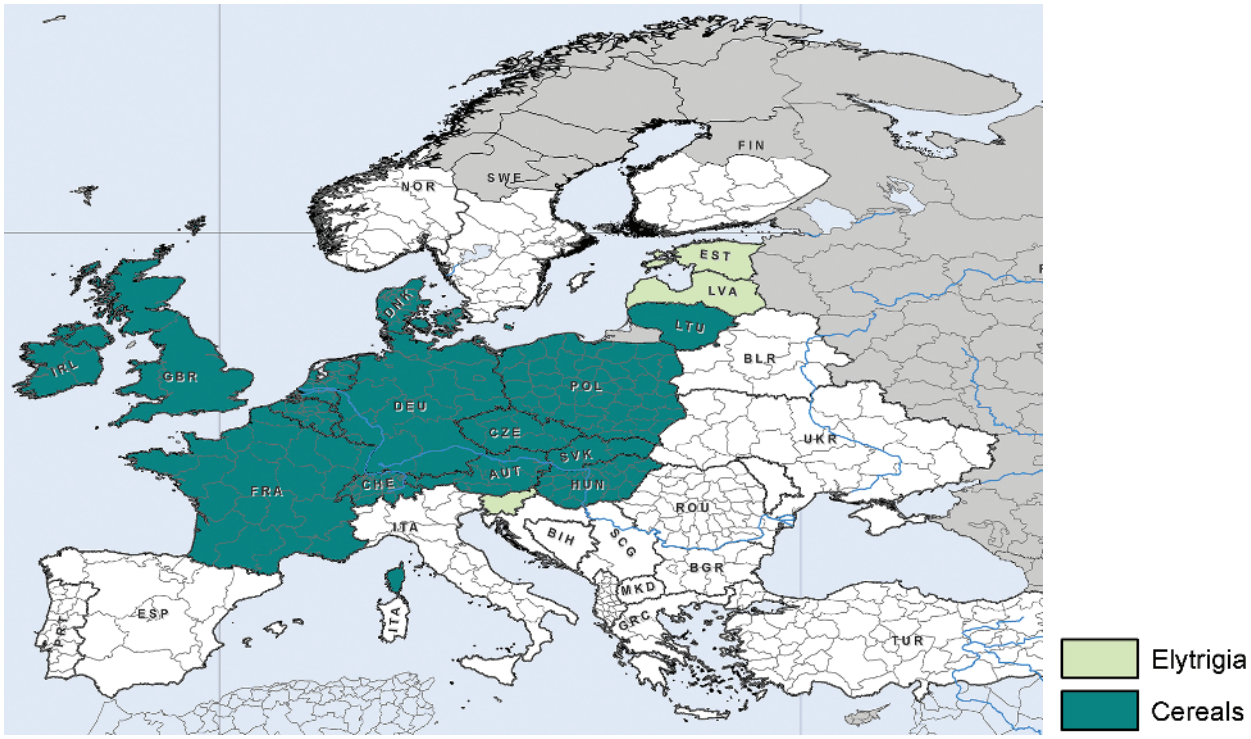

Figure 1.17 Average weed infestation in oilseed rape, most frequent monocots.

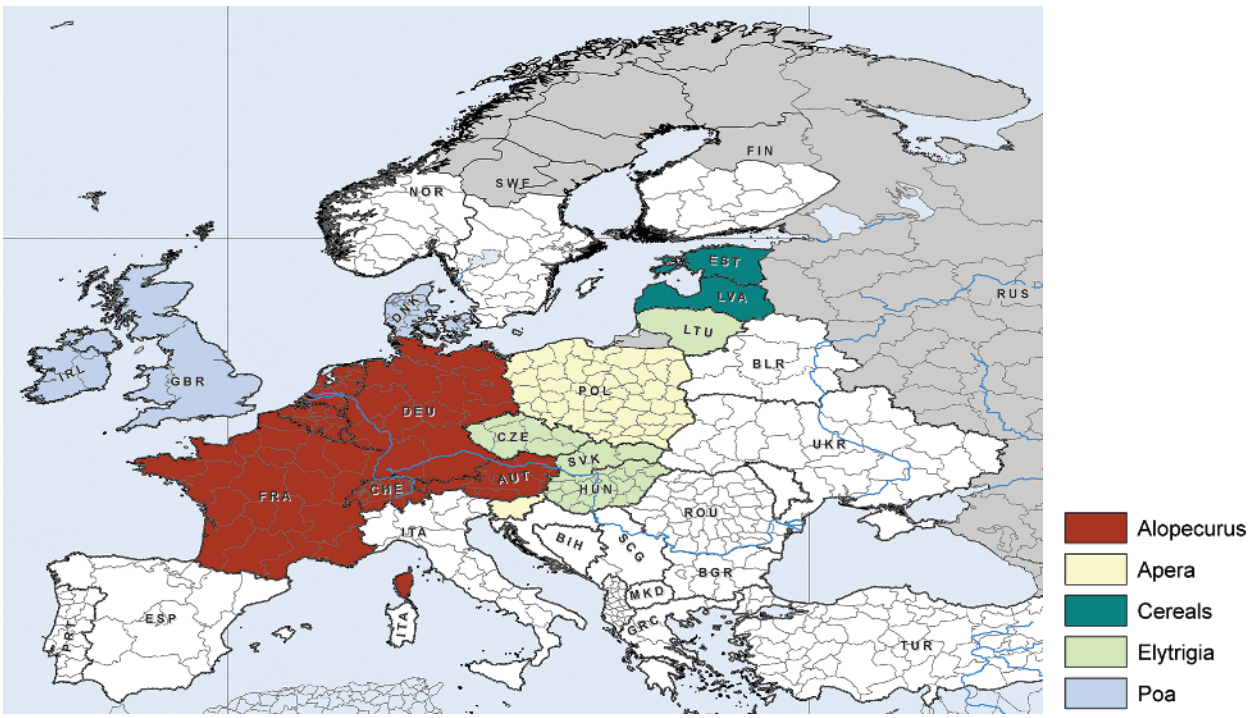

Figure 1.18 Average weed infestation in oilseed rape, second most frequent monocots.

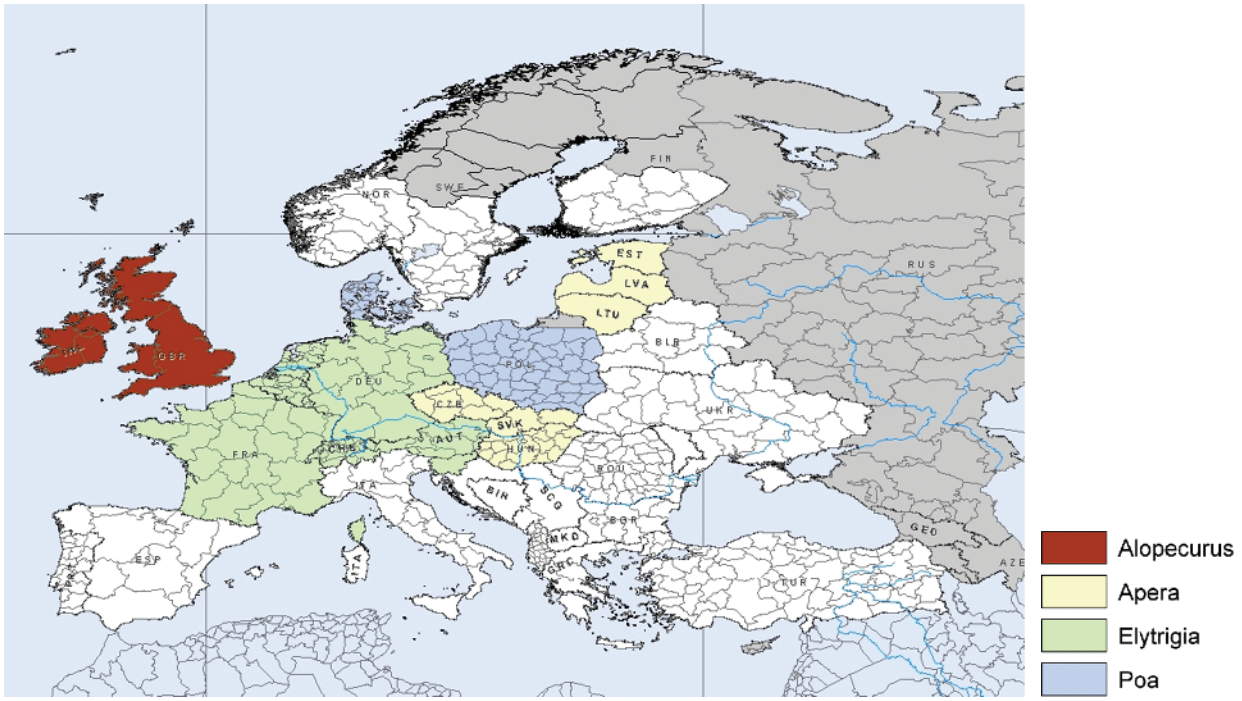

Figure 1.19 Average weed infestation in oilseed rape, third most frequent monocots.

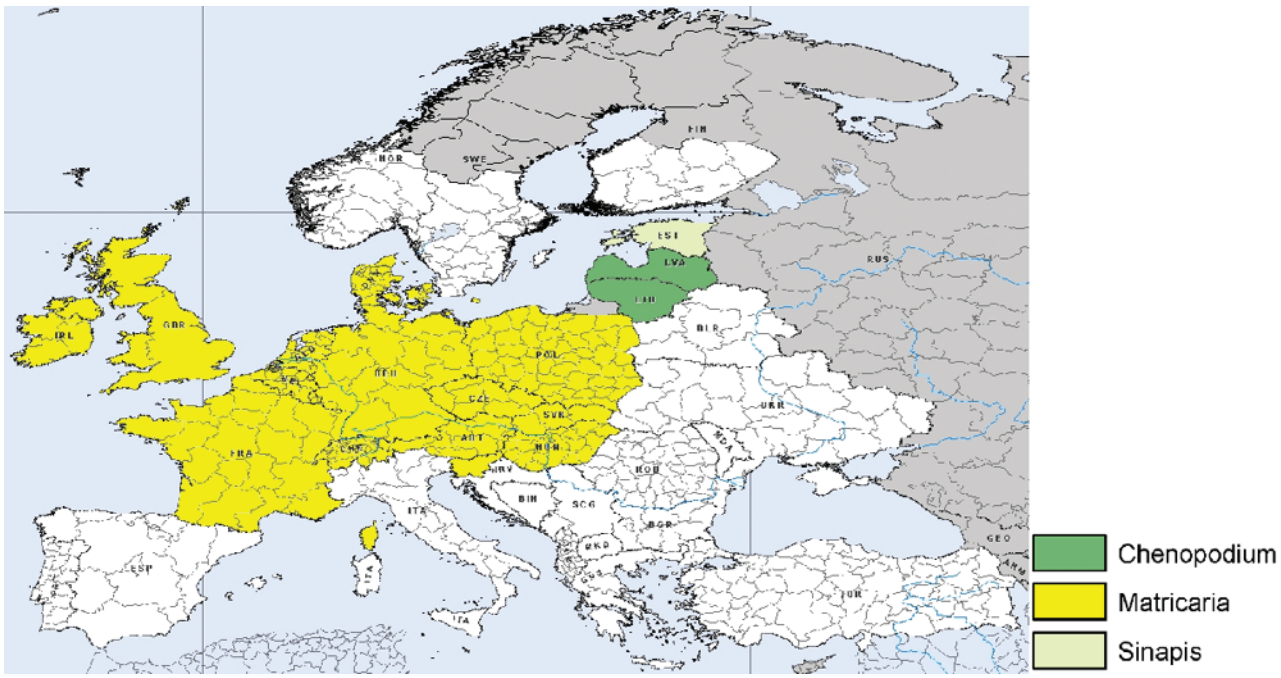

Figure 1.20 Average weed infestation in oilseed rape, most frequent dicots.

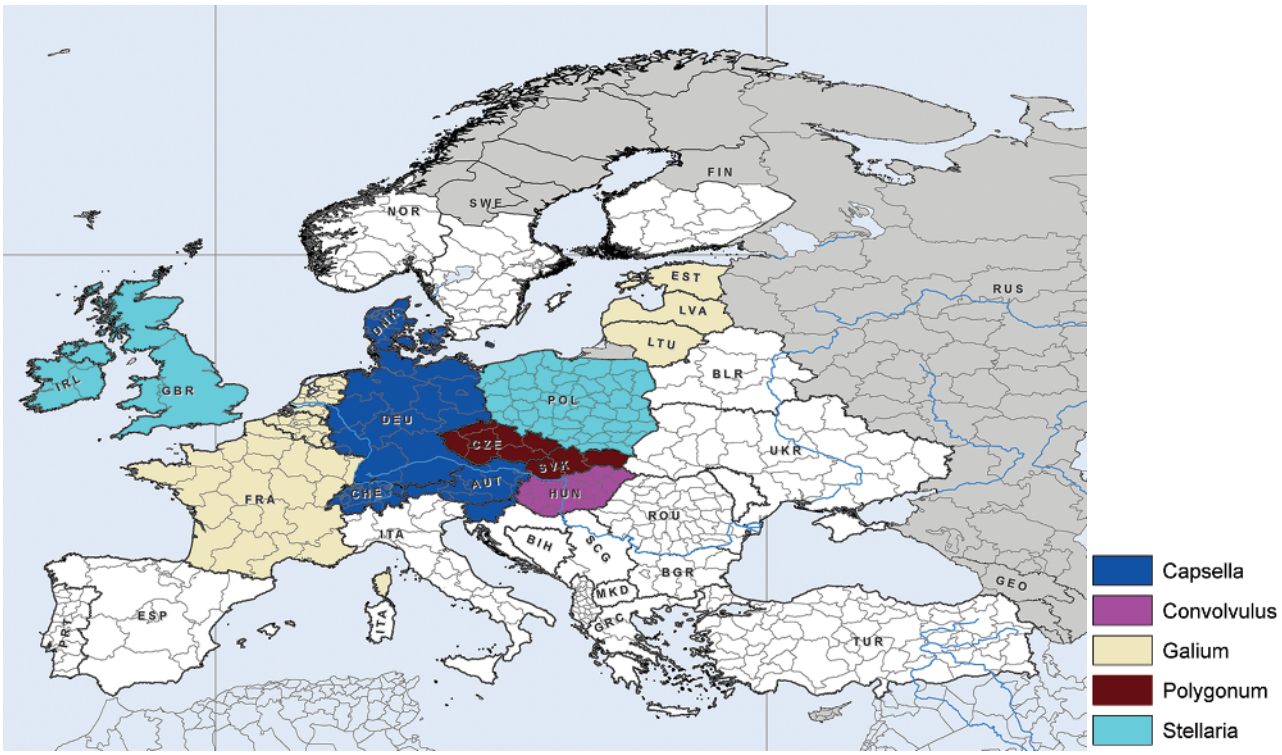

Figure 1.21 Average weed infestation in oilseed rape, second most frequent dicots.

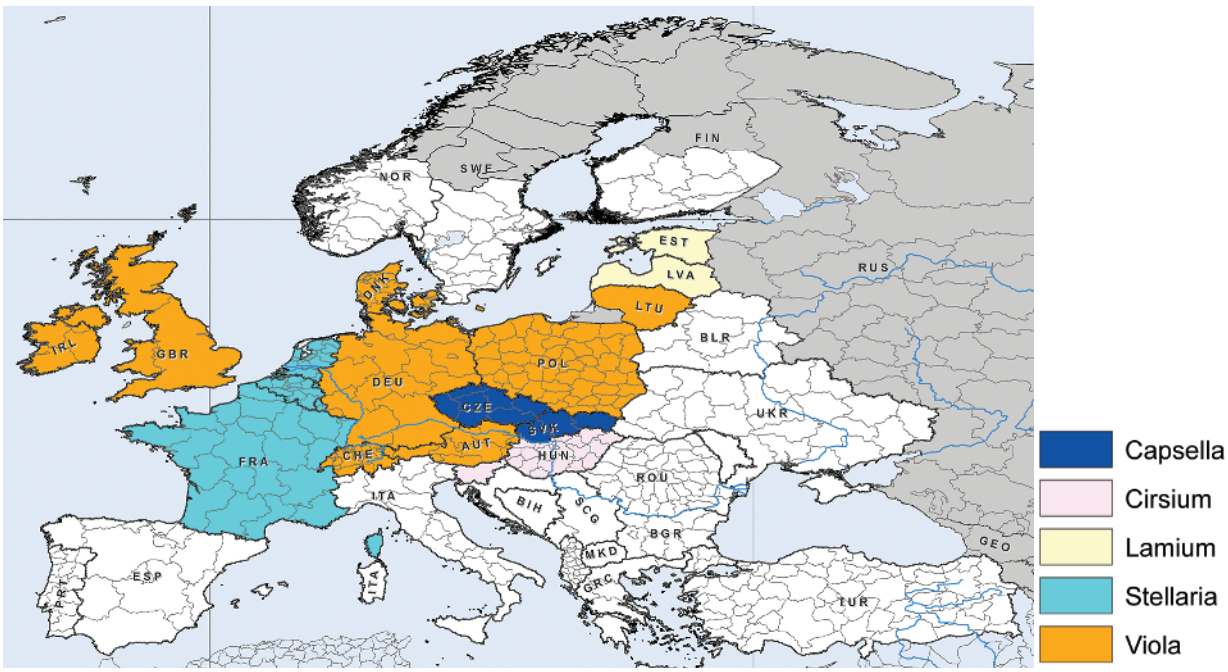

Figure 1.22 Average weed infestation in oilseed rape, third most frequent dicots.

Figure 1.23 *Cirsium arvense* in an oilseed rape field in southern Germany, 21 June 2012.

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