

***BARBAREA ARCUATA* AS A POTENTIALLY EXPANSIVE SPECIES IN AGRICULTURAL LANDSCAPES IN LATVIA**

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Abstract

The distribution and abundance of *Barbarea arcuata* (Opiz ex J. et C. Presl) Rchb. were investigated throughout the territory of Latvia. The field survey was carried out to estimate the abundance patterns, and the herbarium materials were used to compile a distribution map. In total 411 localities were recorded in the period from 2015 to 2017. The species has been commonly found on roadsides, which accounts for 66% of the localities. Seventeen percent of the localities occurred in grasslands, 10% – in croplands, 4% – in fallows, 2% – on road embankment slopes, and 1% – on railway embankments. The highest density of *B. arcuata* were found in new fallows where it forms large populations. Whole field localities account for 5% of the total localities. Medium-sized stands are found in about 20% of localities and are mostly found in grasslands, roadsides, as well as croplands which include cereal fields and oilseed rape fields. Individual specimens are mostly found on roadside habitats and grasslands and account for 75% of the total number of localities. As dominant weed species it is found on fields of oilseed rape, cereal fields and fallows. Herbarium data and the Institute of Biology, University of Latvia lists of species show that *B. arcuata* distribution was frequent during the period from 1970 to 2014.

Key words: *Barbarea arcuata*, distribution, habitats, weeds.

Introduction

Weed species and weed control has been significant for several hundred years. Some weed species are becoming less common or even disappearing, while some other are becoming very frequent and expansive. Weed species composition is determined both by the agricultural crop and by the way of cultivating the land. Factors affecting the composition of weed species cannot be properly investigated without the consideration of temporal patterns (Lososová *et al.*, 2004). Weed vegetation on arable land can change rapidly over time and vary between fields and regions (Andersson & Milberg, 1998). Weeds have numerous interactions with other organisms and some of these interactions can have direct, either negative or positive, effects on the functioning of the agroecosystem (Petit *et al.*, 2011). Cropland is one of the most important weedy habitat, where many annual and perennial weeds grow with disturbing regularity (Zimdahl, 2018).

Barbarea arcuata (Opiz ex J. et C. Presl) Rchb. as native species is distributed in Europe and Asia (Korob, 1979). As for the flora of Latvia, *B. arcuata* was first mentioned in 1846 (Müller, 1846). In the subsequent literature sources it is also mentioned that the species is frequent (Klinge, 1882; Lehmann, 1895; Bickis, 1920; Фарапе, 1988) and locally abundant in Latvia, and also in Estonia and Lithuania (Kuusk, Rasiņš, & Jankevičienē, 1993). As mentioned by A. Rasins (1954), in Latvia *B. arcuata* was biennial or perennial weed occurring on arable land, clover fields, grasslands and weedy places.

A short life cycle and large seed production is a typical strategy of plants inhabiting highly disturbed

habitats (Grime, 2001). *Barbarea arcuata* is characterized by a large number of seeds, ranging from 1,000 to 10,000 to one individual (Rasiņš, 1947) and the seed size is about 1.5 mm long and 1 – 1.25 mm wide (Eleksis, 1955). As the rosettes can grow in low temperature, the growing season extends (MacDonald & Cavers, 1991), thus contributing species presence in habitats. The flowering time for the species takes place during May and June (Kuusk, Rasiņš, & Jankevičienē, 1993).

In 2015, in eastern and central parts of Latvia, a large population of *B. arcuata* was observed on cereal fields one year after abandonment and on the edges of newly built roads, where species has not been observed before. This observation originated the question if there was a similar situation with this species in other regions of Latvia?

Barbarea R. Br. genus belongs to *Cruciferae* Juss. family and includes about 20 species, which are present almost worldwide, although concentrated in Eurasia (Appel & Al-Shehbaz, 2003). Three species are recorded in Latvia. Some authors, e.g. Stace (1992) and Ball (1993) accept only a single species, *B. vulgaris* R. Br. in a wide sense. Other authors (Hegi, 1986; Suominen, 1986) accept *B. vulgaris* as a polytypic species with several subspecies or varieties. In a number of Central European floras, *B. vulgaris* is considered a polytypic species (Kirschner, Kirschnerová, & Štěpánek, 2007), while in Eastern Europe, several taxa are accepted at species rank (Eleksis, 1955; Котов, 1979; Kuusk, Rasiņš, & Jankevičienē, 1993; Цвелев, 2000), separating *B. vulgaris* s. str. from *B. arcuata* (Opiz ex J. et C. Presl) Rchb.

The aim of this study is to clarify *B. arcuata* distribution in Latvia.

Materials and Methods

Species distribution and abundance analysis was based on the field studies and herbarium materials. Field survey was carried out in the territory of Latvia from 2015 to 2017 and totally 411 localities of *B. arcuata* were recorded. In order to evaluate the population size in various habitats, field surveys were carried out. Surveys were conducted mainly along roads, railways, as well as populated areas where species were recorded in the habitat area and assessed habitats on both sides of the road.

The number of specimens of *B. arcuata* were noted using a relative scale by distinguishing three groups: individual specimens (1 – 10 specimens of the species have been observed), medium-sized stands (11 – 100) and whole field (dominant species in habitat). The habitat types in which the species was found were recorded. If different groups were found in one square, then the map shows the one with the higher number of specimens.

For distribution of *B. arcuata* in the territory of Latvia, an analysis of herbarium material and 503 Institute of Biology University of Latvia inventory lists of species were carried out. The sources of the analyzed herbarium materials were: the Herbarium of the Laboratory of Botany, Institute of Biology, University of Latvia (LATV); the Herbarium of the Museum of

Botany, University of Latvia (RIG); the Herbarium of Slītere National Park (SVR); the Herbarium of the Natural History Museum of Latvia (LDM); the Herbarium of Daugavpils University (DAU); the Herbarium of the Latvia University of Agriculture (LLU); as well as from the private collections of botanists Alfreds Rasins (RAS) and Austra Abolina (AB), 175 herbarium specimens in total.

To evaluate the distribution and abundance of *B. arcuata* in habitats, maps were compiled. Distribution maps were prepared using the Biological inventory square network, based upon geographical coordinates and in which one square is approximately 7.6×9.3 km in size. In Latvia, the total number of squares is 1017, of which 822 fall entirely within the territory of Latvia, and 195 partly overlie national borders (Табака, Клявиня, & Фатаре, 1980). For species distribution, the evaluation scale accepted by the Laboratory of Botany, Institute of Biology was used: very rare (1 – 10 localities), rare (11 – 30), rather rare (31 – 100), not rare (101 – 250), rather frequent (251 – 500), frequent (501 – 750), very frequent (more than 751) (Fatare, 1992). The program ESRI © ArcGIS Desktop 10.3.1 was used to create maps.

Results and Discussion

During the field survey, *B. arcuata* was commonly found on roadsides, which make up 66% of the detected localities (Figure 1). Seventeen percent of the localities were found in grasslands, whereas croplands make up

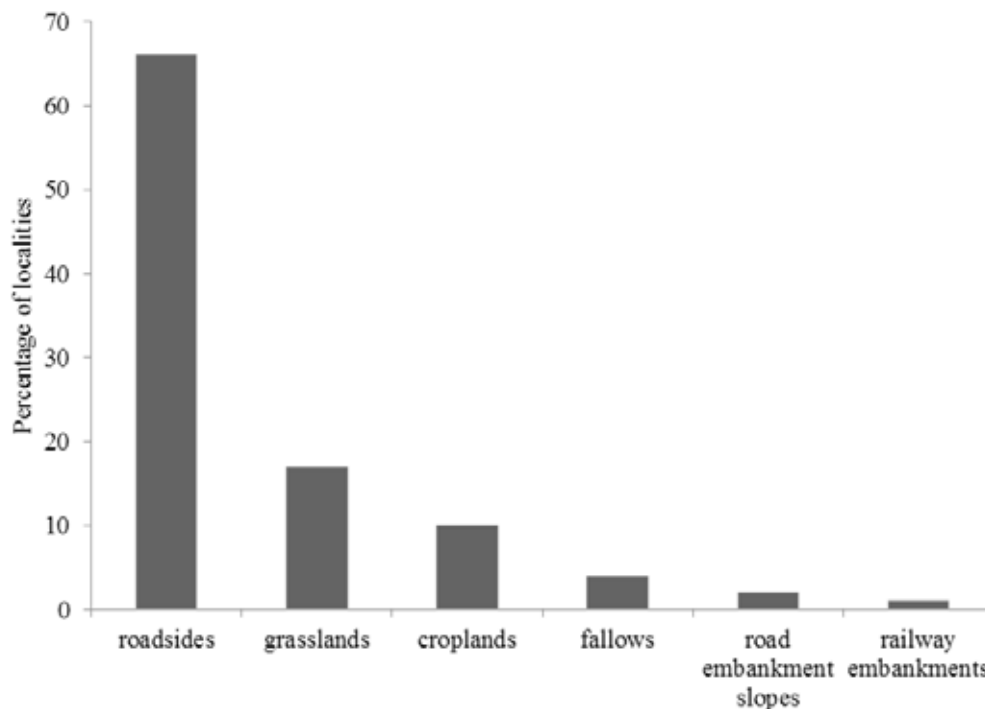


Figure 1. Habitats of *Barbarea arcuata* (Opiz ex J. et C. Presl) Rchb. in Latvia in the observation period from 2015 to 2017.

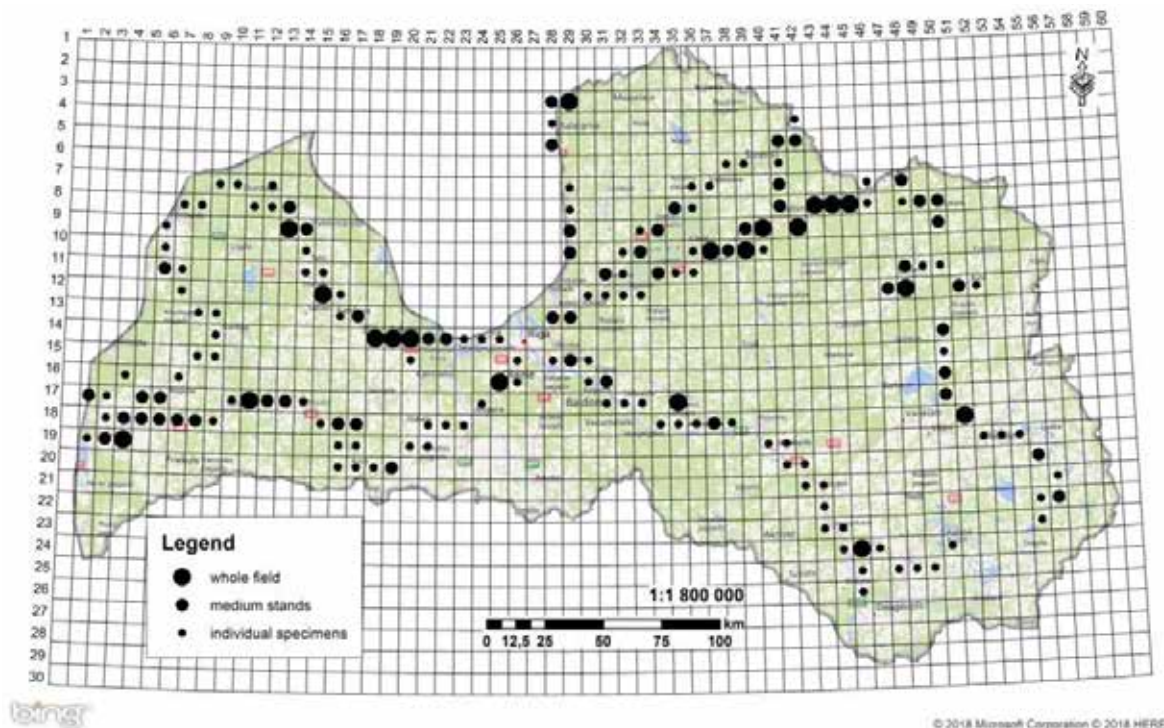


Figure 2. Abundance of *Barbarea arcuata* (Opiz ex J. et C. Presl) Rchb. in Latvia during the observation period from 2015 to 2017.

10% of all localities, fallows – 4%, road embankment slopes – 2% and railway embankments 1%.

It can be concluded that *B. arcuata* has become a widespread weed in different habitats in Latvia. As it has become a rather common species in the roadside plant communities, it spreads also further away from roads in the fields and other habitats. As mentioned by Zimdahl (2018), few weed species grow exclusively in agronomic or horticultural crops or just in one crop. Also *B. arcuata* as weed is found in various agriculture-related areas.

Localities with individual specimens accounted for 75% of the total number of localities (Figure 2). The largest proportion of the localities were found on roadsides and grasslands, some also on railway embankments, oilseed rape fields and cereal fields, as well as in ditch margins. Localities of medium-sized stands are about 20% of whole localities and are found in grasslands, roadsides, cereal fields and oilseed rape fields. Whole field localities occur throughout the territory of Latvia and comprise 5%. Localities are found on cereal fields, oilseed rape fields and fallows.

The largest populations of *B. arcuata* were found on fallows. The species composition and density of weed seed in soil vary greatly and are closely related to the cropping history of the land (Rao, 2000).

Roads serve as corridors for the species distribution (Benedetti & Morelli, 2017) and also for *B. arcuata* contributes to reach new locations,

where they establish as individuals or scattered stands which are quite frequent along roadsides. During road construction or reconstruction, the soil in use can derive from different places. As mentioned by Rao (2000), the seed bank in the soil is the primary source of new infestations of weeds each year. As soil for road reconstruction is transported from different locations, it is possible, if the soil has a large seed bank with *B. arcuata* seeds, that it will promote its establishment in new territories. In recent years, it is becoming more common in renovated or newly created road embankments, which are often dominated by *B. arcuata*.

B. arcuata forms a strong root system, which ensures the ability to absorb nutrients efficiently and creates competition for different crops. As mentioned by A. Rasins (1947), as weed grows on all kinds of soils in grasslands and fields. Short-lived root sprouts for this species have high fitness when regenerating from root fragments as well as when regenerating from seed (Rasiņš, 1954; Klimešová, Kociánová, & Martínková, 2008) and it is difficult to eradicate it in some habitats (Rollins, 1981).

After analyzing the herbarium material and the Institute of Biology, University of Latvia lists of species, it can be concluded that *B. arcuata* in the period from 1970 to 2014 is frequent (Figure 3) and occurs almost throughout Latvia. Herbarium data show that species is mainly found as individual

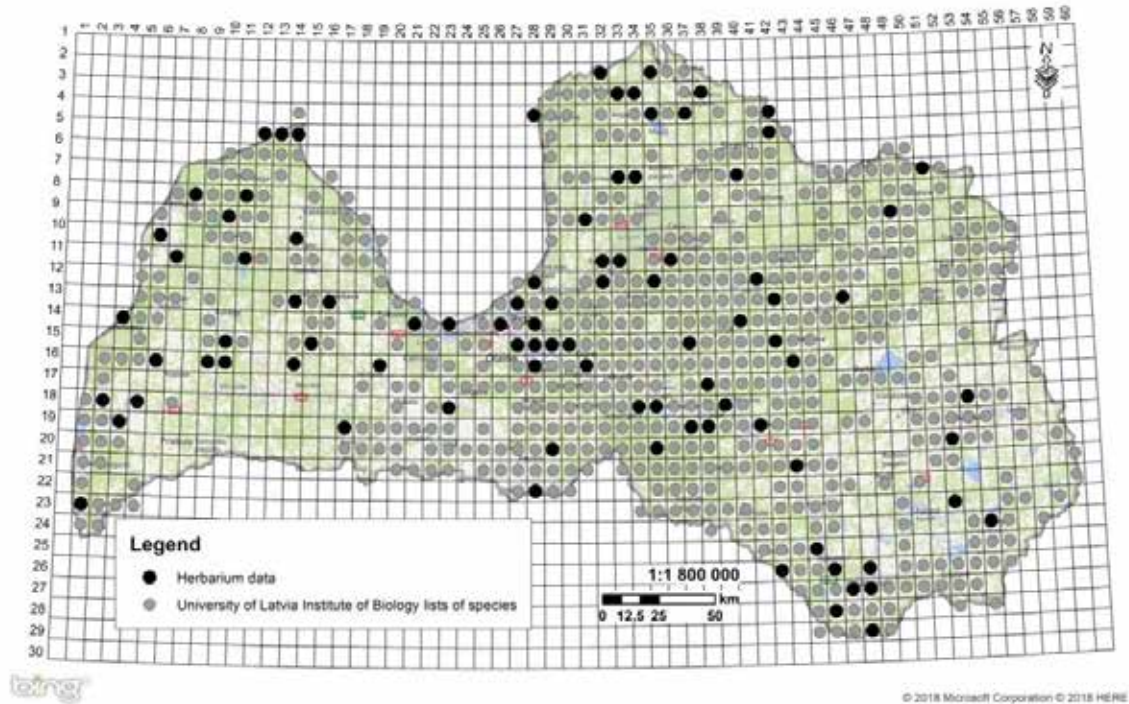


Figure 3. *Barbarea arcuata* (Opiz ex J. et C. Presl) Rchb. distribution in Latvia in the period from 1970 to 2014.

specimens or as co-dominant species, without forming large populations.

Conclusions

B. arcuata is found on roadsides, grasslands, croplands, fallows, road embankment slopes and railway embankments. Roadsides are the most commonly found habitat type in this study and there are mostly found individual specimens. As *B. arcuata* forms large populations in croplands, fallows and grasslands, it can be considered as potentially expansive species in such habitats. Fields with high *B. arcuata* abundance are distributed throughout

the country. This study shows current situation of *B. arcuata* distribution, but in order to estimate the changes in the distribution, it would be necessary to continue the research.

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